Victor Shane's

Drag Device Data Base

Edited by Noel Swanson

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Section 1: The Theory: Expert Advice

The Theory: Expert Advice

Foreword by Lin & Larry Pardey

Of all the fears that creep into the minds of people who venture out of sight of land on a small vessel, the fear of storms is the most difficult to lay to rest. You can practice almost any other aspect of seamanship close to shore. You can try out methods and gear you might use in each theoretical situation. You can simulate the conditions, practice your moves, see what works, what doesn't, then go back into port, change your gear and upgrade your skills. But storms. How can you go out and find safe ones to practice in? Who can you talk to, to get real information?

The average yachtsman, like ourselves, tries to avoid storms by choosing the best seasons, the best routes, for any passage he makes. Sailors with less than 25,000 miles of experience who encounter a gale or storm at sea may be unreliable sources of information, as they will probably not be able to judge the true wind force, true sea conditions, having little to compare against. I know my first encounter with cyclonic winds offshore, in the Bay of Bengal, made me sure I was in the ultimate storm. Then ten years later we were caught in a non-cyclonic storm with far less wind, but, due to currents, encountered seas that could have been catastrophic without the parachute anchor.

Even the most experienced amateur will have probably encountered less than two dozen gales at sea plus, maybe, two real storms in every 50,000 miles he sails. Some delivery skippers may have upped these averages as they move boats to suit owner's schedules and not their own. But even so, the accumulated storm experience will grow so slowly that I'd safely say none of us will ever see a majority of situations which could pop up in a storm. Veteran fishermen, such as those who work the West Coast of the Americas and the Southern Australia Bight and must lie offshore for two or three weeks at a time, winter or summer, would be a better source of information. For when we have met and interviewed them, the parachute sea anchor has often come into the conversation. But they rarely bother to write about storm seamanship.

The *Drag Device Data Base* being compiled by Victor Shane seems one solution to this problem of finding answers to quell the fear of storms, fears that should be in every sailor's mind. By looking objectively at the method and results written by each boat owner, answers may be found. But in the end, each storm will present different problems, different situations. The size and stamina of your crew, their condition, the currents, the duration of the storm, the proximity of lee shores or reefs, each will affect the decisions you will be called on to make. To be prepared to carry out these decisions means having the proper gear on board before you set sail. It means knowing how to use it.

A para-anchor has always been part of our sailing equipment. We've had to use it only half a dozen times in 150,000 miles of voyaging. Each time we learned something new about it. But in each case it did cut our drift down to less than a knot, did keep our boat in an attitude so that no heavy seas came on board, did help create a slick to windward that upset and sapped the power from the breaking waves.

How exactly to rig a parachute anchor on your own boat can only be learned by trial and error, as each boat rides differently to each wind strength. Studying some of these files will give you ideas to try the next time you are in a gale. Our suggestion is do try these ideas in any gale you encounter. This practice, and the procedures and gear that evolve, will smooth things out when your real storm arrives.

Lin and Larry Pardey, *Taleisin* of Victoria, Warkworth, New Zealand, March 1990

Preface by Earl Hinz

Safety is a tough item to sell, not because it is more costly than other commodities, but because people shy away from thinking about the unthinkable. Take, for example, the automobile. We had heaters and radios before safety belts. We had air conditioning before air bags. We had cellular telephones before side panel crash trusses. It is the same with boats. We buy radios before life rafts, watermakers before sea anchors and GPS before drogues. Somehow our priorities get all mixed up in the euphoria of buying our new toys.

In putting the cart before the horse, i.e., amenities before safety, we shun thoughts of danger crossing our paths. We know disaster always happens to the other guy. We read about misfortunes at sea and say, *"That was tough luck. I'm glad it didn't happen to me, but I really have nothing to worry about. I have an insurance policy with sufficient coverage, so I am safe."* Coverage for what? So that your heirs can live a better life? That's the wrong insurance for offshore boating where you can almost instantly vanish without a trace. What you really want are proven safety devices on board to enable you to outlive the paper insurance which means nothing to you when the chips are down.

It took a long time for the offshore sailor to accept the *Emergency Position Indicating Radio Beacon* (EPIRB) as a standard part of his survival gear. Eventually, though, the experiences of others proved its merit. Unfortunately, an EPIRB-induced rescue usually means the end of the line for cruising dreams. The boat is lost and life returns to the mundane. You want more than that. You want safety gear that will assure your survival on the spot. After the usual life jackets, flares, dye marker and other safety items for near-shore rescue, the list should be headed by designed-for-the-purpose drag devices - namely, the sea anchor and the drogue. They are to the boat as brakes are to the automobile, but offshore sailors still question the need for drag devices. It was the same with the EPIRB and, like the EPIRB, the growing experience of others is now giving credence to the safety value of drag devices at sea.

Interestingly, the sea anchor evolved mostly from the experiences of the multihull sailors who proved it to be a valuable device when you needed to stop your vessel and hold its bow to wind and wave. Past practices of lying a-hull and heaving-to, highly touted in the early days of cruising, have fallen into disfavor by those who have had the experience of riding to a sea anchor.

Drogues, on the other hand, were pioneered by monohull sailors who found the need to slow their boats down to maintain positive control but didn't want to stop them completely. Cruising classics abound with romantic stories on the towing of warps, sail bags, lashed oars, automobile tires and other jerry-rigged devices made up in the heat of battle with the elements. None of these worked with any consistency because the fundamentals of drogues were not then known.

We have come a long way since the days of such romantic inventions by the likes of Voss, Hiscock, Moitessier, and other early blue water sailors. Today we have thousands of cruisers around the world living their dreams. Many of the forward looking ones are already equipped with sea anchors and drogues backing up their goals of completed voyages. They have found that sea anchors work as well on monohulls as on multihulls and, conversely, that drogues work as well on multihulls as on monohulls. They have safely returned to port with first hand stories of encounters with survival weather using drag devices as their first line of defense. Their second line of defense, the EPIRB and liferaft, went unneeded.

If you, the potential offshore sailor, need convincing evidence about the value of carrying drag devices on your otherwise well-found boat, you will find it in the pages of the *Drag Device Data Base.* Herein are first hand, real life experiences of those who have survived the "ultimate storm" through the use of drag devices. Read these case histories and then rearrange your equipment priorities. You stand to become the beneficiary and not your heirs.

Earl R. Hinz,

Henderson, Nevada

January 1998

Survival - A Quantum Perspective

The Nature of the Contest

The scientific and religious opportunism of our age notwithstanding, it is becoming increasingly evident that there is a grand contest afoot in the universe. The contest, in short, pits the survival of enclaves of complexity (of which the species and the institution of man are supreme examples) against the rising tide of simplicity, or what scientists call *increasing entropy*. Now whatever else scientists disagree on, they all agree on one thing: entropy - a physical measure of disorder - is increasing in the universe. Moment by moment the universe is becoming more simple, more homogeneous, more divested of its "information content." The plague of simplicity is gaining the upper hand in the universe at large. How it is that patterns of enormous complexity - living things - have managed to survive for so long on earth continues to remain a mystery.

It should be obvious by now that this is not a "user-friendly" cosmos in which we are living. To the contrary, the material first-principle that governs it is in every respect predatory with respect to human life, human welfare, human safety and human survival. Does this universal first-principle have a name? Yes, scientists call it "Entropy Law" (the second law of thermodynamics). What does it do? Statistically, it discriminates in favor of patterns of simplicity, to the detriment of patterns of complexity. One could say that it selects patterns of simplicity for survival, while selecting patterns of complexity for extinction. Entropy Law is constantly at work, trying to reduce everything of complexity and "high information content" down to the order of pre-Big-Bang simplicity. In short, it is trying to reduce the whole lot of us back to the diminutive order of dust.

The institution of Man is quite likely the most complex pattern in the universe. The human endowment of creativity itself involves a complexity-generating process, giving rise to new forms. That is, *in-form-ation.* If the cosmos could be modeled after a giant computer (some scientists do model it that way), then the institution of Man would represent an isolated cluster on which dense patterns of enormously complex information have been written - and are being constantly added to. This would be fine and well if the universe was devoid of Entropy Law, for in that case human survival would not be an issue - it could be taken for granted. Unfortunately, entropy is very much the antagonist of *in-form-ation*. Entropy is like a "virus" that is going around trying to corrupt every scrap of *in-form-ation* in the cosmos.

Given that this is an "information-hostile" universe, given that the mathematical complexity (information content) of a single living cell is astronomically high, and given that the overall mathematical complexity of a single human being is of an order of magnitude that is altogether off the cosmic scale, it is not too difficult to arrive at a more universal, more scientific understanding of the meaning of "survival." Human survival is very much an issue in *this* universe. It cannot for one moment be taken for granted on stable land, much less be taken for granted at sea.

The human struggle to survive, to prosper, to build, to create complex wealth, to enjoy "liberty," articulates itself against the backdrop of an information-hostile cosmos such as this. Every endowment from God, every providence, every gift, every good thing that we humans deem of worth and value has an inverse relationship with Entropy Law. Everything that we hold dear is in constant jeopardy of being vandalized, corrupted and reduced by Murphy and the devil that enforces Entropy Law. Every physical

aspect of human survival, including the plight of a sailor in a storm at sea, has to be understood in the greater context of a universe governed by Entropy Law, a universe in which, statistically speaking, every pattern of complexity is fugitive and outlaw.

Quantum mechanics itself shows deference to Entropy Law. Viewed individually, quantum events may give the appearance of behaving in a random and unpredictable way, but a large collection of quantum events always conforms to Entropy Law, otherwise scientists could never predict large-scale events - nor be able to design and produce such things as transistors and superconductors. All the "quantum densities," all the "gradients," all the "high points" and all the "tight knots" of universal complexity and information stand to be diluted, de-graded, ground down, unraveled and corrupted by the devil that enforces Entropy Law.

It is August 13, 1979. A fleet of glistening white yachts is headed for Fastnet Rock. Complex, composite hulls and elaborately-engineered superstructures hold their shapes against the forces of the sea. Carefully sewn sails strain in the wind, harnessing Energy. Masts and riggings have been precision-tuned like violin strings. A host of sophisticated navigation instruments place critical information before the eyes of helmsmen and navigators. Highly disciplined and resourceful human beings with diverse identities and backgrounds set their faces to do battle with the elements, with Murphy, and with the clock. You and I would associate this picture with some form of *spiritual* order and elevation, and we would be right. We would do well to remember, however, that the *physical* order of the universe is governed by Entropy Law, and Entropy Law takes a disdainful - predatory - view of such complexities. Now picture the same fleet twenty four hours later, plundered, devastated and reduced to simplicity by the sudden gale. Picture dozens of yachts that have been knocked down, capsized, rolled and dismasted. Picture torn life rafts, random debris and a few lifeless bodies floating in the water. This second picture is something that you and I would call "evil," "chaos," and "disorder." And yet, it is this second picture that Entropy Law universally discriminates in favor of. This second picture is more representative of the elemental "order" of which Entropy Law is choreographer. Indeed Murphy himself is a purveyor and practitioner of Entropy Law, always looking for ways of making complex things unravel and fall apart at sea.

Whatever Entropy Law may in reality be, Einstein himself said that it was the premier law of all the sciences. The great physicist Sir Arthur Eddington referred to it as "the supreme metaphysical law of the entire universe." The Nobel Prize-winning chemist Frederick Soddy went so far as to say that Entropy Law determines the rise and fall of civilizations - and even the freedom or bondage of nations! No doubt the pathological influence of Entropy Law can take on myriad gross and subtle shapes here on the planet earth, from twister and tornado to crime and cancer. What we are presently concerned with, however, is the sort of shape it may assume at sea, and how we may deal with it. *Know your enemy* is the first rule of engagement in any sort of warfare.

In order to "survive," one must understand exactly what it is that one is trying to survive. To understand the grosser implications of Entropy Law on the planet earth is to understand the urgency in the sound of police, ambulance and fire engine sirens as they speed by. It is to understand the haste with which Coast Guard personnel run down the dock, when there is a vessel in distress. It is to understand the roar of a C-130 Hercules, taking off on a search and rescue mission. It is to understand the urgent tone in the voice of Paula Dinius during the Queen's Birthday Storm - *Pan Pan! Pan Pan! Pan Pan! This is the vessel Destiny....* It is to understand the note of finality in the last broadcast of *Quartermaster*'s skipper, Bob Rimmer - *Mayday, mayday, mayday!* It is to understand the heightened sense of urgency that prevailed in

the Wellington Rescue Center in New Zealand, people running in and out, phones ringing, messages flashing, lights blinking, buzzers sounding, ships being re-routed, search and rescue aircraft scrambling.

The sea is a fair metaphor of the greater universe in which we live. In many respects the sailor's contest with the sea is a microcosm of the greater contest between man and the devil that enforces Entropy Law, only much more intensified. Hollywood has only recently started to exploit the drama of this ancient conflict. Epic motion pictures such as *Monolith Monsters, The Thing, Terminator, Star Wars* and *Independence Day* all pit the survival of the human race against the plague-like proliferations of some unrelenting, elemental adversary. But the whole business is very ancient. Man has always had some intuitive knowledge about the nature and scope of the mortal contest. In point of fact he has had to resort to myth and superstition to try to rationalize it in past ages.

Hollywood fantasies notwithstanding, the more rational metaphor of "man against the sea" has been a favorite topic of poets and philosophers since antiquity. The most prevalent metaphor in human literature, the sea has been seized upon by great authors like Whitman, Stevenson, Tennyson, Conrad, Longfellow and Masefield to create timeless literature that strikes an apprehensive chord in the soul of the reader. And this apprehension is most decidedly felt by those of us who venture offshore in small ships of our own. It has a way of descending on us like a cloud the moment that we begin undoing the mooring lines. It stems from a deep-down - intuitive - knowledge that the sea is an indifferent medium on which energy flows from high to low potential without any regard for the sanctity of our lives, that she has no respect for us, that she has been consuming the souls of sailors since antiquity, and that, like Hades, her appetite can never be satisfied.

Spiritual Components of Survival

In a universe such as this, the free and independent mobility of man under mast and canvas is nothing short of inspirational. Sailing across an ocean is much more than a pastime. It is a superlative affirmation of human liberty - a *celebration* of the freedom that God bestows on living things and on man, in spite of the ironclad imperative of Entropy Law. Albatross express that freedom on the wing; whales and dolphins on the fin. Poets express it by pen and verse; ballerinas in dance; athletes in Olympic competition; Benny Goodman expressed it with his clarinet; Anne-Sophie Mutter with her violin. What artists express and celebrate with brush and canvas, we sailors express and celebrate with mast and canvas. And what a grand celebration it can be at times. In the words of Joseph Conrad (speaking about the beauty of sail):

> *The setting of their sails resembles more than anything else the unfolding of a bird's wings; the facility of their evolutions is a pleasure to the eye. They are birds of the sea, whose swimming is like flying. In charge of a capable man, the cutter seems to handle herself as if endowed with the power of reason and gift of execution. One laughs with sheer pleasure at a smart piece of maneuvering, as at a living creature's quick wit and graceful precision.*

(***The Mirror of the Sea,*** **1906**)

And yet, at sea man is always at war with the elements. Why is this so? Why couldn't it be "fair winds

and following seas" all the time? Perhaps it is so because God structured the universe in such a way that it would afford "challenge," "risk," "enterprise," "courage," and ultimately, "liberty" itself. Certainly, and as the scientist Stephen Hawking points out in *A Brief History Of Time*, an omnipotent Creator could have structured the universe any number of other ways. He could have created a bland and easy cosmos where entropy might have increased at a much slower rate, in which case spring might have been eternal, you and I might have lived to the ripe old age of five hundred, and maximum sustained winds in the worst storms at sea might have amounted to twenty-five knots! A Cosmos-Designer could in fact have created the universe a proverbial "Disneyland," if you will, for the benefit of the faint-hearted and the spiritually anemic. And yet He seems to have chosen otherwise. He has seen fit to custom-design the universe exactly the way that it is, perhaps to give purpose, meaning and value to the struggle of the sailor laboring against the gale.

Putting out to sea is not the same thing as going to Disneyland. Disneyland is easy but it is also unreal. Crossing an ocean, on the other hand, is very real. Very real indeed, and not something to be trifled with. As the last paragraph of the official inquiry on the Fastnet tragedy of 1979 reminds us, "In the 1979 race the sea showed that it can be a deadly enemy, and that those who go to sea for pleasure must do so in the full knowledge that they may encounter dangers of the highest order." On land we humans may be able to build the bulwarks of industrial and technological complexity that shield us from elemental forces. When we put to sea in a little sailboat, however, we come face to face with those forces. In the words of the great seafarer Carleton Mitchell, "Every small vessel that ventures offshore is a lonely entity, face to face with the most elemental force on planet earth." Ultimately, out at sea our only practical bulwark and defense may end up being the discipline that we call *seamanship*.

There is something very ancient and inspiring about the image of a lonely sailboat struggling against the sea. Perhaps this is because such an image is evocative of the jagged edge of Man, rising up in a cosmos that is being ground down to curvature, smoothness, compromise and homogeneity by Entropy Law. From time to time we have to remind ourselves that this jagged edge has *spiritual* foundations, and that it can only be borne up by strong *spiritual* sinews. It takes spiritual strength to keep that edge well-honed. The human ability to "stand up," in a cosmos in which every material gradient will eventually "fall down," is rooted in *spiritual* strength. If we are to survive, the greater part of our struggle must be fought with *spiritual* weapons. Upwards of ninety percent of the struggle of a sailor in survival situations may be a spiritual one. Material trust alone - reliance on gadgets and things - is no substitute for the potent weapon of the human spirit itself. In the words of John Rousmaniere, "The human spirit, no matter how it is manifested, is the best survival tool there is." This is so because the ironclad imperative of Entropy Law can only rule over the material things of the universe. It cannot rule over the non-material spirit of man. So, in taking proper inventory of all the components that contribute to safety and survival at sea, we would do well to put the spiritual component at the very top of the list. Indeed, if any form of human struggle is to be successful, it must of necessity exploit the weapon against which the devil and Murphy are powerless, and that is the *spiritual* weapon. This statement does not admit of religious rigmarole or superstition. It just means that a strong, determined, enterprising spirit is to be most valued at sea.

Weapons of Spirit and Mind

Resolve and discipline, determination and obstinate endurance of will, a confident sense of humor, the refusal to give in to despair, the resilience to adapt to changing circumstances, the spiritual strength to persevere and prevail come what may - these are priceless commodities when the wind rises to Force 10.

Unfortunately they cannot be packaged and bought over the counter. They have to be acquired in different ways.

Two illustrations. A yacht sinks and a young couple end up adrift in a life raft. Three weeks later the girl - a ninety pound weakling - is still alive, but her musclebound boyfriend is dead. What was the crucial variable? A fishing boat sinks off the coast of South America and the crew piles into two lifeboats. A spirited individual with leadership qualities takes charge of the first lifeboat. He is relentless. He is a reservoir of encouragement and hope. He sustains morale. He keeps goading, provoking and forcing his comrades to hang on for one more hour, one more day, one more week. The second lifeboat has no leader, no hope and no purpose. A month later the Chilean Navy finds the two lifeboats. All are still alive on the first one. All have long since died on the second. What was the crucial variable?

Coast Guard, Navy and Air Force survival experts all agree that there is no underestimating the role that spirit, mind and attitude play in survival situations. "Attitude is the main thing," said Mike Munroe, who survived the 165-knot winds of Hurricane Allen (1980) in a Givens life raft. While rescuers have marveled at the tenacity demonstrated by some survivors, they have also been perplexed and disturbed by those who seem to give up with little struggle, evidently the sheer will to survive having been the crucial determining factor between life and death itself. "It is a very hard thing to define, the will to survive," said retired Coast Guard search and rescue chief, John Waters (March 1988 issue of *Soundings*). The will to survive is born out of the quality of the human spirit itself. In an age in which sustenance for the soul has been reduced to junk food, the quality of the human spirit that can do hand-to-hand combat with the sea is difficult to come by. Some of us have been brought up on the empty husks of materialism and are, in certain respects, handicapped at sea. This is exactly the sort of handicap that the sea will exploit to the limit.

One does not tend to worry so much about the older, wiser generation. Rather one tends to worry about "generation X" out there, many of whom are now buying sailboats and nonchalantly putting out to sea as though they were off to Disneyland. Fortunately the desired quality of the human spirit is quite contagious. It can be transmitted from one generation to the next. In fact, it can be literally transmitted across the airwaves. In true survival situations, when a vessel is in distress and life's precious balm is hemorrhaging by the minute, there is a vast reservoir of spiritual strength, hope and confidence in the sound of another voice. Indeed sometimes the mere sound of a human voice, crackling over the radio, is enough to tip the balances in favor of survival. No doubt Jon and Maureen Cullen of New Zealand's *Kerikeri Radio* have saved many lives in this way. In the words of Jon himself, "You have to talk them through a problem, and convince them that they can do it.... They will all survive, if they have a will to live, and get confidence."

A reference, to illustrate the value of human communication in genuine survival situations, might be made to the plight of the yacht *Destiny* in the Queen's Birthday Storm. Recall that when *Destiny* fell off that 80-ft. wave Dana Dinius was injured and totally incapacitated. It then fell on Paula Dinius to take charge of the situation. Fortunately Paula *did* possess the spiritual qualities that we are referring to. Notwithstanding, her resolve and determination were reinforced by the crew of the Orion circling overhead. In the night when monstrous waves were using *Destiny*'s broken mast as a battering ram against her hull, in the dark hours in which Paula and Dana were descending into the valley of the shadow of death, it was the voice of the pilot and crew of that Orion that kept goading them on. You will recall also that when the Wellington Rescue Center advised the pilot of that Orion to leave the scene and attend to a

matter elsewhere the pilot refused, sensing that the situation was touch and go down below.

Survival Technologies

In survival situations those who are isolated are in graver risk than those who have some way of communicating with other human beings. This is where complex human technology can now keep the devil at bay. It all began with VHF which was useful, but had a very limited range. Single sideband pushed back the envelope. Then came Inmarsat. The advent of the global cell phone is about to close the gap of human communication at sea. The "isolation factor" can now be taken out of the formula of survival. No one is saying that black boxes should be made a substitute for other things, or that they should be used as crutches out at sea. Notwithstanding, black boxes *are* products of human creativity and ingenuity. They *do* belong in our human arsenal of warfare.

At the very least *do not put out to sea without a 406 Megahertz EPIRB.* Make certain it is properly registered before you set out. If you go missing out there, loved ones will send the whole world out to look for you. If it is known that there is an EPIRB on board the task becomes infinitely easier. If not, then the search and rescue operation may very well turn out to be a dangerous and costly exercise in futility. Millions of taxpayer dollars may end up having to be spent and hundreds of search and rescue personnel may have to risk their own lives in a wasted effort to comb vast stretches of otherwise empty ocean, in the vain hope of accidentally sighting the hull of your boat. Taking along an EPIRB is not an indication of spiritual weakness. Machismo has nothing to do with it. The forces that generate storms at sea are elemental in nature - they originate within the corona of the sun. At times man is no match for such forces. Let us remind ourselves of the words of the great seafarer Hillaire Belloc, *"The sea drives truth into a man like salt."* Presumably he meant there are times when the best of seamen can do little or nothing to help themselves. Even so, at such critical times all seamen can do a great deal to help those who are risking life and limb to rescue them. The responsible seaman will do everything in his or her power to facilitate his or her own rescue, should that rescue become necessary. This means having an operational EPIRB on board, preferably one with a GPS module included.

Route Forecasters

Hurricanes and typhoons have been known to sink battleships and destroyers. Again, we humans are no match for such forces. On the right boat, with the proper tools, proper skills - and a great deal of luck - it may be possible to push back the envelope of survival from sixty knots of sustained wind to eighty, and possibly even a hundred. Clearly, however, there is a certain point beyond which the statistical probability of survival drops off sharply. What then is the wisest course of action? What is a sailor's axiom of first principle? It is, and has always been *avoid bad weather if you can.* This means choosing your seasons and your routes carefully. Remember the old adage that has saved so many lives at sea? Here it is again: **NEVER PUT OUT TO SEA ACCORDING TO CLOCK OR CALENDER**. Wait for a weather window. Ask for knowledgeable advice and heed it when it is given. In this connection there are a number of professional and amateur *route forecasters* around the world. Get to know them and avail yourself of their services. Foremost among the professionals is the renowned Bob Rice. For a reasonable fee *Bob Rice Weather Window, Inc.* will do a professional job of route forecasting for you. Some of the others, among them Canadian Herb Hilgenburg (sadly, now retired), will do it for free, though you may have to wait your turn to talk to them on the radio. These route forecasters know their trade, and their

tools are improving all the time. Most have access to the same high resolution satellite data and basic NOAA models. All have intimate knowledge of most of the wind and weather patterns of the planet earth, and some use sophisticated software to make educated guesses about the unknown. They can deliver a constantly updated weather prospectus, "site-specific forecast" and/or weather maps to your sailboat via SSB, Inmarsat or global cell phone. Yes, you will need more complex black boxes. And yes, the devil and Murphy will do their best to make them fall apart at sea. But some of our black boxes are very reliable now - reliable enough to give Murphy and the devil fits.

While the 4-5 day forecast remains somewhat elusive at the present time, the record is fairly good when it comes to 48-72 hour predictions, and that record is getting better all the time. Forty eight hours of advance warning can translate into some useful - site-specific - advice at sea. Advice such as the following (stated hypothetically): "The low pressure system that you are in is moving at twenty knots. If you stay put you should be out of the circle of 50-knot winds within twenty four hours. If you run with it, you can expect to be in 50-knot winds for three more days...." Or conversely: "The tropical depression to the north of you is stalled and strengthening. If you can sail a hundred miles south in the next twenty four hours, you should be in a safer position."

Sometimes a distance of a hundred miles may mean the difference between seventy or fifty knots of sustained wind. Route forecasters are providing this sort of invaluable advice to vessels at sea daily. Even when the weather is routine and boring they can impart rhythm, structure and order to long ocean passages. Quite often the radio call becomes the high point of the day on such passages, relieving the tension of vertigo and isolation. And if the yacht does actually run into heavy weather (sometimes unavoidable) some route forecasters can play the part of "mission control," as did Jon and Maureen Cullen in the Queen's Birthday Storm. You will find a list of route forecasters in Appendix II at the end of this publication.

Tools of Knowledge

It takes an uncommon and enterprising sort of individual to put out to sea, fully prepared to deal with any eventuality out there. Happily the sailing community is full of such individuals. On the other hand it takes a reckless fool to put out to sea ill prepared and ill equipped, under the pretext that "there is someone up there watching over me." While a statement such as this may in fact be true, it is also presumptuous to ask someone up there to do for you what you are perfectly capable of doing for yourself. At the very least do not put out to sea without a thorough *understanding* of the disciplines of seamanship. While there are no government regulations preventing you from doing so, there are nevertheless some responsible steps that you must voluntarily take before putting out to sea. Foremost among them is some serious "reading up" on some of the literature that has been written on the subject of heavy weather tactics. You will find a list of such books in Appendix I at the back of this publication.

If you have never done any sailing before, take the course in boating safety offered by the Coast Guard. Try to take other courses in sailing and seamanship if you can - there are a number of schools and academies that offer them around the world. *Cruising World*, *Sail* and other boating organizations offer seminars on seamanship. Try to attend one. Unfortunately there are very few hands-on courses offered on storm tactics at the present time. This is probably because heavy weather conditions can't be duplicated in a controlled environment - there are no "safe storms" to go out and practice in. Apart from going out on windy days and trying to hone your skills in realistic conditions, the next best thing is to study up on the

lessons learned by those who *have* run into storms at sea. The greater portion of this publication deals with such "case histories." Study them well. The files in this book may very well end up being the only "crash course" you take before you put out to sea in a vessel of your own.

Think of this book as your stint in boot camp. Within its pages you will be forced through the gauntlet of gales. You will be battered by storm waves. You will be deafened by the shriek of the wind. You will be ridiculed, put down, compromised, brow-beaten and violated by the elements, but you will have to pick yourself up and carry on. You will learn how to deploy and retrieve state of the art heavy weather weapons. You will learn how to do hand-to-hand combat with the devil and Murphy alike. You will broach. You will get knocked down. You will capsize. You will pitchpole. You will fall overboard. You will face hypothermia and nearly drown. You will watch in anguish as your new sails are reduced to ribbons before your eyes. You will lose expensive gear due to chafe. You will learn how to crawl through barbed wire on your belly, the sea exploding all around. You will find yourself sliding about on the forepeak on a dark night, white-knuckled and knees bleeding, trying to unravel a mess of lines as cold waves wash over you.

All this you will do, and more, *vicariously*, in the pages of this book. And when you have finished reading your mind will be better prepared for combat. When the sea throws down the gauntlet, when the forecast is *Force 10 Imminent*, it will not come as a shock and a surprise to you. It will be as if you have been through all of it before. You will remember your harsh training in boot camp and start doing things "by the numbers." You will sound "battle stations," size up the enemy, assess your options, decide on a course of action, and act on it with all the resolve you can muster. More you cannot do.

Emerging Tactics: Alignment

Tactic of Choice

Sailors like to debate storm tactics. A generation ago some were arguing in favor of *lying a-hull*, others for *heaving-to*, others for the wisdom of *towing warps* and *running before it*. While no one is extolling the virtues of lying a-hull any more, the argument still goes on and to this day no treatise can claim to have resolved the issue conclusively. The writings of the most noteworthy sailors of history leave the question in part unanswered, as does the legendary masterpiece of K. Adlard Coles, *Heavy Weather Sailing*. Nowhere in his writings was the late Adlard Coles dogmatic about any particular method of negotiating gales at sea. Indeed, in all respects he tried to leave the issue open, recognizing that he himself did not have all the answers. No one has *all* the answers. The issue is not an easy one to resolve. It involves many different types of boats in many different types of sea conditions.

The advent of modern sea anchors and drogues may have revitalized the debate, but it has not resolved it. In November 1994, for example, someone posted a question about drag devices on Compuserve's *Sailing Forum* (Section 2, *Seamanship and Safety*). This led to a twelve-month-long heated debate about the uses of sea anchors and drogues. Numerous sailors from all over the world, among them seasoned veterans and renowned safety experts, jumped in with feedback, opinions, observations, prejudices and disagreements.

In the end, however, all the exhausted participants more or less agreed that seamanship is a continual learning process and that there are a great many things that are yet unknown. The marathon debate was subsequently "packaged" and placed in the Library Section of Compuserve's *Sailing Forum*. The megabyte-size file (three hundred pages of printout) is called *Thread on Drogues & Sea Anchors*. It can be downloaded and perused at one's pleasure using Compuserve's Windows-driven software: just hi-light the item and click on "retrieve."

The issue before us may be difficult to resolve but we must never give up trying to do so. Here we need to remind ourselves of the words of John Rousmaniere, who was himself at the helm of the yacht *Toscana* during the ill-fated Fastnet race of 1979:

> *We must not give up trying to improve our skills and equipment so that the tragedies of the past are not repeated in the future. We must not allow outdated or misinterpreted stories to shackle us to fatalism. We must learn to reinterpret old stories, and even write new ones, in light of new challenges, new data, new experiences.*
>
> *`Another Fastnet' is always possible, but it is ever less likely if we learn from the experiences of those unlucky men and women who were caught out there, and who suffered so badly in that terrible storm. The lessons that will help us improve our boats, our gear, and our seamanship are there for us all to learn.*

(*Ocean Voyager*, 1988, annual publication of *Ocean Navigator Magazine*, by permission.)

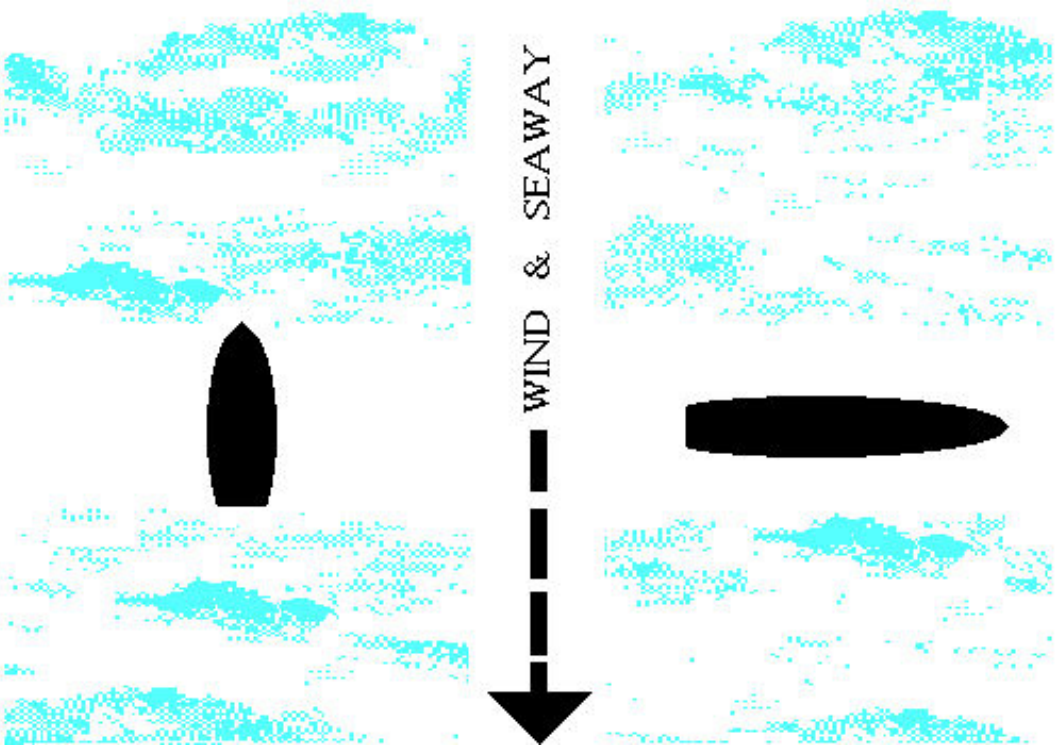
The Nature of The Problem

In inquiries of every kind there are certain first principles on which all subsequent reasoning must depend. Do we have any useful first principles relating to vessel design and seaworthiness? Indeed we do. Round up a dozen naval architects and ask them if they design their boats to take the seas on the beam, and the answer will be a resounding "no!" We have to start on the correct premise that boats are not designed to negotiate the seas beam-on.

Ninety-nine percent of all vessels (including large ships) are in fact designed to negotiate heavy seas with their pointed bows. It is the low buoyancy, knife-like bow of the boat that offers the least amount of exposure to the force of the sea. When a vessel is facing into the seas she has her shield up, so to speak. When she does not, the shield is down and the former protection is no longer there.

The problem, of course, is that although boats are designed to penetrate the waves with their bows they will not face into the seas when disabled. All boats in existence (or at least 99% of them) will want to fall off the wind and let down their guard at the worst possible of times. One might say that the average sailboat is in many respects like the stubborn Grand Canyon mule that insists on walking along the very edge of the precipice, with a nervous tourist on his back. The moment that the sails are lowered, or steerage is lost, or the engine conks out, the stubborn creature will fall off the wind and edge her way towards the precipice. No sooner disabled than she will let down her guard and expose her vulnerable broadside to the waves. And she will remain there, at the edge of that precipice, rolling in the troughs, rails buried, inviting disaster in the shape of a knock-down, capsize, or even a 360° "barrel roll."

Most sailboats are just like stubborn mules in this respect. A sailor needs a whip, a spur, a bit, a bridle - a sea anchor or a drogue - to force the obstinate creature away from the edge of the abyss. One needs a method, a technique, a **tactic** that will make the stubborn creature do what one wants it to do, instead of always doing what it wants to do.



Vessel on the left is properly aligned and is far better poised to survive a storm than the vessel on the right.

CLASSIC PREAMBLE OF HEAVY WEATHER SAFETY: **Boats have to be forcefully brought into alignment by some clever, auxiliary means.**

In some instances this may involve the use of sails, as with the proven tactic of *heaving-to.* In other instances it may involve the use of the engine. Commercial fishermen call this *jogging into it.* When a commercial F/V runs into a gale offshore the captain will usually place the engine in slow-forward and use the minimum number of RPMs that it takes to maintain steerage and keep the vessel facing into the seas.

Many a sailboat skipper has done the same thing, with the wind up and the mainsail in ribbons.

More recently, however, the "clever auxiliary means" has come to involve the use of drag devices - sea anchors and drogues. Nowadays more and more sailors are using the tether of large **sea anchor** to pull the bow of the stubborn creature into the teeth of the gale, or the bit and bridle of a smaller **drogue** to keep her passions restrained as she tries to careen and cavort down steep watery slopes out of control - whoa girl, whoaaa! Both tactics are in widespread use today. Which one is better in a given seaway? When is it wiser to use a "sea anchor" off the bow? When should one consider using a "drogue" off the stern instead? The authors hope to shed considerable light on this difficult question in the subsequent pages of this publication.

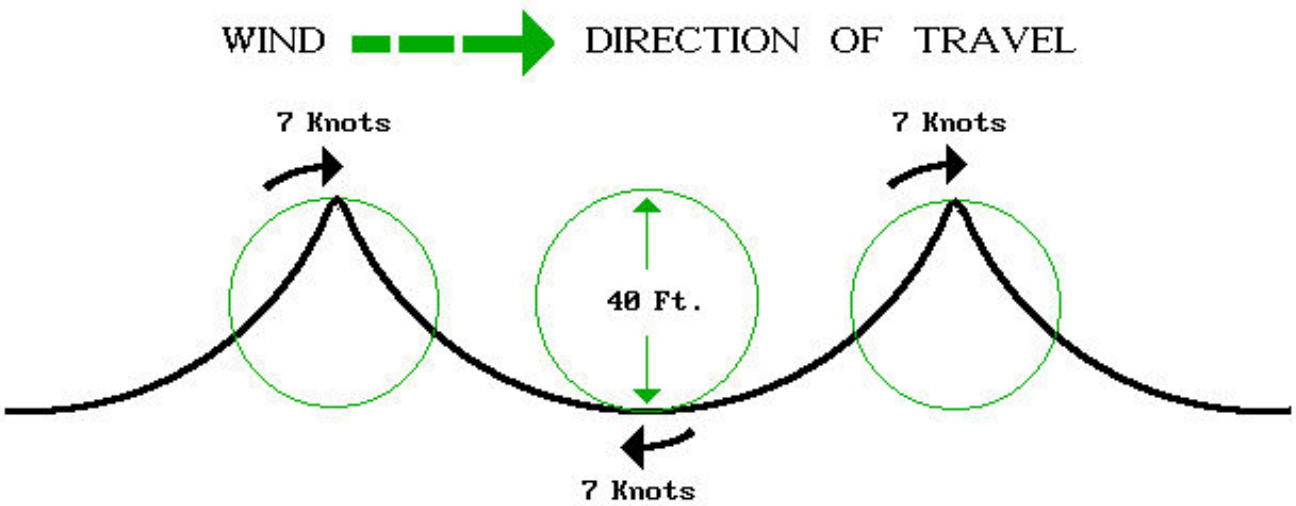
Wave Dynamics

We said, "in inquiries of every kind there are certain first principles on which all subsequent reasoning must depend." Do we know of any useful first principle relating to the dynamics of the sea itself?

Indeed we do.

It has to do with the so-called *Trochoidal Wave Theory*. The subject of deep water wave characteristics is extensively covered in publications such as *Oceanography And Seamanship* (William Van Dorn, Dodd Mead 1974), *American Practical Navigator* (Nathaniel Bowditch, U.S. Navy Hydrographic Office 1958), *Waves and Beaches* (Willard Bascom, Doubleday 1980). We will not drag out complicated formulae here. Suffice it to say, however, that we need occasionally to remind ourselves that the motion of a wave at sea is not to be confused with the motion of a stream or river.

Deep water waves are sometimes compared with the undulations of rope which is being moved up and down at one end. "Crests and troughs" will be seen migrating from one end to the other in wave formations. The transverse motion perceived is that of *energy*, and not that of rope fibers themselves. Similarly, the transverse motion of a deep water wave is also of energy and not the motion of the water itself. The water at the surface of a wave does not move with the wave across the surface of the sea. It merely rises up and falls down - actually rotates in small orbits, forward on the crest and backward in the trough, which motion, when viewed from afar, gives the illusion of real transverse motion.



Trochoidal wave theory:(from Greek 'trochos' meaning 'wheel'): Although the waves look like they are moving to the right, in fact the molecules of water merely rotate in circles. the diameter of the 'wheel' is equal to the height of the wave. The period of the wave determines the time it takes for the 'wheel' to make one revolution. The approximate speed of the water molecules on the surface of the water at the peak and trough can be determined by dividing the circumference of the wheel (= ? x wave height) by the wave period.

We have to start out on the correct premise that the sea is, for all intents and purposes, a *stationary* medium. The popular notion of "running with it" or "going with the flow" sounds plausible enough, until we stop and remind ourselves that most of the time there *is* no material "flow" to speak of. The waves that frequent the surface of the sea articulate the flow of energy, not the flow of water itself.

It is one thing to run full bore down the rapids of the Colorado River, where the entire field of water is moving. It is another thing to run full bore in a gale at sea, where the field is more or less stationary.

Even so, in every gale there is the *perception* that the whole field of water is actually moving. Because of this perception, there is often a false sense of security associated with running downwind. One gets the feeling that one is "going with it," as it were, and "not resisting nature."

Not only is this perception itself false, but the false sense of security it evokes can be quite dangerous at times as well. Falling off a crest in the rapids of the Colorado may be harmless enough - rafters do it all the time, grandma and the kids squealing with delight. Unfortunately, falling off a wave at sea is an entirely different proposition. It is a very dangerous thing for a running yacht to fall off a wave at sea.

Why?

Because the yacht does not land in a cushion of water that is moving at the same speed as itself. Rather it usually does a belly flop into a concrete wall of stationary green water.

Remember doing that first painful belly flop off the diving board at summer camp? If so then you will understand why so many sailboats have received near death blows after falling off waves at sea.

Inertial Augmentation

Which is the wiser course of action? To heave-to or to run with it? In attempting to answer this difficult question one has to bear something else in mind: *Inertia is a two-edged sword.*

Unless they are actually breaking, which is very rare, sea waves do not impart significant amounts of net energy to *motionless* vessels.

They do most certainly impart significant amounts of net energy to *moving* vessels, however.

There is a principle of *inertial augmentation* that has to be considered here. This augmentation can, for all intents and purpose, be ignored when the vessel is stationary and hove-to. It cannot be ignored when the vessel is running downwind at great speed. Needless to say, we are dealing with the old familiar formula that relates force, mass and acceleration: *F = ma* (*Force = mass x acceleration*). As the speed of a heavy vessel increases downwind, the inertial forces tend to augment themselves precipitously - along with the risk factors.

The inertial forces associated with a 20,000 lb. yacht that is hove-to are minimal in trochoidal (stable) sea states. The inertial forces associated with a 20,000 lb. yacht that is surfing down the face of a twenty foot

wave at twelve knots are horrendous even in trochoidal sea states, to say nothing of cycloidal (unstable) ones. If this speeding yacht falls a mere five feet off the crest of a huge wave she may very well impact green water with a force of 100,000 foot-pounds. And heaven help her if she lands on her belly....

Newton's 1st law states: ***Any body, once set in motion, will continue to move forward in a straight line with uniform velocity forever, provided it is acted upon by no force whatever.*** His 2nd law states: ***When any force acts on a moving body, its deviation from a straight line will be in the direction of the force applied and proportional to that force.***

Inertial augmentation is minimized when a vessel is stationary and hove-to. The augmentation curve begins to fluctuate wildly when the vessel is running unrestrained.

What happens when a wave breaks? The reaction of a stationary vessel is fairly predictable, ignoring the possibility of structural damage. The reactions of a moving vessel, on the other hand, are anything but predictable. In the case of the stationary vessel we are dealing with one fairly straightforward reaction. In the case of a moving vessel however, we may be dealing with many unpredictable reactions. If the impact is squarely on the transom of a speeding yacht, the boat may get hammered down into the adjacent trough and pitchpole unexpectedly. If the impact is at an angle, the yacht may get "derailed" and make any number of dangerous contortions and/or maneuvers.

Given equal measures of physical hull strength, the residual vices of a particular yacht design are minimized when the vessel is hove-to and is struck by a breaking wave. They are all too exaggerated when she is running and gets struck by a breaking wave. In the words of John Voss:

> *To sum up, I have found that breaking wind waves in the open ocean become dangerous only when the vessel is driven through the water, and the faster she is traveling the more damage a sea is likely to inflict. Pooping seas, i.e. seas breaking over the stern when running, are the worst of all.* **(*The Venturesome Voyages of Captain Voss*, Gray's Publishing, 1968)**

Some boat designs are well suited to running downwind. A great many are not. Their dynamics can become all too complicated. The configuration of the rig, the position of the center of effort, the trim/ballast ratio, the prismatic coefficient, the shape of the buttocks, the underwater profile, the length of the hull's turning arm, the shape and position of the rudder assembly, the ever shifting position of the CLR (center of lateral resistance) all in all awaken a great number of unpredictable reactions from the boat that is running in a storm, any one of which can be her undoing.

Although a high speed scream downwind can be extremely challenging, rewarding and exhilarating on a well-crewed maxi yacht, it may not be the wisest course of action on the short-handed cruiser. The behavior of a yacht that is running unrestrained in a gale is all too fluid, all too unpredictable. One needs the reflexes of a grand prix driver to keep things under control at all times. One needs to be as tireless as Superman as well. Racing boats may have a team of grand prix drivers - and Supermen - taking regular shifts at the helm, but the retired mom and pop about to cross the Atlantic would do well to learn the ancient art of heaving to.

Rudder Reliability

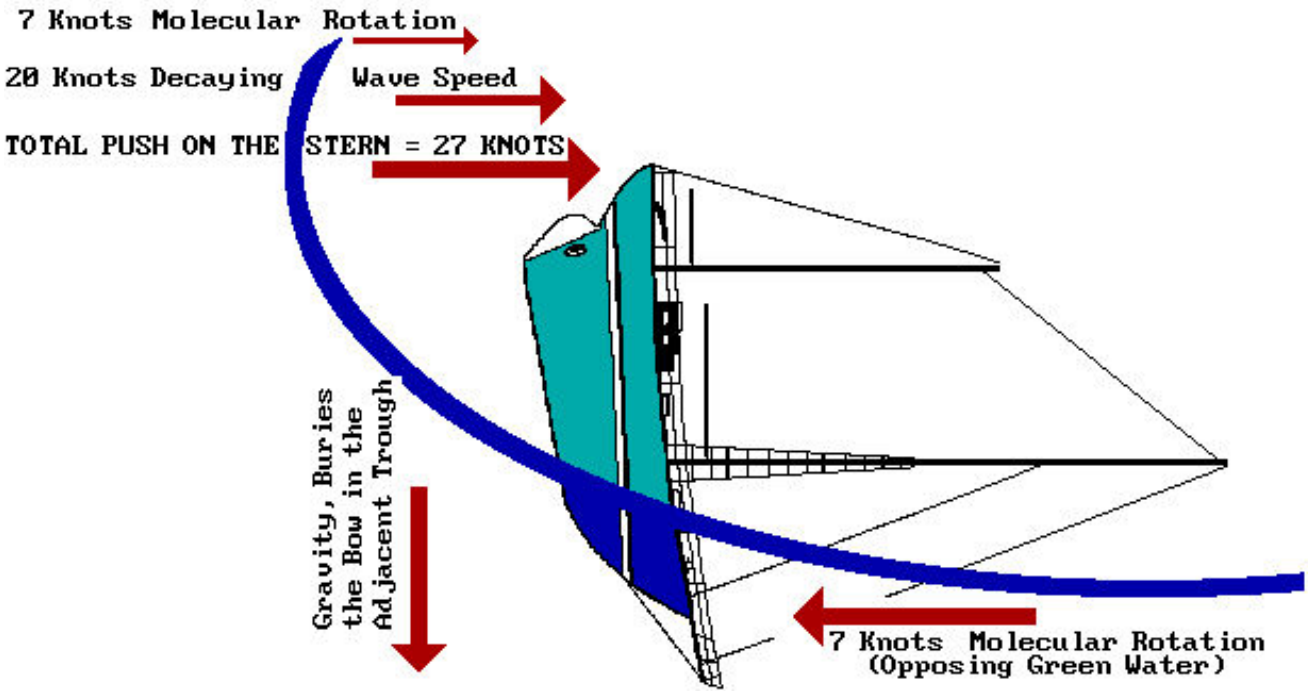
There are other risk factors associated with running, not the least of which has to do with rudder reliability. In order to maintain control while running one needs an effective rudder.

Aside from cavitation or outright breakage, sailboat rudders tend to lose their effectiveness on wave crests. Because of the orbital rotation of the water molecules themselves, the blade tends to loose its "bite" on the crest of a wave, precisely where one needs a maximum amount of directional control.

Have you ever tried to steer a sailboat down a canal basin or a river? If so then you will know how difficult it is to maintain steerage on moving water. This is so because the body of water is moving along with the boat. Water has to be flowing *past the rudder* at a sufficient rate before it can be used to steer the boat. The rudder tends to become sluggish where the water and the boat are moving together in the same direction. One runs into the problem of sluggish rudders on the crests of mature sea waves, where the water molecules are, briefly, moving in the same direction as the boat.

Pitchpole

There are other hazards associated with running before a storm. The most serious of these occurs when the height of a steep breaking wave matches the length of the boat. Sudden, unexpected, explosive, violent and catastrophic pitchpole is sometimes the result. Throughout maritime history a great many vessels have been pitchpoled while running. Not too many have been pitchpoled while hove-to and stationary, however. The diagram below shows a 40-ft. yacht being pitchpoled by a 40-ft. breaking wave.



Formula for Disaster

Whereas a rising tide will lift a boat vertically by a force equal to her displacement (usually many tons), a steep wave will "lift" the same boat horizontally with equal displacement force (*DF*) at wave speed. Speed of orbital rotation is already about 7 knots on the crest of a 40-ft. wave. The decaying crest hurls tons of water at a wave speed of 20 knots at her transom Force of gravity drives the bow down into the adjacent trough where it is briefly met with 7 knots of reciprocal rotation coming from the opposite direction. Result: The stern goes flying right over the bow without any hesitation at all, which is probably what happened to *Tzu Hang* in File D/M-1**.**

Bernard Moitessier's Experience

But what if *all* the waves are breaking and the whole surface of the sea is in motion? Would it be safer to release all the brakes and go full bore then?

The renowned French mariner Bernard Moitessier ran into a once-in-a-life-time phenomenon such as this in a prolonged Southern Ocean storm.

At the time he was dragging a number of items behind his 40-foot Bermuda ketch, *Joshua*, a center-cockpit steel boat, with inside steering station.

Describing the waves at the height of the storm as "absolutely unbelievable," he opted to cut away all warps/drags and run the "rapids" at full bore. Statistically speaking, however, the phenomenon witnessed

by Bernard Moitessier in the high latitudes of the Southern Ocean - gigantic storm waves breaking "without interruption" for from 650 ft. to nearly 1000 ft. and "leaving acres of white water behind them," are very rare indeed. Other sailors who have made many circumnavigations have never run across such an occurrence.

As far as the average cruiser is concerned the surface of the sea will seldom if ever undergo the sort of wholesale, violent horizontal displacement described by Bernard Moitessier in his epic book, *Cape Horn, The Logical Route* (Grafton Books, 1987).

Unless a number of severe storms are getting in synch on the unlimited fetch of the Southern Ocean, or unless a small yacht is caught in the dangerous quadrant of a category five hurricane (in which case *everything* is uncertain) there is always an admixture of moving and non-moving water to play havoc with the tactic of choice.

The dichotomy between moving and non-moving water is precisely the thing that makes the issue of heavy weather tactics so difficult to resolve. One could easily render a judgment in favor of "running" in the case of the rapids of the Colorado. One could easily render a judgment in favor of heaving-to in the case of normal storm waves. But what about the not-so normal wave? What about the *occasional* breaking wave? What about *episodic* waves that are different from the rest? What about microburst-generated ESWs (extreme storm waves)? What about rogues and mavericks coming from different directions?

If a vessel is running unrestrained, and if the entire field of water is also moving with it, there is little to worry about, relatively speaking. But what if the field is stationary but the occasional wave is breaking? What happens then? What happens if the yacht just happens to be at the wrong place at the wrong time? What happens if she is picked up and "captured" by the fast-moving crest of a breaking wave?

On the rapids of the Colorado the "capture" would not amount to much; the keel would right the vessel and she would continue merrily downstream. But this is not what happens to a vessel when it is captured by a breaking storm crest out at sea. Out there, *crest capture* represents one of the most dreaded of all scenarios. In *Heavy Weather Sailing*, Adlard Coles quotes the words of Commodore Nigel Warrington Smyth:

> *One has to realize that a large breaking crest in a full gale may be traveling at 15 or 20 knots, whereas the green water underneath it has virtually no horizontal motion. It follows that any vessel which is small enough or of shallow enough draft may be picked up and carried to leeward by the crest at great speed until some part of her stabs into the motionless green water, and she will be smashed down, capsized, or turned head over heels.* **(*Third revised edition, page 277*.)**

Fastnet '79

The memory of Fastnet '79 haunts every sailor. Who can forget those names - *Grimalkin* and *Ariadne*, *Flashlight* and *Cavale, Trophy* and *Gunslinger* - names that evoke visions of the most bittersweet

melodramas that pit mortal man against the tempestuous sea? What was so startling about Fastnet '79 was that never before had so many people died in so many boats while using all of the traditional storm tactics.

One hundred sailboats were knocked down; 76 capsized, many rolling full circle under the water; 5 sank; and 70 had to be towed back to safe harbor. Fifteen lives were lost; 136 sailors had to be snatched out of the gaping maw of death by British and Irish helicopter crews. All the more baffling because these were among the best racing yachts in the world, manned by well-disciplined, resourceful and highly experienced crews. Yet, when the wind and the sea took over, many found traditional survival tactics wanting.

The very idea of *survival* implies an ultimate defense. That is, *a last, final and concluding tactic.* Mother Nature, for instance, provides almost every creature with its own peculiar form of survival tactic. The fawn, separated from its mother, will instinctively try to hide and lie still at the approach of a predator. Why? In order to *optimize* its chances of survival. The beetle will roll over and play dead in a similar situation. Why? In order to *optimize* its chances of survival. The puffer fish will inflate itself into a spiny ball too big for the shark to swallow, and the turtle will withdraw into its shell and wait it out.

It must be noted that in all of the instances cited above, and indeed throughout the entire gamut of struggle in the Natural world, the survival tactic that is resorted to last is more often than not a *passive* one. That is to say, a strategy more conducive to the *conservation* of strength and resources. At times of severe stress the human body itself is a master of such *shut-down-and-conserve* procedures.

It must be noted, also, that in all of the instances cited above the strategy resorted to affords no *guarantee* of actual survival. It merely maximizes the chances of doing so. Of course, the gamble may involve a trade-off of some sort. A peculiar species of lizard, for instance, will gladly part with a tail in order to survive, because the creature gains his very life by that trade-off. Besides, he can grow another tail later.

In genuine "Fastnet conditions" a sailor may similarly be faced with a trade-off, in which case he must make a choice between the risk which can be reasonably accepted as regards his property (boat), and the risk which must be rejected as unacceptable as regards the lives on that boat. In this connection it was traditionally regarded as more acceptable, beyond a certain point, to abandon the sailboat in favor of a life-raft, thus sacrificing replaceable property in favor of irreplaceable human life. But if Fastnet '79 taught us one thing, it taught us that **we should be absolutely certain that a boat is about to sink before abandoning it**.

Indeed, from 10.00 p.m. of August 13th until 6.00 p.m. the next day, when the air waves filled with maydays and the skies over the Western Approaches were dotted with brilliant distress flares, no less than twenty-four yachts were abandoned by crews who took to rubber life-rafts believing that their vessels were about to sink. Astonishingly enough, however, only four of the twenty-four abandoned boats were actually sunk by the storm. And while many souls perished in or near capsized life-rafts, some of which split apart at the seams, fully nineteen of those abandoned sailboats were found to be still floating and intact after the storm had passed on. Astonishing and difficult to believe.

Alignment Again

The question that is asked over and over again is, *why did all those sailors abandon their boats?* Quite likely they abandoned ship because the random and catastrophic motions that they experienced led them to judge the situation untenable. We return to the fundamental question of *alignment*. Indeed, once disabled, 99% of all sailboats in existence today will fall out of alignment and lie broadsides to the waves, in that vulnerable position subject to the same random and catastrophic knock-downs and "barrel rolls" that did so much damage in the course of Fastnet '79, turning cozy cabins into combat zones ("cottage cheese became a lethal flying object," said one survivor), throwing the crew around inside along with broken glass and battery acid, inflicting injuries worthy of an automobile accident, forcing them out into the cockpit area, there to be thrown violently against the ends of their safety harness lines by boarding waves, or be washed overboard and lost at sea.

What then, was the lesson of Fastnet '79? Perhaps the lesson can be summed up in the following words: *there is something basic missing in small craft survival equipment.* None of the yachts participating in that race had purpose-made sea anchors and drogues on board. In short, those ill-fated sailors had no adequate drag device equipment to align and stabilize the attitude of the boat, making her motions much more predictable, much more stable, much more tolerable, in which case they might have thought twice about abandoning ship in favor of rubber life-rafts.

Many life-rafts rely heavily on the drag device (sea anchor or drogue) that they come equipped with. It stands to reason that, with the proper drag device deployed, a yacht itself can become a "survival platform," far sturdier, far better built and far more comfortable, far better equipped and provisioned than the little inflatable one that comes in the suitcase.

Queen's Birthday Storm

Fastnet '79 was a milestone in our understanding of heavy weather tactics. Fifteen years later we have another milestone in the form of the Queen's Birthday Storm. In June 1994 a regatta of pleasure yachts left New Zealand, headed for Tonga. En route, the boats were devastated by an unseasonable cyclone. The event coincided with the celebration of Queen Elizabeth's birthday, and has been referred to as the Queen's Birthday Storm ever since.

We will not go into the details of the life and death dramas that transpired on high seas. They are described in great detail in other texts and videos, among them Tony Farrington's book *Rescue In The Pacific* (International Marine Publications, 1996 - recommended reading), and Ninox Films' videographic masterpiece, *Pacific Rescue* (recommended viewing - *Ninox Films Ltd., PO Box 9839, Wellington, New Zealand*). Suffice it to say that the Queen's Birthday Storm also involved severe knock-downs, capsizes and barrel rolls. There was one catastrophic pitchpole. Many vessels had to be abandoned, crews risking life and limb and even performing daredevil trapeze acts worthy of the Flying Zambinis to get off their boats. One yacht, the 45-foot sloop *Quartermaster*, sank outright, with the loss of three lives.

Who can forget the utter frustration and incredulous despair in the voice of *Quartermaster*'s skipper, Bob Rimmer, during his all but final radio communication with New Zealand's *Kerikeri Radio*: "We've just

had a second knock-down, Jon.... I don't know what to do...." Who can forget the plaintive tone in the voice of Kerikeri Radio's Maureen Cullen later on, as she tried in vain to raise the ill-fated *Quartermaster* on the radio: "*Quartermaster, Quartermaster,* Kerikeri Radio calling, do you copy? *Quartermaster, Quartermaster,* Kerikeri Radio calling, do you copy?" The silence that followed was haunting.

A Ray of Hope

In one respect, however, the Queen's Birthday Storm was different from Fastnet '79: more crews tried to avail themselves of drag devices, makeshift and otherwise. A number of the boats had purpose-made sea anchors and drogues on board, and did manage to use them in earnest.

The vessel *Destiny*'s use of the Australian *Sea Squid* drogue is reported in file D/M-12 of this publication. The vessel *St. Leger*'s use of an American *Galerider* drogue is reported in file D/M-17 of this publication. The catamaran *Heart Light*'s use of a drogue, as well as a large parachute sea anchor, is reported in file D/C-5.

The catamaran *Ramtha* had a parachute sea anchor on board, Bill and Robyn Forbes having deployed it a day or so before the fiasco in order to make repairs to the steering cables. But they lost the parachute during retrieval and had nothing to deploy when the real storm hit.

Victor Elias, owner of a Westsail 43, managed to get some sort of short-lived benefit from a 2.5 foot Shewmon drogue before losing it outright to line chafe. Elias had a Shewmon sea anchor on board as well, but, according to the message that he posted on Compuserve on 30 December '94, "we felt that the conditions were too dangerous to go on deck to deploy it. Instead we motored bow-on. We made it through with little damage, but were very lucky." (No further details available at the present time).

Skipper Sigmund Baardsen deployed warps, an old mizzen sail and a dinghy anchor to slow down his 40-foot Offshore yawl *Mary T*, but the aft windage of the rig caused her to lie a-hull instead.

The 32-foot cutter *Sofia* derived some benefit from dragging looped warps behind the boat. The 44-foot New Zealand yacht *Waikiwi II* streamed a makeshift drogue made out of automobile tires, but the contraption failed to do an adequate job of aligning the vessel with the prevailing seaway.

A number of boats tried to convert sails into sea anchors, one with noteworthy success. After being dismasted, the crew of 42-foot sloop *Silver Shadow* streamed a #4 jib off the bow, tied like a diaper at the head, tack and clew on 200 feet of rope.

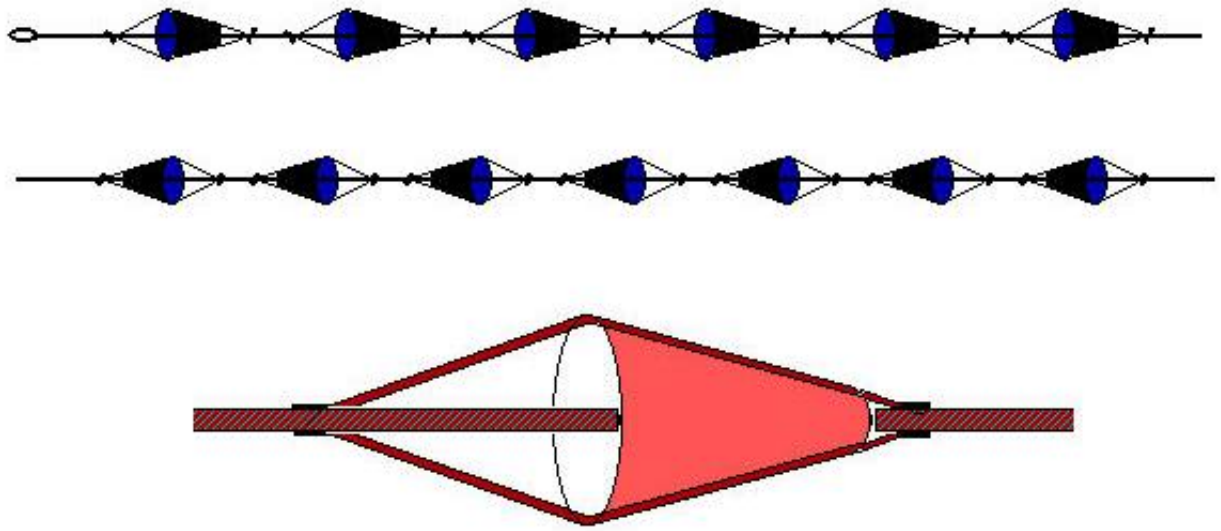
They then jury-rigged the storm trysail up on the stern to help bring the boat's head around. *Silver Shadow* then lay hove-to for the next forty hours without further mishap, her skipper Peter O'Neil emerging as one of the unsung heroes of the Queen's Birthday Storm. Although the 360° roll that dealt the death blow to *Silver Shadow* had left Peter severely injured and in excruciating pain - broken bones literally grating together in his chest - the relatively stable attitude of *Silver Shadow* as she lay hove-to enabled Peter to decline immediate assistance in deference to the needs of others in more immediate danger, who had to be taken off their boats as soon as possible.

The Same Lesson

That so many stricken crews would instinctively try to convert sails into sea anchors and automobile tires into drogues ought to convince us that purpose-made drag devices belong in the inventory of every small vessel that ventures offshore.

The lesson of Fastnet '79 seems to have been reinforced by the lesson of the Queen's Birthday Storm - the need for suitable drag devices. ***One needs a suitable drag device to maximize one's chances if one runs into a gale offshore.*** But there is still some confusion as to what a suitable drag device might be. How does one choose between the various different classes and types of drag devices on the market today? There are, for example, large-diameter, high-drag parachute type *sea anchors* that can be used to physically anchor a sailboat to the surface of the ocean. There are smaller, low-drag *speed-limiting drogues* that can be towed off the stern to slow a boat while allowing a fair amount of helm control. These come in a variety of sizes and shapes - in solid plastic as well as various textile and webbing configurations.

And then there is the medium-drag *series drogue* conceived by Donald J. Jordan. The series drogue, composed of a hundred or so 5-inch diameter cones strung on heavy tow rope at 20-inch intervals, is also deployed off the stern, but is in fact more of a sea anchor. It provides just enough drag to all but stop the boat dead in the water, but not as much drag as the true sea anchor that might be used off the bow. In effect, the series drogue places the yacht on "standby mode," ready to yield only to the impact of the rare wave that is actually breaking.



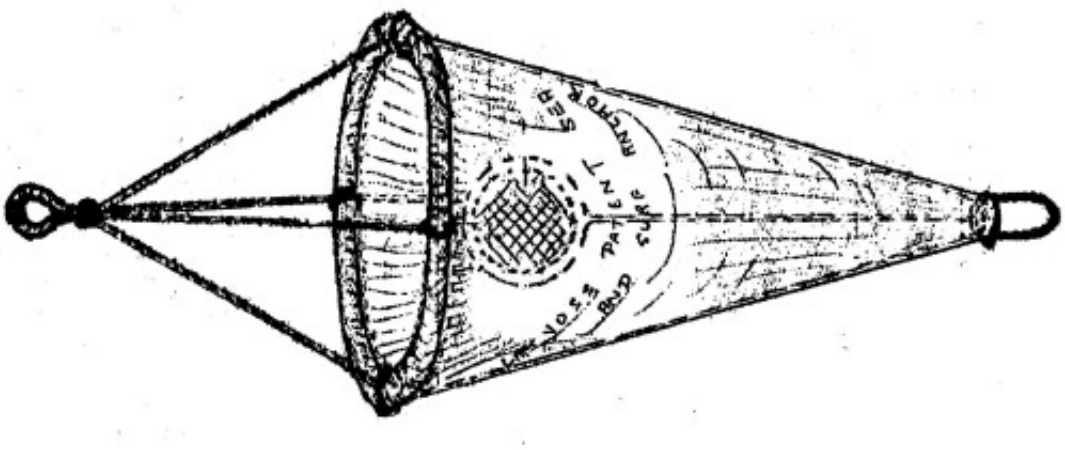
The Jordan Series Drogue consists of dozens of 5-inch cones spliced to a long warp. A weight is then attached to the distal end.

How does one sort between all these different drag device concepts? One way of doing so would be to build a database of documented case histories and then look for recurring patterns in it.

Sea Anchors

Admiralty Pattern Cones

Small cone-shaped drag devices have been around since the early 1800's. These had to be used in conjunction with a riding sail and had a reputation for putting great strains on sailboat rudders. Joshua Slocum used one on board *Spray*. John Claus Voss popularized such a device in his *Venturesome Voyages* (see File S/M-1).



Captain Voss Patent Sea And Surf Anchor." From a hand sketch believed to be Voss's own. (Courtesy of the Maritime Museum of British Columbia).

The term *sea anchor* itself appears about three dozen times in the third edition of Coles's *Heavy Weather Sailing*, in almost every instance of attempted use the results being dismal. Closer examination, however, will show that in each and every instance the term is misapplied to a small *admiralty pattern cone*, probably about 21 inches in diameter (see pages 98, 102, *third edition*).

A 21-inch cone is not a "sea anchor," meaning something that you would use to anchor your boat to the surface of the sea, but is a *drogue* or a *drag device*. Most of the skepticism surrounding sea anchors in Coles's time can be traced to the attempted use of admiralty pattern cones by sailboats.

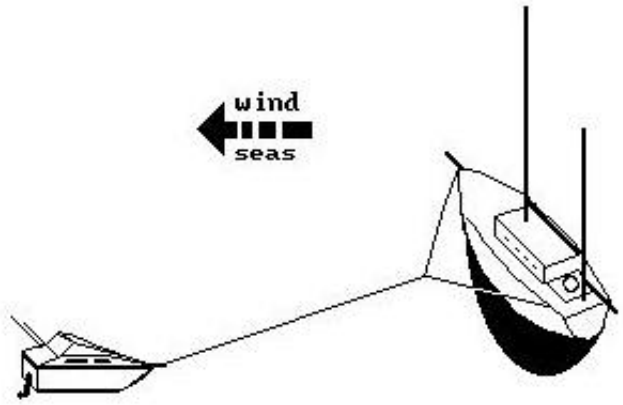
Closer investigation of the classic books and volumes written on the subject of heavy weather tactics will reveal the same misrepresentation. It seems that throughout the entire litany of sailing legend and tradition the term *sea anchor* was once used synonymously with miniature cone-type drag devices.

Having said that, modern publications are getting much better. In the 6th Edition of *Heavy Weather Sailing* Peter Bruce has devoted a whole chapter to the use of Drag Devices, and the case reports (using modern para-anchors etc) are much more encouraging, though he does still stress the need for 'further evaluation'.

Sailboats have deep keels that generate tremendous turbulence if pushed to the side. This *lateral*

resistance makes the keel behave like a sea anchor when the boat is lying beam-to the seas.

Immerse a three-foot diameter circle of plywood into a swimming pool and try to push it sideways. After several attempts you will appreciate the magnitude of the lateral resistance that even a small plane such as this is capable of producing. Sailboats have much larger planes. The image below dramatizes the point. The shallow-draft powerboat on the left is using the full keel of a stationary yacht as a "sea anchor."



The flat-bottomed, high windage power boat on the left is using the deep draft of a sailboat that is lying a-hull as a most effective "sea anchor"!

With a draft of six feet, the full keel of a 36-foot sailboat will likely bite green water with turbulent force equal to that of a 4-6 foot diameter sea anchor. In this case, the turbulence generated by the keel (as the boat drifts slowly sideways in high winds) is some twelve times greater than the turbulence generated by a 21-inch diameter "admiralty pattern cone."

In point of fact, therefore, the yacht itself has a far better grip on the surface of the ocean than does the little cone. Axiom: **A sea anchor must have a cross-section large enough to overcome the lateral resistance of the keel, before it can pull the bow of the sailboat into the seas.**

This is why parachutes have such a good track record. They do what a sea anchor is supposed to do, by first overcoming the lateral resistance of the keel itself. In the words of Van Dorn, "In truth, aerial parachutes make the best sea anchors." (*Oceanography And Seamanship*, Dodd Mead, 1974)

Para-Anchor

It is not known who first lowered an aerial parachute into the sea from a boat. Quite likely it was a

fisherman, for the sake of economic necessity. Fishermen don't like to return to port empty handed. "Breaking up a trip" because of thirty-knot winds is an expensive proposition. So they use parachutes to stay out and finish the work.

In Australia commercial fishermen use throwaway surplus parachutes, often putting out to sea with three or four on board. Pacific Northwest fishermen who brave Cape Flattery's stormy waters usually carry parachutes on board.

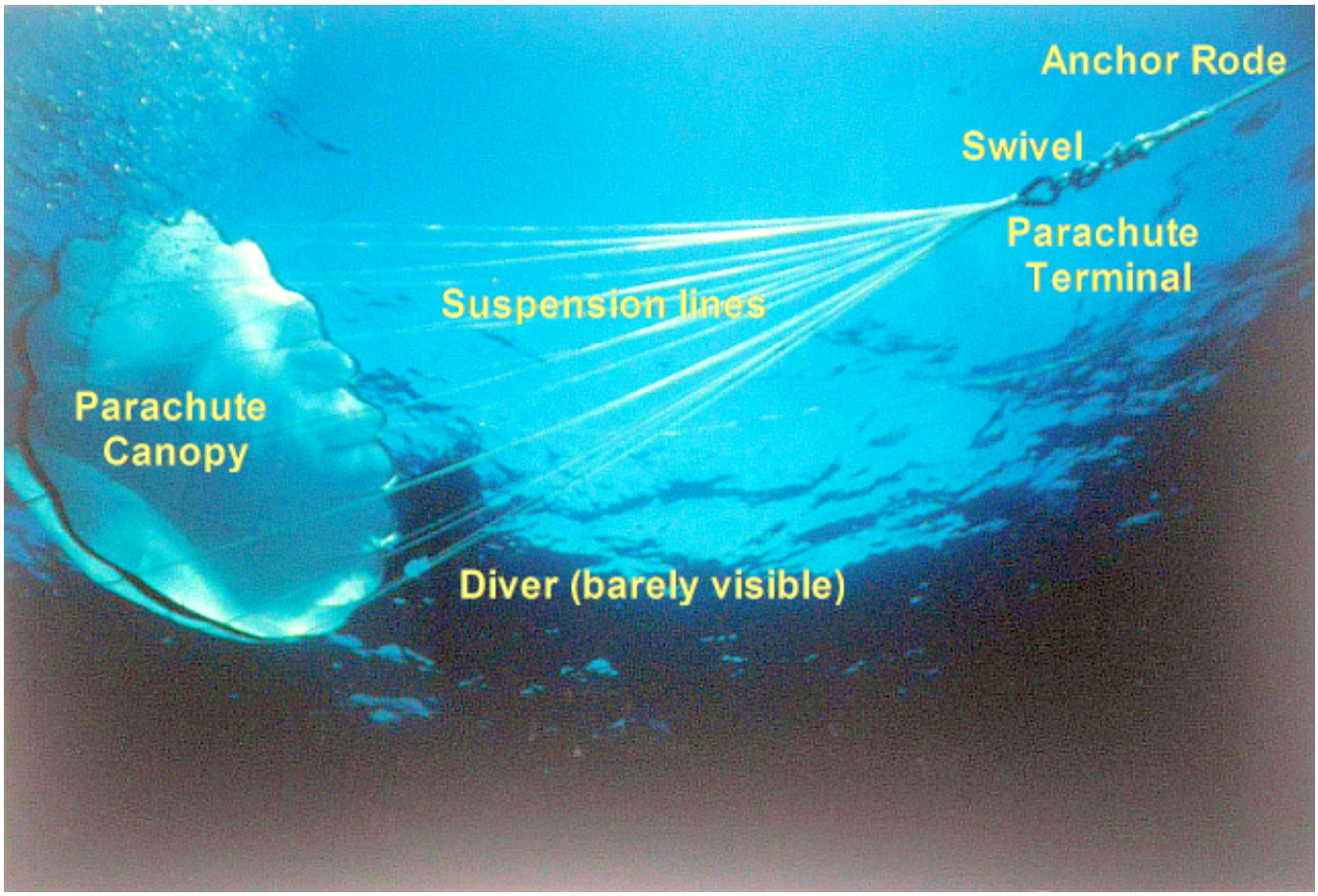
Fishing boats from Monterey, Mexico, use parachutes to maintain station and ride out bad weather. Generations of Indochinese fisherman have used large bamboo baskets to heave-to in the South China Sea. Many fishing junks and even large commercial fishing boats are now using para-anchors. Vietnamese fishermen who recently emigrated to the United States use Para-Tech sea anchors to heave-to in the Gulf of Mexico.

The term *para-anchor* itself was coined by Patrick M. Royce, author of *Sailing Illustrated* (Western Marine Enterprises, 1982). Royce undertook to conduct methodical tests on parachute sea anchors in 1964, and was probably the first to advocate their use on small craft (see pages 156-163 of *Sailing Illustrated*.)

Around 1970, Joan and John Casanova began advocating their use on multihulls, having used them on their own boats in the course of a twenty year, 200,000 mile cruise (see File S/T-1).

In the course of their many journeys Lin and Larry Pardey have used para-anchors to heave-to in numerous storms, and have developed a unique bridling system that they describe in many of their books, including the one entitled *Storm Tactics Handbook* (see Files S/M-3,4).

After several decades the term *para-anchor* is now in common usage. Safety experts, editors and writers use it to describe a wide variety of large diameter sea anchors, including military *ordnance* parachutes, 24-foot diameter army *chest reserves*, 26-foot diameter navy *conicals*, 28-foot diameter air force *C-9s*, converted skydiving parachutes, and other purpose-made sea anchors patterned after aerial parachutes.



A 9' diameter BUORD being deployed in the Santa Barbara Channel. The diver, barely visible, is swimming about ten feet behind the canopy (Victor Shane photo)

Uses and Applications

Heaving-To: Heaving-to entails stopping the boat, bringing her into alignment and placing her in a defensive posture. The ways in which parachute sea anchors facilitate this are covered in the *Sea Anchor* files of this publication.

Reducing Storm Time: The average North Atlantic gale may have a diameter of about three hundred miles, and it may be moving at twelve knots, covering a distance equal to its own diameter in a day.

If a sailor can anchor his ship to the surface of the ocean he will likely emerge from the clutches of the gale in 24 hours. If he runs with it he may not be able to part company for three days.

Statistically at least, you can avoid two days of gale time - and umpteen big waves - by heaving to the para-anchor. Yes, you will end up arriving at your destination two days late. But so what. Better late than never. The gale may develop into a full blown storm and then it will be too late to think about ways of escape.

Drift Control: Many boats are lost annually when - initially disabled - they drift out of control and run aground. A para-anchor may enable you to hold your position and keep your disabled craft off the rocks long enough for rescue and a tow back to safe harbor.

Moreover we have all heard stories about the yacht that beat all night and in the morning the skipper found that he had not made good a single mile. In the words of Peter Blake, "no sailboat can go to windward in a storm."

Sometimes it just doesn't pay to beat into heavy seas. The wear and tear on the boat and crew does not justify the paucity of miles gained upwind. Sometimes it is wiser to stop and wait for more accommodating wind and seas. But to stop the boat may mean losing in a few hours the miles that you had suffered to gain in a full day. A para-anchor will enable you to hang on to those hard-won miles.

Damage Control: Most people who have never spent protracted periods of time at sea cannot appreciate just how difficult it can be to go about the business of repairing or pumping out a disabled boat this is rolling - rails buried - in the troughs.

A para-anchor can align the boat in such conditions, easing the motion and stabilizing the attitude. Repair work and pumping out operations then become a great deal easier and safer. ***Tip*: In non-heavy weather - damage-control - situations the para-anchor can be deployed off the stern.** Need to go up the mast to effect emergency repairs in the trade winds? Deploy the para-anchor off the stern, then you can do so in relative safety.

Safety Valve: For the shorthanded crew exhaustion, hypothermia and lack of rest are as dangerous as the sudden gale. Brain numb from lack of sleep and the whole outlook seeming bleak and hopeless, the shorthanded sailor will soon cross a dangerous threshold beyond which all is error, wrong judgment and wrong decision. It is precisely at this moment that the para-anchor is worth its weight in gold. Put out the chute. *Call time-out.* Get some rest. Then, you can get up to fight again, with your brain back in working order.

Safe Landfall: "Land is a mixed blessing," to quote the words of Webb Chiles. Heaven knows how many boats have successfully completed difficult ocean passages and then gone belly-up on the reefs because the skipper couldn't wait to set foot on dry land. If you make landfall at night and the harbor is unknown to you, or if the entry is a difficult one, our recommendation is as follows: *Lay off a safe distance and wait for daylight.* In areas where there are no currents and stiff winds blow night and day a para-anchor can be a most effective "parking brake."

Anchoring Offshore

Boats of every description have been riding out storms at anchor, inshore, since antiquity. When we read about a storm driving anchored boats aground we seldom hear anything about the ones that rode it out safely.

Case in point: The infamous gale that swept over Cabo San Lucas in December 1982 left a mangled mess of poorly anchored boats up on the beach, among them Bernard Moitessier's *Joshua*. But did you know that six boats, properly anchored, rode it out with little or no damage, all this in shallow water, with storm surge and huge breakers coming in?

Most sailing is done over water too deep to use a regular anchor. That is where a para-anchor must be used. A para-anchor turns the whole ocean into an anchorage of last resort, a wide open - private - anchorage with plenty of water beneath the keel, an anchorage free from the hazards of the "foul berth," an anchorage in which a sailor can pay out as much elastic rode as he wants and not have to worry about the perennial problem of swinging into other boats - or poorly anchored boats upwind dragging down on him, as happened to poor *Joshua*.

A Danforth anchor moors the boat to the seabed inshore. A para-anchor moors the boat to the sea-surface offshore. Unless the para-anchor is deployed in a current, there is surprisingly little drift involved. Many of the case histories listed in this publication include accurate drift rates that were obtained from GPS readings (the rates are listed in the summary section of each file). Some of these drift rates are in fact so low that one could say the boats were "anchored."

A para-anchor is a "portable mooring," used where the water is too deep to anchor the boat conventionally. It is generally used off the bow. No mariner in his right mind would use a Danforth to anchor a conventional sailboat stern to a storm. Likewise with the para-anchor, which is the offshore equivalent of the Danforth, Bruce or Plow. In truth, using a para-anchor offshore is a great deal like using a Danforth inshore. Many of the same principles apply. As with the Danforth, adequate yield and "give" must be incorporated into the *system*, otherwise some of the loads may exceed the limits of the components.

Above are two views of Prisana II of Adelaide. Which end would you choose to present to the brunt of a storm? (Deborah Schultz & Stephen Edwards photo)

Forces Involved

The following information is from the American Boat and Yacht Council (ABYC). The numbers are subject to 101 caveats, are by no means the whole of the story, and should NOT be used as hard and fast standards. The table is presented here for the sole reason that many manufacturers refer to it to obtain some idea ("a ball park") about the sort of loads that might be placed on ground tackle in different wind and sea conditions. Loads are in pounds.

	Beam		***Wind Velocity in kts***			
LOA	**Sail**	**Power**	**15**	**32**	**42**	**60**
10'	4'	4'	40	160	320	640
15'	5'	6'	60	250	500	1000
20'	7'	8'	90	360	720	1440
25'	8'	9'	125	490	980	1960
30'	9'	11'	175	700	1400	2800
35'	10'	13'	225	900	1800	3600
40'	11'	14'	300	1200	2400	4800
50'	13'	16'	400	1600	3200	6400
60'	15'	18'	500	2000	4000	8000

Calculating forces on conventional anchors has never been easy. Calculating forces on para-anchors is all the more difficult. We will not drag out complicated force/vector formulae here. If the reader is so inclined he should consult other texts for such formulae, among them *U.S. Coast Guard Report #CG-*

D-20-87 by Carol L. Hervey and Donald J. Jordan (National Technical Information Service, Springfield, Virginia 22161), the RORC-commissioned *Report on Model Tests to Assess the Use of Drogues and Similar Devices to Prevent Yacht Capsize in Breaking Waves* (Report #801, Wolfson Unit for Marine Technology and Industrial Aerodynamics, University of Southampton, Southampton, England S017 1BJ), and Daniel C. Shewmon's *The Sea Anchor and Drogue Handbook* (Shewmon, Inc., 1000 Harbor Lake Drive, Safety Harbor FL 34695-2310).

Instead of dragging out mathematical formulae we will instead try to focus on the seamanship side of the equation, that is, *practical ways of taming some of the forces involved.*

We will concentrate on principles and techniques which, when understood and applied, will reduce those forces as much as is humanly possible. One has to start out by saying that the modern fiberglass sailboat is built to withstand tremendous forces at sea.

As Fastnet '79 will bear witness, many of these boats can be rolled, capsized, thrown violently about, and still remain intact. The bow-cleat on such a boat can usually withstand several thousand pounds of loading. Modern drag devices, rope, chain, tackle and hardware can easily withstand similar loads if properly sized and properly used. **Most of the forces encountered in a gale are within the "normal operational parameters" of boat and equipment.** A few forces can occasionally exceed those limits and have to be watched for very carefully. What are they?

Wind Loading

The forces imposed on the hull and rig by the wind are ordinarily within the normal operating parameters of boat and hardware. They are the lesser of our worries.

Example: A 36-foot monohull may expose about **180 ft²** of area to the wind when lying a-hull (mast & rig 45 ft² + hull 100 ft² + cabin 35 ft²), and **105 ft²** when facing into the wind (mast & rig 45 ft² + hull 40 ft² + cabin 15 ft²).

At 60 knots sustained (Force 11) the wind imposes a force of about **12 lbs.** on each square foot of exposed surface. The wind loading on this 36-ft. sailboat is therefore **2160 lbs.** when she is lying a-hull (180 x 12) and **1260 lbs.** when she is facing into the seas (105 x 12).

These figures are conservatively skewed. In reality they will be somewhat less. The rounded shape of a modern hull, for example, will mean a lower drag coefficient, resulting in lower wind loading. Bear in mind, also, that in Force 11 conditions large waves will tend to blanket out the wind when the boat is in a trough.

Aside from the destructive effects of *microbursts* (cold, dense air blowing straight down in a thunderstorm cell, knocking down any vessel with sails up), and aside from the possibility of the wind turning a multihull over by getting under the wings, wind forces on hull and rig have seldom been the cause of major failure and loss offshore. The culprit forces are usually others.

In the case of sailboats using sea anchors they are:

(1) **Displacement force**

(2) **Divergence force**

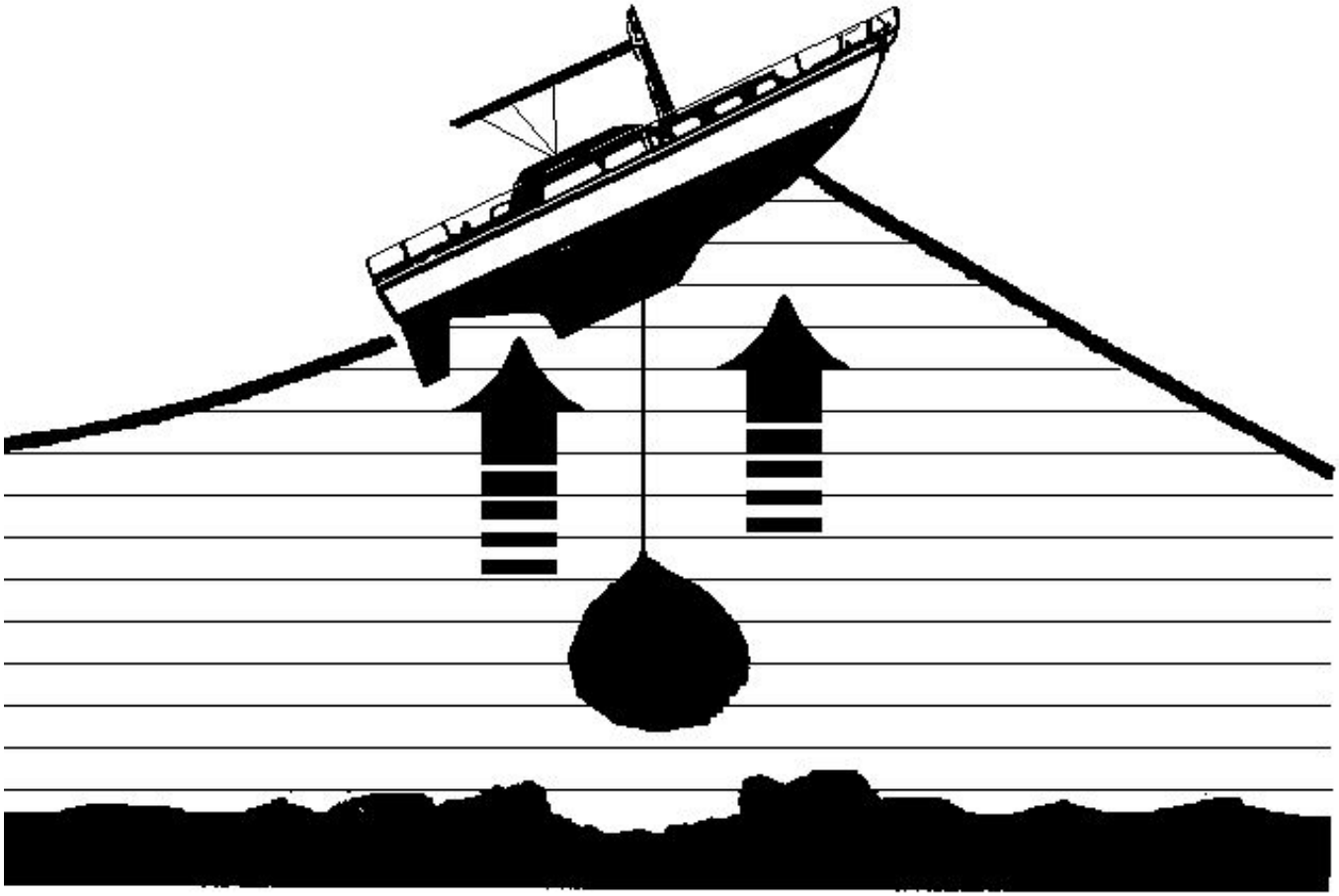
(3) **Breaking waves**

(4) **Rogue waves.**

There is much that a sailor can do to tame the first two. The fourth, *rogue waves*, can be summarily destructive but is mercifully rare. The acid test of any tactic, therefore, mainly involves the third, *breaking waves*, even though these are quite rare as well. Those of us whom Lady Luck has placed on the extreme "right tail" of the statistical curve of probability distribution may make many ocean passages without witnessing a single breaking wave.

Displacement Loads

Displacement loads can be formidable - on an order of magnitude equal to the displacement of the boat, even on a windless day. In the case of an improperly anchored boat, displacement loads can instantly yank an anchor out of the bottom, bend its flukes, cause rope to snap like string, or even pull a large cleat out by the roots. The figure below is an oversimplified dramatization of the point. A 36-foot heavy-displacement sailboat has been moored to a 3-ton rock by means of unyielding steel cable. Question: What happens when a large swell lifts the boat? Answer: the boat will lift the rock right off the bottom.



Displacement loads at anchor can be formidable - of an order of magnitude equal to the displacement of the boat itself.

Here we have a displacement load of 6,000 lbs. being placed on the mooring bit of a yacht on a calm and windless day. (Compare with a wind load of 1260-2160 lbs. in Force 11 conditions.)

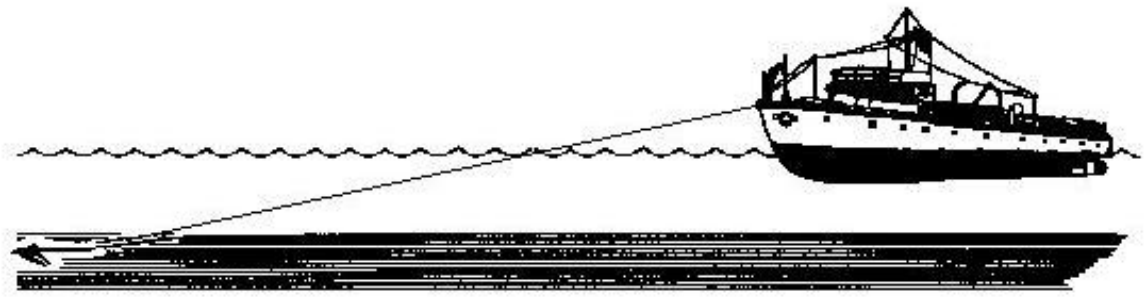
The figures are from a booklet called *Anchors and Anchoring* and are reproduced here by permission of Rule Industries, manufacturers of world-famous Danforth anchors. The booklet was originally co-authored by Robert Danforth Ogg, progenitor of the Danforth anchor, and is still available from Rule Industries for the grand sum of one dollar (*Rule Industries, Cape Ann Industrial Park, Gloucester MA 01930*).

The figures were obtained by means of an electric load-measuring cell and tell the story in a language as plain as A, B, C. In only ten knots of wind the cell registered **6450 lbs.** when the 104-ft. vessel was moored by means of 200 feet of unyielding steel cable. It registered **280 lbs.** when a 70-ft. length of chain was incorporated into the cable, freeing the ship to rise and move with the waves - *a 95% reduction in surge and displacement loads.*

SOLID CABLE

Wind: 10 mph - Waves 2½'

Depth of water 25' - Scope 6.8 to 1

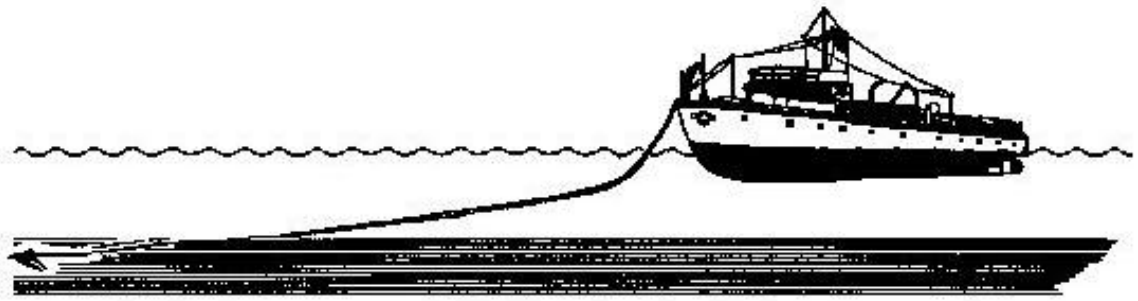


Load cell at bowcleat measured 6450 lbs.

70' CHAIN WITH CABLE

Wind: 10 mph - Waves 2½'

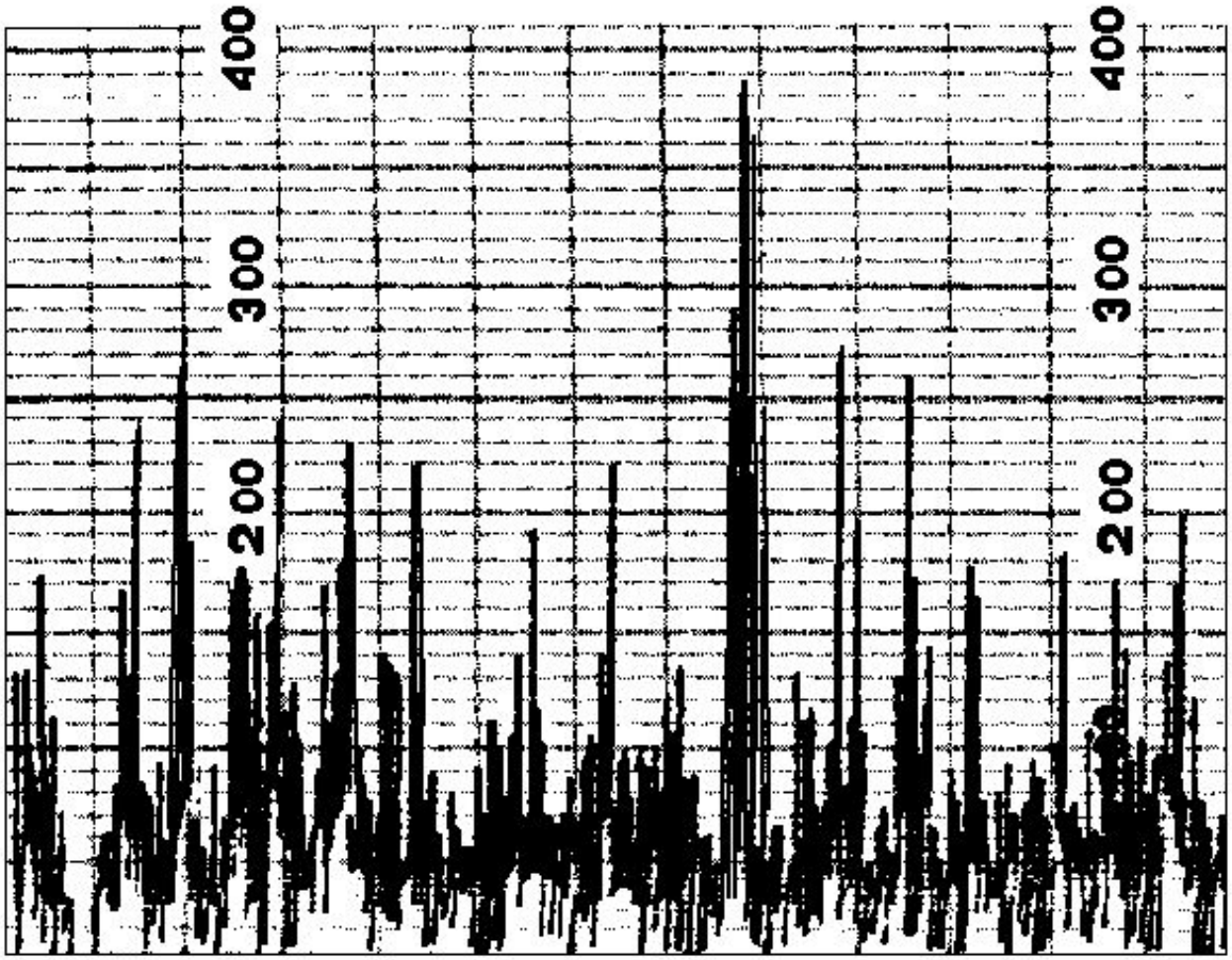
Depth of water 25' - Scope 6.8 to 1



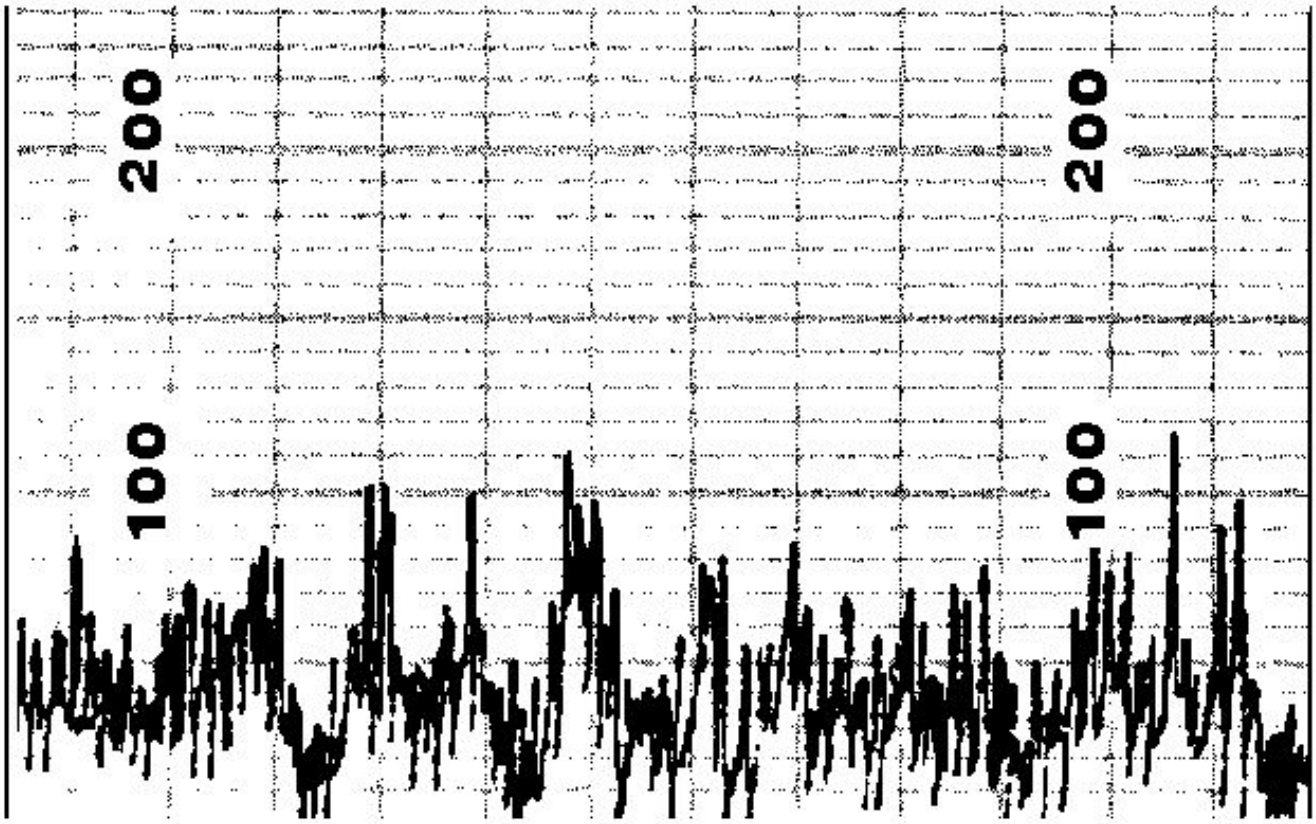
Load cell at bowcleat measured 280 lbs.

The graphs below show a similar reduction in peak dynamics loads, achieved by merely paying out more

rode.



SHORT SCOPE



LONG SCOPE

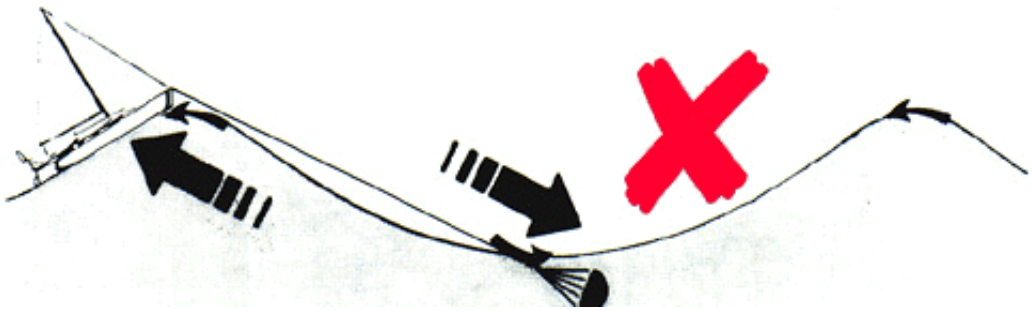
The tremendous value of long scope can be appreciated by noting the reduction of peak horizontal loads in the charts, recording with short and long scope on a 34-ft. cruiser offshore with a steady 25 knot wind and 6-8 foot seas.

The moral is this (quoting from the same booklet, *Anchors and Anchoring*, page 17):

> *The forces required to hold a boat in position solely against waves will generally be slight but only if ample freedom is allowed for the boat to oscillate with the waves. Allowance for this freedom is a major consideration in the proper design of a mooring or selection of anchor rode. Failure to provide this freedom may result in tremendous and even destructive surge loads.*

Displacement loads are principally encountered on vessels anchored to the seabed, though they can apply to vessels using para-anchors as well. Even though the rode is leading *out* to the para-anchor (instead of *down* to the Danforth), it may cause the parachute to interfere with the ability of the yacht to rise with the seas if it is too short (see Figure below).

Divergence Loads



Too short of a rode can put huge displacement forces onto the boat owing to the divergent direction of water movement at the peak and trough of a wave. Not also that the short rode interferes with the yachts ability to rise up on the wave. All in all a disastrous situation and probably the cause of the parachute failure in File S/P 1

Divergence loads are encountered when boat and mooring move apart. They apply doubly to vessels using para-anchors. The Danforth obtains its purchase from the seabed, remains stationary, and cannot move back and forth in repeated cycles. The para-anchor, on the other hand, obtains its purchase from the sea's surface, which is frequented by waves. With the passage of each wave, the water molecules on the surface move in an orbit, causing the parachute and boat to move back and forth over real ground when viewed from above.

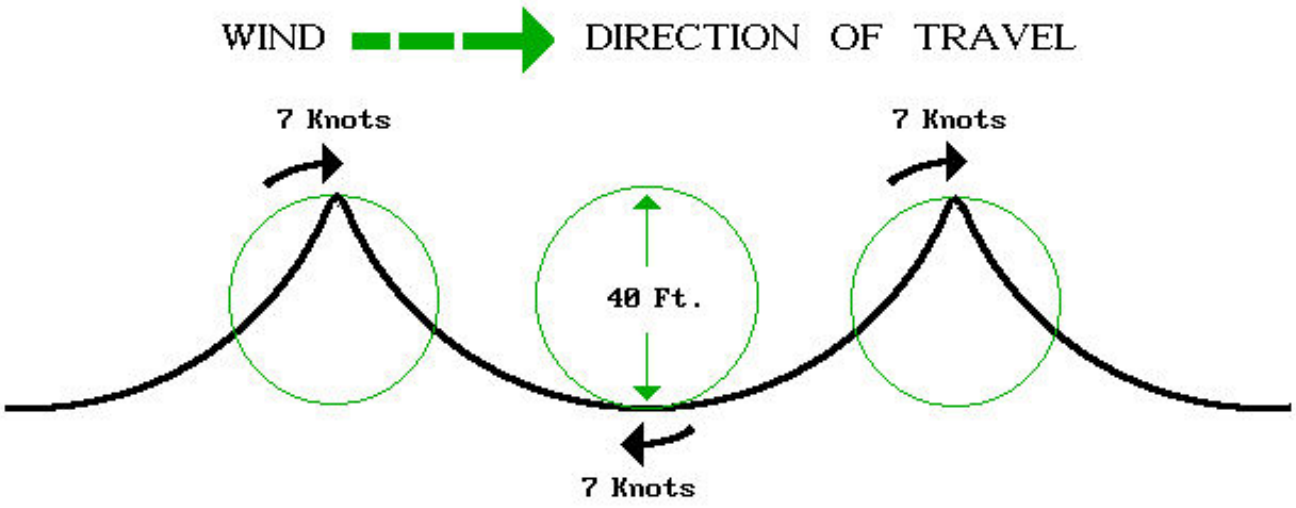
To get a clearer picture it helps to imagine that the parachute and the boat are situated on the rims of two adjacent flywheels, arranged like the wheels of a locomotive. The back and forth motion of the parachute and boat would then correspond to the horizontal motions of some imaginary piston, the rode playing the part of the piston rod. If the waves are twenty feet high, then each flywheel has a diameter of twenty feet.

As the first wheel goes round and round, it causes the boat to oscillate back and forth twenty feet (one diameter) when viewed from above.

As the second wheel goes round and round, it causes the parachute to do the same thing. So then, looking at the affair from above, and depending on the length of the rode, one might see the boat and para- anchor doing some "synchronized swimming" - moving back and forth in unison. Or, one might see them doing the "Charleston" - converging and diverging.

The moving water molecules set up a "rotary current" that flows downwind on the crest, and upwind in

the trough. The approximate rate at which this "current" flows can be determined by dividing the circumference of the "wheel" by the wave period.



Trochoidal wave theory:(from Greek 'trochos' meaning 'wheel'): Although the waves look like they are moving to the right, in fact the molecules of water merely rotate in circles. the diameter of the 'wheel' is equal to the height of the wave. The period of the wave determines the time it takes for the 'wheel' to make one revolution. The approximate speed of the water molecules on the surface of the water at the peak and trough can be determined by dividing the circumference of the wheel (= ? x wave height) by the wave period.

The force required to hold a sea anchor stationary in a three-knot current, for example, is the same as the force required to drag it behind a tug at three knots.

Tests conducted by Shewmon and Para-Tech have shown these forces to be far greater than was once imagined. In tug tests conducted by Para-Tech Engineering in San Diego Bay, for example, a sustained force of almost 6000 lbs. was required to drag a 12-foot diameter para-anchor (flat circular, zero porosity canopy) behind a tug at three knots. This gives some indication of the magnitude of the forces that may come into play if a heavy boat and a larger para-anchor are moving apart from one another at several knots.

The orbital surface current in a major Southern Ocean storm may amount to *seven knots* or more. One can easily envisage a short-rode scenario in which a heavy boat and a large sea anchor (laden with tons of water) move apart from one another at a combined rate of *fourteen knots*, causing the system to be "drawn

and quartered."

The rope would snap. Hardware would let go. A cleat would pull out. The panels of the parachute would explode outward.

Or so one would hope. For if the components were indestructible the boat would likely end up being physically dragged through mountains of green water! Reminds one of the Hollywood spectacle of the hapless slave being dragged to death behind the Roman chariot.

Depending on their relative positions on the wave trains, the boat and the sea anchor may dance in step. Or they may do the "push-pull." If the latter is the case the rode will repeatedly tighten up, then go inexplicably slack. This can be a problem. At the very least it may cause a jerky motion, along with excessive yawing. In a worst-case scenario (extremely short rode) it may pull a cleat out, cause rope failure, or damage the parachute. Such things *have* happened in the past, but only when short rodes have been used.

In 1985, for example, the 60-foot trimaran *Rogue Wave* encountered such a problem in the Mediterranean. By all tokens the forces should have been within the limits of the boat's heavy duty hardware. But somehow they exceeded those limits. Hardware was pulled out, and the seams of the rugged Shewmon sea anchor being used were ruptured. After the incident Daniel C. Shewmon, founder of Shewmon Sea Anchors, Inc., wrote a paper entitled *Sea anchor - Rode Tactics*, explaining what happened (see Figure above, and also File D/T-3).

Divergence force explains some of the problems that commercial fisherman in particular have had with large parachutes. A disgruntled fisherman interviewed by Victor Shane in Monterey, California, for example, said that he was winching in a 24-ft. diameter surplus parachute in 8-foot coastal seas when, suddenly, "it started to pull my boat under."

The figure above tells the likely story. As the fisherman winched the boat closer to the parachute, it arrived at the precarious juncture where the ten-ton boat was being lifted up and moved back on the crest, while the parachute, containing tons of water, was moving down and forward in the adjacent trough a few feet away. The short, heavy anchor line could not stretch enough, giving the fisherman the impression that the parachute was trying to pull his boat under. So he fetched the knife and cut the rode.

As a storm develops the waves will begin to grow in size. Their lengths (crest to crest) will begin to increase as well. Depending on rode length, at a certain stage the phenomenon of divergence and convergence may make itself felt at sea anchor. If the wave lengths continue to grow the problem may go away by itself after a while.

Generally speaking, the more developed the seas - or the shallower the water - the more acutely will the phenomenon be felt. At times the rode will tighten up to breaking point, then go inexplicably slack, giving the impression that the parachute is alternately filling and collapsing. This can be a nuisance. It can also be dangerous. If the rode is too short and the waves are inordinately high, *displacement* load and *divergence* force may reinforce one another - recipe for certain disaster. Lady Luck may play a huge part here, however. A skipper may in ignorance have paid out only sixty feet of rode but, lucky for him, the waves just happen to be sixty feet from crest to crest. "Ignorance is bliss," as they say.

Usually Lady Luck favors the wise, the crafty and the prudent, however. By knowing the principles involved, and by compensating - making adjustments in rode length - a sailor can usually make the jerkiness go away almost immediately. However in the case of a multihull with a fixed bridle, adjustment may be impractical. More so, going on deck to adjust the rode in a full-blown storm may be out of the question altogether. What then is the solution? What can the wise and prudent sailor do?

At the very least a sailor can try to buffer all systems loads by supplementing the long nylon rode with a length or lengths of chain. Rigidity and inflexibility will not do in a storm. Forces must be buffered, or they *will* break something. Only Superman can withstand the forces of the sea without flinching. The rest of us have to try to come up with clever and ingenious ways of rolling with the punches. As the skydiving instructor tells his students: "When you hit the ground, try to *roll* with it."

Breaking Waves

Individual sea waves are ordinarily benign phenomena. If left alone, and given plenty of deep water to tread on, they may travel thousands of miles before depositing their packets of energy on a shore. The problem is this: they are not always left alone, and they do not always tread on deep water. Shoals, ocean currents, tidal flows, secondary wave trains and even the disturbance created by the wake of a large ship may interfere with the fluid motion of a wave and cause it to break prematurely, delivering a crippling blow to a sailboat that just happens to be in the wrong place at the wrong time.

Modern fiberglass hulls afford great protection nevertheless. They may be rolled around by breaking waves, but are greatly resistant to outright breakage. Some of the better built ones - Pacific Seacraft and Island Packet, to name just two - are all but indestructible.

As long as hulls can be kept afloat people can somehow survive inside them, even in the case of a capsized multihull. But the problem has seldom had to do with the failure of the hull itself. With monohulls in particular the problem usually starts with the failure of something *appended* to the hull - a mast, a rudder, a pilothouse, large windows, a weak hatch, or even large heavy objects such as batteries flying about inside. One thing leads to another and before you know it the situation is untenable and people are wanting to be taken off the boat.

Breaking waves need not render deathblows to sailboats. One must believe this. To believe otherwise is a sort of failure in itself. In very truth there is a great deal that a sailor can do to protect his or her vessel from the destructive influence of breaking waves. Many of the sailors featured in this publication have done just that.

By using a purpose-made drag device a sailor can greatly *minimize* the chance of his vessel being rolled - and dismasted. Prior measures can be taken to strengthen and reinforce masts, for example, so that they don't come down so easily.

And since broken masts have a reputation for doing-in otherwise intact hulls, hi-tech tools such as hydraulic wire cutters can be taken along to enable the crew to quickly and easily cut away a downed spar, *before* the sea can turn it into a lethal battering ram. Or stainless steel standing rigging could be replaced with modern super-fibres such as Dyneema Dux - stronger than steel, yet easily cut in an emergency.

Preparation is ninety percent of a mariner's labor. When it comes to breaking waves, *a great deal can be done to prepare the boat beforehand.* At the very least, measures can be taken to secure all items above and below decks. No responsible sailor will venture offshore with loose cannons on board - carelessly secured dinghies, tenders, anchors, spinnaker poles, batteries, large containers, jerry cans, appliances, cabinet doors, mirrors, glass items, drawers, floor boards, foodstuffs and the like that can vandalize a yacht in a gale and make it unfit for human habitation.

Securing everything above and below decks is doable. *It should be the first order of business*. And yet, for strange reasons (better known as human inertia and laziness) sailors procrastinate and vacillate and put off doing the work that needs to be done.

The authors are just as guilty as anyone else in this respect. We always seem to be sailing off with some important preparation work left unfinished. And then it is too late. A few big waves and the fiberglass dinghy becomes a life-threatening object. Climb down into the interior of any cruising boat and you will see all the loose cannons poised and ready to fly at a moment's notice.

In particular check the way the batteries are secured. If they are locked down by unassailable oak frames and thick stainless steel bolts then you will know that the boat is owned by a real seaman. If they are held down by bungee cords you will know otherwise.

Buffering The Loads

Given a seaworthy, watertight and well-secured boat, the parachute anchoring system affords a means of pushing back the envelope of survival a little further. It enables one to do a great deal to *buffer* the heavy blows of the sea.

Indeed there is a great deal that is working in one's favor already here. To begin with, the para-anchor is deployed in a fluid - a yielding medium. It is fabricated from nylon materials, which stretch under load. If it is of *flat circular* construction, the very shape affords an added measure of flexibility as well. Unlike the rigid shape of a conical sea anchor, the canopy of a flat circular parachute can tense and relax. Victor Shane has seen the phenomenon close hand from helicopter and chase boats. The canopy looks very much as though it was some living creature - a huge jellyfish. It changes its shape. It seems to be "breathing." It expands into a rigid, flattish disk under load, then relaxes back into a looser, bowl-shaped affair in the slack cycles.

The fluid behavior of the parachute notwithstanding, the long nylon rode leading to it is an excellent shock absorber in, of and by itself. And there is even more: **The shock absorption of the nylon rode can be significantly boosted by the mechanical - catenary - shock absorption provided by a length of chain.**

Chain, properly used along with nylon rode, can be another bargaining chip in a storm. Chain will sink during slack cycles, helping to maintain system tension. This will reduce side-to-side yaw, which will reduce exposure. If a wave breaks against the hull the load will have to be transferred to the parachute via the elastic rode and sagging chain.

The force of the breaking wave will have to straighten the curve rapidly. The hundreds of links in the chain will then shed vortices, producing turbulence and building resistance. In effect the chain will then play the part of a "flopper stopper," sinking without complaint during slack cycles, but putting up considerable resistance when a sudden force tries to lift it up rapidly. Such an arrangement will go a long way to further reduce, buffer and mitigate any and all peak dynamics loads.

Allowing for suspect forces by the use of a long rode and chain tether, and by keeping a sharp eye on all short-rode applications, especially when retrieving a parachute in large swells (a full or partial canopy trip line should be used to avoid what happened to the Monterey fisherman), the mariner can use a para-anchor off the bow to align and restrain his boat in heavy weather, minimizing catastrophic events such as knock-downs, capsizes and barrel rolls.

There is only so much that even the most resourceful sailor can do, after which he will have to turn on the EPIRB. We *are* mortal.

Rolling With The Punches

What happens when a yacht is struck by a breaking wave? Everyone would like to know. The speculation is endless.

Books and a great many articles have been written on the subject. Model sailboats, looking very much like children's toys, have been subjected to "virtual storms" and "cloned waves" in test tanks.

Computer models have been used, and scientific papers have been published, adding bits and pieces to the sum of knowledge. And yet the whole of the sum remains elusive, because in a real storm no two breaking waves are exactly alike. Neither do they produce identical results. Moreover, even if real storm waves could also be "cloned," they would likely produce different results when striking different boats from different angles.

Being struck by a breaking wave is a little like being hit by a ten-ton avalanche moving at 35 knots. How is the boat moved by that avalanche? What sort of a reaction can one expect?

What happens in the ensuing seconds can determine the whole of the outcome. While a great many things can happen in those ensuing seconds, we can be sure of one thing: If the boat is under restraint of sea anchor the tension in the tether will build rapidly, *hopefully to the point where it can pull the low-buoyancy bow back up in time*.

The avalanche hits; the yacht is moved away from the sea anchor, pivoting on her CLR (center of lateral resistance) as she is being moved back; the tether builds up a reciprocal load and pulls the bow back up and over. If the line goes slack for some reason, the worst that can happen is that the bow will fall off temporarily. If another wave happens to break there and then, there is indeed a chance that the boat may get knocked down, capsized or rolled. In theory, however, there is a greater chance that the force of the impact will again take up the slack and rotate the bow back toward the origin of impact.

Whenever a boat is subjected to a large displacement of water, the sea anchor will try to pull the head around, irrespective of the influence of the wind. Take a toy sailboat, tie a string to its bow, place it in a stream and see for yourself. Anchor any boat in a river and the flow of water around the hull will align the vessel against the current, irrespective of wind direction. Since water is 800 times heavier than air, water alignment will always supersede air alignment.

The problem is this: in trying to align a vessel at sea, we have to make do with air flow most of the time. Since very few waves actually break, we are primarily relying on the wind to align the boat for us, and wind-alignment is a fickle business at best. The pressure of the wind against the topside, cabin, superstructure and rig is seldom constant in a storm. It may drop off in a trough, for example, allowing the bow to fall off.

No matter, if a wave breaks there will be real flow of water to align the axis of the boat against and direction of flow. Whatever shape the breaking wave may assume, in theory it can only capture and carry the boat a relatively short distance before she comes up short against the tether, which should - at a critical time - pull the bow up, over, or through the foamy upper portion of the wave.

Obviously this is not the case if the boat is lying a-hull, without a sea anchor system. Without the restraining influence of an adequate sea anchor the boat may be "taken for a ride," flung violently onto her beam ends, capsized, or even thrown end over end.

Victor Shane's Personal Experience

Shane's understanding of sea anchors and their many uses came by way of not too little white-knuckled experimentation in the windy Santa Barbara Channel, beginning in 1976.

The experience paid off later when he sailed a little trimaran to Hawaii and back in the summer of 1979. The boat was a 24-foot Piver Nugget, a 1200-lb. daysailer - "glorified outrigger," to quote the words of harbormaster of Hilo.

Three hulls, built out of quarter inch plywood. No hatch. Just a canvas curtain to keep the sea out of her cuddy cabin. *Providence* was her name, and she is to date the smallest multihull to have been sailed *back* from Hawaii singlehanded. An "adventure" to be sure, and yet that adventure would have turned into an ordeal had it not been for the drag devices that Shane took along - several parachutes and a number of makeshift drogues.

Providence *of Santa Barbara. This was the 24' x 14' x 1200 lbs. Piver Nugget on which Victor Shane learned so many lessons regarding sea anchors. With her compliment of drag devices, and a QME windvane, Shane sailed her to Hawaii in 1979. She is likely the smallest multi-hull to have been sailed back from Hawaii singlehanded.*

Ordinarily a boat like *Providence* has a very limited cruising envelope. The drag devices had the effect of pushing back that envelope, making possible a major ocean passage. On the first leg of the journey, for example, Shane used a 9-foot diameter para-anchor to heave-to in the outer coastal waters of California, gale-force winds advisories being in effect on VHF and WWV for a region extending from Monterey all the way to the Mexican border!

Later on in the trip he used the same para-anchor for heaving-to and for damage control in large chaotic seas generated by a combination of reinforced trade winds, vicious squalls, and big swells originating from a tropical storm named *Dolores*.

For five days, from a distance of five hundred miles, the lady *Dolores* stalked the *Providence* across the Pacific, making life miserable for boat and sailor, as though life in the cold, lumpy, gray, overcast trade winds was not miserable enough already.

One day out of Hilo Shane used the para-anchor for drift control - to engineer daylight landfall. Three weeks later he used it again in the Isthmus of Maui to bring the head of the boat up into 30-knot afternoon winds, in order to hoist and double-reef the mains'l - ever try hoisting a main in thirty knot winds without an engine to bring her up into the wind?

The Isthmus of Maui is shaped like a mountainous funnel that faces into the NE trade winds. On the afternoon of 11 August 1979, *Providence* was caught in that funnel with her mains'l down, trying to beat her way out with a working jib alone.

It was on that afternoon that the wind, the sea, Murphy and the devil did their very best to impale her on black rocks awash. It was touch and go for a while, the boat side-slipping, the rocks looming closer and closer, Victor Shane trying to force the tiller, paralyzed with fear and sweat pouring down his face. But the para-anchor saved the day. It enabled him to call "time out" and stop the boat long enough to hoist and double-reef the main.

With waves crashing on nearby rocks and the double-reefed main flogging and cracking like a shotgun, Shane backwinded the jib. The little trimaran turned away from the rocky grave. Thereafter she began beating her way out of the Isthmus of Maui with a bone in her teeth, like a champion, windward float flying and her bow shaking off spray like that of a battleship steaming into a gale.

An hour later she finally rounded the north-eastern tip of Maui and, easing her off the wind, Shane was able to breathe a sigh of deep relief, now sailing smoothly on crystal clear water, magnificent coral heads visible below, steering a course for the calm anchorages situated on the sheltered side of that magnificent island.

The Fastnet tragedy of that same year occurred a few days later when *Providence* was tied up in *Black Manele Bay*, on the island of Lanai. Shane first heard the news while listening to the BBC on the short-wave radio, and it was disheartening news indeed, not only for him, but for all the other boats tied up there too. It made all of them stop and wonder about the whole business of "cruising." And it made the prospect of sailing that little plywood trimaran back to the mainland seem all the more impossible, all the more foreboding for Shane.

Notwithstanding, on Friday 30 August 1979 *Providence* rounded the western tip of Oahu and, with a fresh bone in her teeth, began the long, arduous beat back to California.

The specter of the Fastnet tragedy haunted Shane throughout the entire voyage, never giving him a moment's peace - just as well, because on 22 September 1979 *Providence* ran into a gale 650 miles northwest of San Francisco.

He was well prepared, however. Shaking his fist at the sea and railing none too kindly at the wind, as is the custom of singlehanded sailors, he had the para-anchor deployed, the rudder tied, the sails off, everything battened down and chafe gear in place in record time.

Lying to a sea anchor in a gale at night, one gets a feel of what is going on through the seat of the pants. A thermos full of hot tea laced with honey and rum has a way of putting things in perspective well.

At times one becomes part of the boat, able to anticipate every action and reaction, every strain and stress, every complaint and protest. And it is not long before one gets an appreciation of the way in which the boat is rolling with the punches.

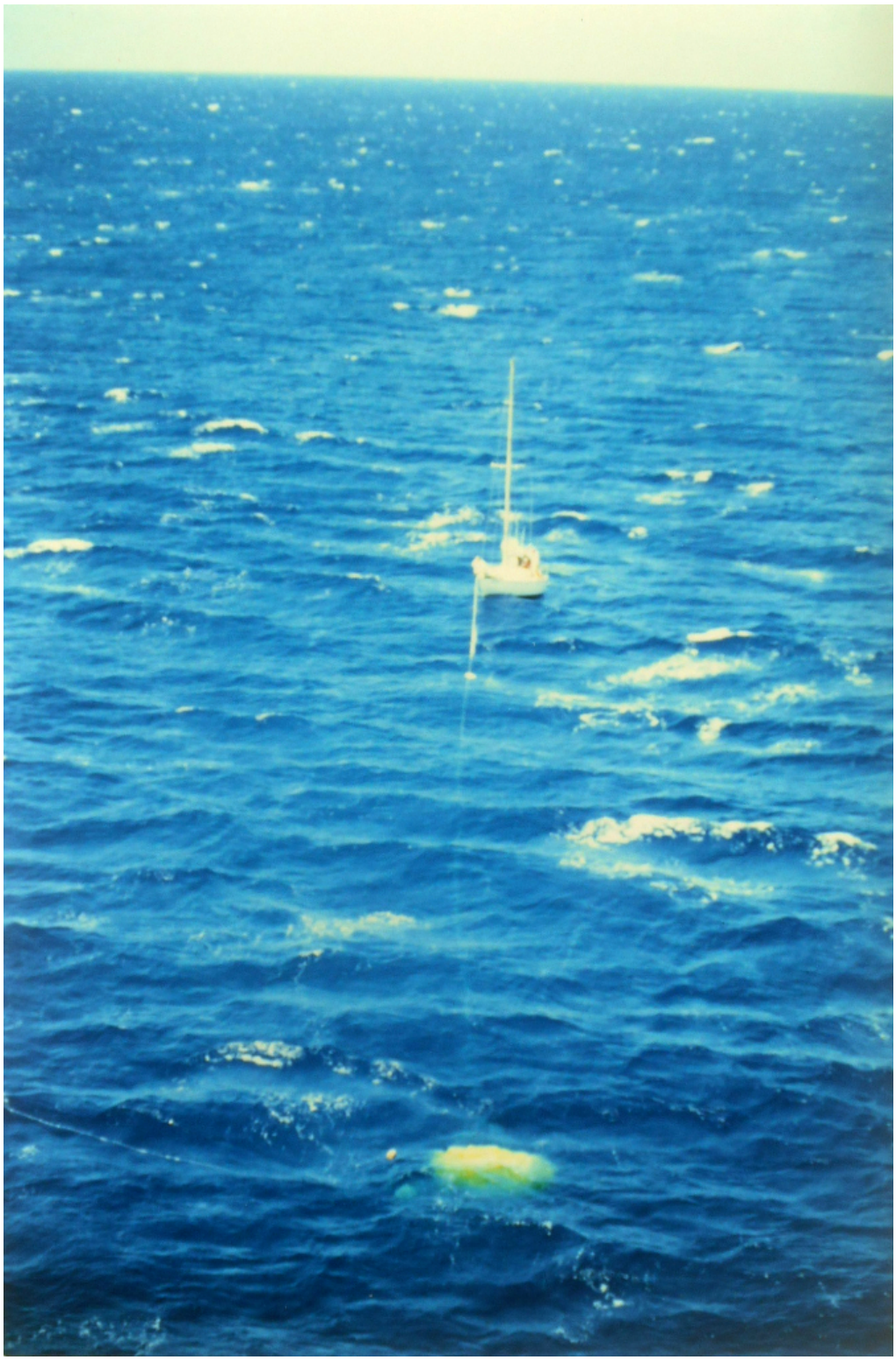
Most of the time she does so by *pivoting* in place. Contrary to popular opinion, a sailboat at sea anchor does not recoil or kick back like the barrel of a cannon, when hit by a wave. No, the reaction is nearly always rotational. Mostly, she *pivots* on her CLR (center of lateral resistance), parrying the blow of the sea like a Kung Fu expert.

This is what happens: First she rises smartly to the crest (not so much because of her buoyancy, but because of the elevator effect of the orbital rotation of the wave itself). As the crest hits she pivots briefly, as though to parry the blow. Then she faces front again. If there is unstable water at the crest then that is when one hears the loud, hollow "thunk" and feels the boat pivot and tug on the nylon tether, which then pulls - rotates - the bow back into the seas. It is a noisy affair, and the slapping and banging sounds are enough to drive a sailor mad at times. And it is uncomfortable in a small boat. There is roll, there is pitch, and none too little of the business of hobbyhorsing. But the predictable reactions of the boat have a way of instilling confidence in the mind, in spite of the noise, the discomfort, the cold, the wet, the worries and the fears.

Ordinarily a vessel held to a sea anchor yields to an advancing wave by rotating on her CLR. This produces uncomfortable side-to-side yaw, and conventional wisdom has it that side-to-side yaw should be avoided at all costs. While excessive side-to-side yaw is indeed undesirable, the ability of the yacht to pivot on her CLR may be a blessing in disguise. To be sure it produces some discomfort, but one should not confuse safety with comfort.

In principle the mechanism is not too different from that of the suspension arm of an automobile, only here the yacht's CLR is the pivot point, and the stretch of the nylon rode is the shock absorber. As in the case of the automobile suspension, the bow does not have to be deflected a great distance to absorb the shock, but the short distance that it does move is critical (the entire frame of an automobile would be irreparably damaged without those shock absorbers).

The idea that a sea anchor works by keeping the bow of a vessel snubbed 100% into the teeth of a gale is a fallacy. That's not how a sea anchor works. Every sailboat has a CLR, which is the fulcrum around which the force of an impacting wave is initially translated into turning moment. The yacht pivots, parrying the blow with the point of her hull, stretching the nylon rode, which then pulls and rotates the bow back towards the origin of impact.



Lying to a sea anchor in a fresh breeze. Note that the bow has yawed off the wind slightly. In a stronger wind this is likely to be less pronounced. To stabilize her further, set a small riding sail on the backstay.

If the reader will forgive the pun, the theory of bow-deployed sea anchors "hinges" on the yacht's CLR. Given the fulcrum of the CLR, the para-anchor and the elastic rode work together to keep the yacht

aligned in spring-loaded fashion, producing a strong restoring force when the boat tries to fall off the wind and lie beam to the seas. This restoring force is most effective on multihulls having recourse to wide bridling systems. It is less effective on some monohulls. But even on the most difficult of monohulls it is a decided improvement on the foolish practice of lying a-hull in storms.

Things You Will Need

Sea Anchor: See Appendix III at the back of this publication for a list of sea anchor manufacturers and providers. Although independent, Shane has worked closely with a number of drag device manufacturers, principally Para-Tech Engineering in Colorado, formerly in San Diego, and the authors are in contact with others regarding the DDDB program.

Throughout this publication the authors use parachute industry standards for determining diameter. Diameters indicated are therefore *nominal*, and not *inflated* or, as the British parachute rigger might say, *flying diameter.* For an exhaustive listing of parachute industry nomenclature and standards see *The Parachute Manual*, by Dan Poynter (Para-Publishing, 1984). Some manufacturers use different standards for determining sea anchor diameter.

U.S. SAILING's *Recommendations For Offshore Sailing* suggests that, as a general guideline, the diameter of the parachute sea anchor be at least 35% of the LOA (length over all). This is a good ballpark figure. Sea anchor sizing is not a precise art, however. Refer to manufacturer's recommendation for sizing. **When in doubt err on the larger side.** In the authors' opinion there is no substitute for diameter. The larger the para-anchor the more reliable its grip on the sea, the less the chance of it being tumbled by surface action, the better the behavior of the boat, the lower the rate of drift and the less the strain on the rudder and its fittings.

A possible exception to this rule may involve the Pardeys' method of heaving-to, requiring that keel generate some turbulence of its own (see Files S/M-3 & 4). Even so, the Pardeys themselves have always used medium size para-anchors and have never advocated the use of "21-inch diameter admiralty pattern cones." In the authors' opinion, trying to reduce system loads by choosing a smaller - "more yielding" - sea anchor is bad logic. Earl Hinz has this to say about it in *Understanding Sea Anchors and Drogues*:

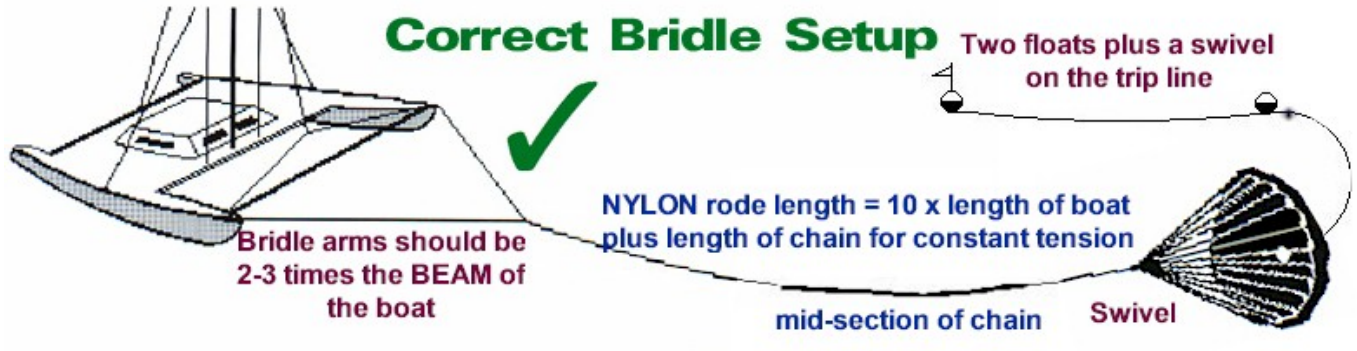
> *Some writers say that they want a sea anchor with `give' to it - they don't want to be held firmly against the impact of a wave. The idea that a properly sized sea anchor will `give' with the wave is patently untrue. The large mass of water in a sea anchor cannot be accelerated rapidly enough to absorb a wave's impact on the hull. A small sea anchor only lets the boat drift to leeward faster and yaw into a broaching position. As the sea anchor becomes smaller and smaller, the boat begins reacting more and more like a boat that is lying a-hull.*
>
> *Did you ever think that a larger ground anchor would transmit increased loads to your boat? Certainly not; all it does is assure that you have a more positive grip on the seabed. Similarly, a larger sea anchor gets a better `bite' on the water and is in a better position to withstand constant loads of the wind on the boat. The strains on tether and hull will be no greater than with a small sea anchor that is not slipping. In fact, a small sea anchor that lets the boat yaw excessively will*

cause a greater strain on the boat when a wave hits it broadside at its greater angle of yaw. **(From *Understanding Sea Anchors and Drogues* by Earl R. Hinz, copyright - 1987 by Cornell Maritime Press, Inc. By permission.)**

Nylon Rode: Adequate "scope" must be paid out to leave the yacht free to rise and rotate with the waves and to buffer the shock forces involved. Generally speaking, the longer the rode, the less the strain on the system. For heavy weather applications it is suggested that the length of the nylon tether amount to about **ten times the length of the boat or a minimum of 300 feet, whichever is greater.** This is a basic rule of thumb which was first proposed by the Casanovas.

Ideally speaking it would be more "scientific" to relate the length of the tether to the height of the waves, as does Daniel C. Shewmon. Wave heights - and lengths - can quickly change in a developing storm, however. Moreover it is very difficult to determine wave heights after dark.

Tethers must have thimbles spliced into both ends (use stainless steel thimbles, and always whip, serve, tape and secure the thimble in place). In addition to the main tether, multihulls must rig a full-width, symmetrical bridle, one that leads from the tips of the outer hulls or floats. Side-to-side yaw can be greatly reduced on multihulls by means of such a bridle. The multihull bridle-tether looks like an inverted "Y" . **It is generally agreed that the length of each bridle arm should be 2-3 times the maximum beam of the multihull, and that the length of the tether itself should be at least 10 times the length of the multihull.**



Some sailors use their existing anchor lines for sea anchor tethers. There is nothing wrong with this, as long as the line is fairly new, in good condition and up to the task. Other sailors prefer a *dedicated* sea

anchor rode. It is best to go with higher quality if purchasing new rope. Better ropes have higher strengths and come with high-tech coatings that can reduce chafe. Cheap, hardware store variety ropes, especially automotive polypropylene "tow ropes" should be avoided.

In the meantime the controversy between three-strand and braid rages on. Some sailors swear by one - and at the other. Three-strand is coiled like a spring, is easy to inspect, and affords more stretch - up to 30% and more. But it is stiffer, chafes through more rapidly, and torques under load - as it tries to unlay. Three-strand has been known to kink and hockle. Braided nylon has less stretch - up to 15% and more - but is easier to handle, easier to store, seems to be more resistant to chafe, and is torque-free. More importantly, braided nylon can be up to 45% stronger than three-strand for a given diameter. The commercial half-inch three-strand sold at downtown hardware stores, for example, may be rated at about 6000 lbs., whereas Pelican's premium double braid half inch is rated at 8,500 lbs. Always check rope manufacturers' specifications.

In general, rode diameters should be the same as ground tackle rode. Try to avoid overkill. The security afforded by one-inch line is more than offset by the lack of stretch if the boat is a J-30, for example. A forty-ton schooner may be able to stretch one-inch nylon line. Not so a J-30.

The parachute anchoring system relies heavily on *buffered elasticity*. One wants a rode that is always loaded enough such that it is stretched and providing restraint, but still within recoverable elastic limits. Using one-inch braid on a J-30 would be tantamount to using steel cable. The boat would be "held" all right, but the spring would not spring and the entire rig would take a severe beating. At the other extreme one would not want to use quarter-inch three-strand on a J-30 either. Why not? Because even if was of adequate strength it could still be stretching as the boat was being capsized. A compromise has to be struck between strength and stretch. Sometimes this is not an easy compromise to make.

Example: It takes a sustained load of about 8000 lbs. to stretch brand new half-inch nylon braid to its limit. If the wind loading on a 36-ft. yacht is about 2000 lbs. in a storm, does this mean that the rope is always 25% loaded? In theory yes. In practice no.

Orbital rotation in the trough, along with the blanketing action of big waves will create slack, which will reduce the loading. Alternatively, a breaking wave will rapidly increase the loading.

Regardless, what we are aiming for is *constant tension*, a reserve of strong elasticity *part of which is in constant use*, a spring that is partially deflected all the time. This sort of model cannot be achieved with short rodes, or with rodes that are too heavy. It takes a long, properly-sized rode to obtain the desired result. We want a spring-loaded affair, with the spring seldom bottomed out at either end. This will result in better alignment, less side-to-side yaw, and lower peak dynamics loads. Notwithstanding, chain can be a great help, even in the case of oversized rope.

Chain: Although some sailors will prefer to forego the chain altogether, it will help keep the system spring-loaded, regardless of the stretch of the nylon rode itself. **An all-chain tether is not recommended.** At least half of the tether should be nylon. Ten fathoms (sixty feet) of 5/16" chain will likely do for a J-30 hove-to in a bad gale. A Westsail 42 could probably do with 100 feet or more of 3/8"

in a storm.

How much chain depends on wind force and the peculiarities of the boat. The thing to do is to keep an eye on the angle at which the tether leads down. Too much chain in too little wind will result in the tether leading almost straight down. *If the tether is leading straight down there will be no horizontal pull on the bow cleat and the loss in tension will allow the boat to lie a-hull.*

If they decide to use a length of chain, multihulls may incorporate the chain between the bridle and tether. One hundred feet of chain did wonders for a 42-ft. Crowther catamaran in a severe North Pacific storm (see File S/C-6B).

Smaller monohulls without windlasses can incorporate the chain mid-scope - or use a heavy rope snubber to bring the chain on deck. A snubber is a short length of sacrificial rope, about ten feet long, with a steel *chain hook* on the end. *Chain hooks* are specifically made for 5/16", 3/8" and 1/2" chain (available through West Marine). Although the hook engages the chain somewhat superficially, it has seldom been known to come off under tension. Nylon or Dacron snubbers are a must if there is any possibility of the chain "sawing through" something. With a little creativity, chain can be incorporated into the parachute anchoring systems in any number of ways.

Some writers advise that the chain be hooked up at the sea anchor end. While this idea may have merit in a hurricane, it may also allow the sea anchor to sink too deep - as the eye of the hurricane passes over and the wind briefly fizzles out, for example. Unless adequately buoyed, in the few minutes that it takes for the eye to pass overhead the sea anchor may sink to the depths and afterwards interfere with the ability of the yacht to rise with the seas (displacement loads again). This is why Victor Shane personally prefers to incorporate the chain elsewhere, either mid-scope, or next to the boat itself.

Larger monohulls with heavy duty windlasses have a decided advantage. The owner can attach the bitter end of the para-anchor rode to the existing anchor chain and pay out as much as is necessary, sometimes by the push of a button. This is quite convenient, but *be sure to remove the steel anchor beforehand.* Letting the steel anchor out as part of the system may be asking for trouble in a big storm.

Although many sailors do this because it *is* very convenient, and even though the added weight of the anchor improves mechanical shock absorption, the benefit is not worth the risk, in the authors' opinion. *The steel anchor may get thrown against the boat.* It is best to take the steel anchor off. In the Queen's Birthday Storm a huge wave picked up a drogue and 200 feet of rode and bridle and threw the whole kit and caboodle onto the stern of the catamaran *Heartlight*. Food for thought.

Anchor chain comes in three classifications: *Proof, BBB* and *high-test.* All can be used, though high test provides more strength for a given weight and storage volume. When purchasing brand new chain make certain the links will fit on the capstan's gypsy or chain wheel (many windlass manufacturers specify the chain type that needs to be used). Make sure also that the link welds are properly done - the authors have seen links just break apart at the weld, even under low load. See Appendix IV at the back of this publication for strengths and working loads on chain and related hardware. See West Marine's big catalog for a wealth of information on chain, hardware, rope and everything else (*West Marine, P.O. Box 50050, Watsonville, California 95077-5050*).

Hardware: *Make certain there are no weak links in the system.* The extent to which sailors turn a blind eye to weak links is truly amazing. Walk down the dock and note all the $2 galvanized shackles that are uniting $500 CQRs with hi-test chain on $75,000 yachts. Admittedly chain is not easy to hookup. The links on hi-test, for example, are far too small to accommodate the pin of a shackle of equal strength. The sailor who is in a hurry is sorely tempted to use a small union shackle - with a quarter of the strength of the chain. Resist this temptation. **Union shackles must have strengths that match other components.** There are a number of ways of getting around this. Higher strength stainless steel *chain shackles* for one. Or specialty fittings available through marine catalogs - always check their load rating. *Lok-A-Loy* fittings, manufactured by Crosby Corporation for the logging industry, are specifically made for the purpose of connecting chain to rope.

Although they tend to rust after a while, Lok-A-Loys are in widespread use by commercial fisherman. A 3/8" Lok-A-Loy (used to connect 3/8" chain to rope) has a safe working load in excess of 7000 lbs. - the equivalent of a 5/8" galvanized shackle. (*Crosby Corporation, P.O.Box 3128, Tulsa, Oklahoma 74101-3128*).

Titanium fittings are slowly showing up on the market. Titanium is used in the manufacture of critical components on fighter aircraft and nuclear submarines. It feels like aluminum but is corrosion proof and far stronger than stainless steel. The 3/8" titanium shackle made by Suncor Marine, for example, has a safe working load of 7500 lbs. (*Suncor Marine and Industrial, Inc., 7 Riverside Drive, Pembroke, Massachusetts 02359).*

Another option is the use of Dyneema rope - a 1/4" 12 strand line has a breaking strength of about 9,000 lbs, floats, and is remarkably abrasion resistant too. It can also be used to make simple and quick soft shackles that can then be used to assemble the parts of your sea anchor system.

Attachment Points: Heavy duty cleats, bollards, padeyes, through bolted with backing plates, should be used for attaching the tether. The rule is OVERSIZE, OVERSIZE, OVERSIZE. When purchasing cleats, for example, purchase the larger - ten or twelve inch - stainless steel *Herreshoff* cleats that require four bolts. Stainless steel anchor rollers should be OVERSIZE as well, with no more than four or five inches of overhang. *Make certain the roller has a securing pin to keep the rode from jumping out.*

Many modern catamarans come with a single anchor roller affixed to the middle of the relatively week aluminum crossbeam that holds the trampoline up. This roller may be convenient for anchoring a cat in moderate conditions, but is not recommended for storm anchoring. There is a strong possibility that the failure of this aluminum crossmember may have resulted in the tragic capsize of the catamaran *Bayete* in a Mediterranean *Mistral* (see File S/C-19).

CAUTION: Catamarans should use full-width symmetrical bridles anchored to the strong hulls themselves. Ensure that the attachment point is STRONG. Dave Abbott of Exit Only gives an example of how to beef up the bow attachment on a catamaran (scroll down to the bottom to find his schematic for how to make it yourself).

Chafe Protection: In the authors' opinion chafe is the principle gadfly of the parachute anchoring system. To avoid this gadfly the Casanovas ended up *shackling* the bridle to custom-made stainless steel bails on the floats of *Tortuga Too* (see File S/T-1), similar to Dave Abbotts system just described.

Unfortunately, shackling the rode to large outboard eyes on *monohulls* is not practical - unless one is dealing with a steel boat. Monohulls are stuck with having to bring the rode to a cleat on deck, and it always ends up rubbing against something en route to the cleat.

This contact point is where most of the chafe takes place, not at the cleat itself. Chain solves much of the problem, although it has been known to literally saw boats in half in hurricanes. A heavy Nylon or Dacron snubber would greatly reduce such a possibility.

Nylon chafes through much more rapidly than Dacron. The stretch that provides shock absorption also produces chafe at any contact point. Stretch and relax a rubber band across the edge of a table repeatedly. This is the "sawing effect" that causes chafe. Now try it with a piece of string. Dacron does not stretch as much and is more immune to chafe.

Perhaps it would make better sense to make our snubbers out of heavy Dacron - or even Kevlar. Three-strand chafes through quicker than braid - once the "knobby high points" are gone the rest of the line will chafe through very quickly.

With a tightly cleated line there is very little chafe at the cleat or bollard itself. Ditto tightly knotted mooring rings. Maximum chafe always takes place where rope is free to move about - usually at a chock. *The farther away the chock is from the cleat, the greater the chafe.* In a storm, a chock that is six feet away from a cleat becomes a deadly *rope cutter*.

Never doubt that the heaviest rope can chafe through in a matter of minutes in a storm, if it is left unprotected on a chock. Concerning chafe the best advice the author can give is this: *Don't take anything for granted.* Use several layers of redundancy. Use anything it takes - discarded firehose (call your local fire station), heavy duty garden hose, reinforced plastic hose, leather gear, rags or even grease. In olden days sailors were handed buckets of grease and assigned stations at the chocks of a ship in tow.

Even so, never assume that the protection is going to stay in place. Garden hose is notorious for migrating away from the chafe point. Freshen the nip when everything else fails - let out a few inches of line every so often to shift the wear point and reduce localized chafe. The best arrangement the authors have seen is on commercial fishing boats: a chain bridle, encased in firehose.

Rudder Considerations: One of Victor Shane's first concerns about the parachute anchoring system was rudder vulnerability. Almost four decades later, it is much less of a concern. If the sea anchor is large enough it does not appear that the strains placed on the rudder/s will exceed normal limits. Most fears about "drifting down on the rudder" are unfounded, as Joan Casanova confirms in File S/T-1.

Boats do not drift down on their rudders at anchor. They may surge back, but they do not drift down. Notwithstanding, weak rudder assemblies are at risk in a storm. Then again, everything of a weak nature

is at risk in a storm. If your rudder breaks in a gale - several "exploded" during Fastnet '79 - will you be able to jury-rig a substitute? With the right tools, some nuts and bolts, a bunkboard or two and an oar handle you could do so. No matter, if the rudder breaks it breaks. Rudders are replaceable. Lives are not.

Tillers should be secured amidships with several layers of bungee to allow a little "give." Shane lashed two layers of quarter-inch bungee for *Providence*'s small tiller. The tiller on a Westsail 32 will likely require five layers.

Although most wheels can be mechanically locked it is better to use a similar bungee restraint somewhere down below, perhaps on the quadrant itself. Strains on wheel systems are always a source of worry in a storm. "One of the most common failures during rough weather is metal fatigue in the steering cables leading to the wheel," write the Pardeys in *Storm Tactics* (page 103). **Vessels with wheel steering should have easy access on deck to a shaft head to which an emergency tiller can be attached for back-up steering.**

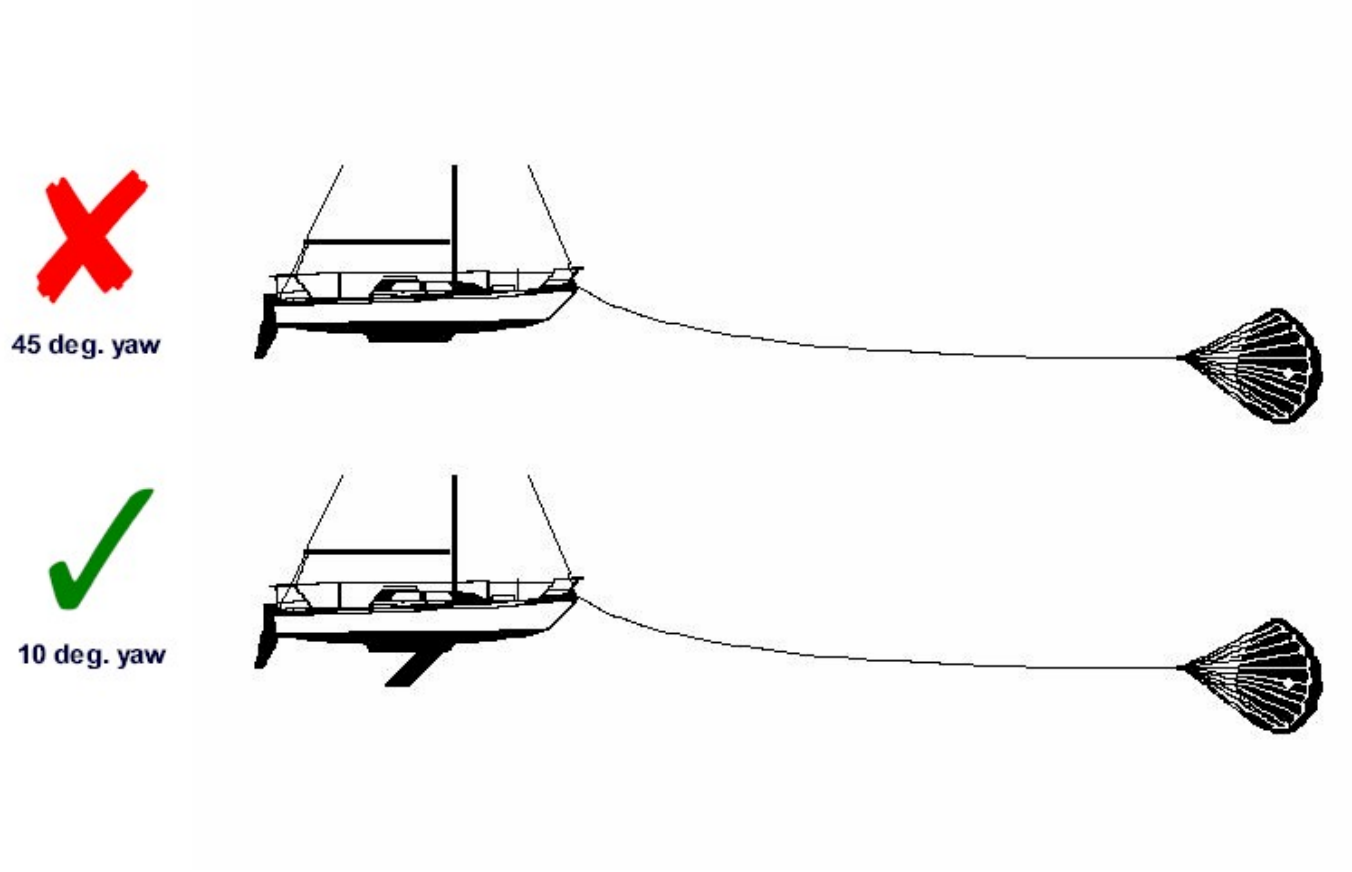
Don't put out to sea without this sort of a backup, and make certain your emergency tiller is big enough and hefty enough for ordinary, everyday steering. The little two-foot aluminum club won't do.

Here is some more good advice: *Devise a way of leading steering lines directly to the rudder itself.* Many old salts do this. Some install padeyes or eyebolts above the waterline, others bolt a flange to the blade down below.

Victor Shane installed padeyes on *Providence*'s transom rudder and they proved invaluable in the journey to Hawaii and back. The steering pulley fell off its shaft in the outer coastal waters of California and it took all of sixty seconds to restore backup steering. Old sailing ships had five-inch round holes cut out in their rudders, for purposes of attaching emergency steering rope.

Centerboards & Swing Keels: v **CAUTION:** *Lowering board/s and keels, or lowering them all the way, may give the yacht something to trip over. By and large, and as an important rule of seamanship, boards and keels should be raised in storms so that the yacht can "slip-slide," and not have something to trip over.*

However, certain small monohulls may need to lower - or partially lower - the swing keel, in order to reduce side-to-side yaw. When the swing keel is fully raised on a smaller - trailerable - monohull, the CLR moves all the way back to the plane of the rudder. As the boat surges back at anchor it "trips" on that plane, causing the bow to fall off to either side and yaw excessively - see File S/M-11.



Small monohulls may need to partially lower their centerboard to bring the center of lateral resistance (CLR) forward so as to reduce yaw.

On such boats, swing keels and boards can be lowered at sea anchor, to reduces side-to-side yaw. They can be *partially* lowered to provide less of an underwater appendage for the yacht to trip over in a gale.

Additional Things: Life jackets, flotation vests, safety harnesses, jacklines, whistles, etc. are absolute necessities. Don't even think about venturing on deck in a gale without safety harness and life vest. A good pair of sailing gloves will make rope handling less painful. You may find it easiest to use the ones that leave the tips of the fingers exposed (for handling tools, fittings etc.)

When working on deck in a gale one is usually on one's knees, and this is where a good pair of knee pads can make a big difference. Purchase knee pads sold in hardware stores - the one's worn by bikers and skaters don't quite fit the bill.

Often the force of the wind and/or driving spray makes it very difficult to look straight ahead in a gale, so eye protection is a must. At the very least diving goggles will do. Inexpensive safety goggles are better than nothing. Ski goggles are better. Racing goggles are best, and excellent ones are made by *Uvex*. *Uvex* goggles are used in outboard racing, the boats attaining speeds of 200 mph on lakes. They cost around $70 and come in two models, one of which can be worn over eyeglasses (available from *Lifeline, 1601 Kofa Avenue, Parker, Arizona 85344*).

In the course of traversing great oceans one can usually journey for weeks without seeing other vessels, and the whole ocean can be one's own private anchorage, so to speak. In coastal waters the situation may be different.

If deployment takes place in the vicinity of other craft (commercial fishing boats, for example) you are required to let them know that you are "at anchor." When anchored to the ground this is done by showing the proper shape by day, a black ball in this case (*SKU # 203646 in the West Marine catalog*), or an anchor light by night.

However, being anchored at sea does not fit the COLREG definitions of being at anchor, and a black ball would not doubt confuse people way out at see. In those situations, the correct signals are TWO black balls by day, and TWO red lights (one above the other) at night - vessel not under command. In practice, however, few yachts are able to conform to those signals, in which case a bright all-round white anchor light is better than nothing. If you have an AIS transmitter, keep it on, and be ready with a bright white flare in case anyone comes too close.

Along with the VHF a bullhorn can be a great help in tight quarters.

Commercial fishermen have been known to run over para-anchor lines. A submerged sea anchor and its long rode is not easy to see and the whole idea of a boat being "anchored" offshore is new. One should therefore remain alert and adopt a responsible attitude about warning other vessels. It is better that you take on the initiative yourself, and not leave anything to chance. At the very least observe existing regulations. Then you can say that you were in conformity.

Caution: Do not deploy a large sea anchor in the axis of a major current unless it is absolutely necessary. Ocean currents are a mixed blessing. The free ride that they may provide can be very costly in a storm. Try to traverse the current at right angles and *get well clear* before deploying the sea anchor.

WARNING: Do not deploy sea anchors inside shipping lanes! You may get run over. Victor Shane knows whereof he speaks, and will never forget the pitch black night in which he woke up to the smell of diesel fumes in the middle of Pacific and was terror-stricken by the proximity of something huge and wall-like sliding by. Large container ships carry millions of dollars of cargo and are on very tight schedules. They are not looking out for little sailboats. Their radars are set to warn them about other large ships. They could not stop for you if they wanted to.

Statistically speaking the hazard of collision increases year by year as more and more container ships - and cruising sailboats - ply the high seas. Most container carriers stick to the shipping lanes to conserve fuel, and most collisions take place in those shipping lanes. **Major shipping lanes are clearly marked on Pilot Charts - the great circle routes.** Don't put out to sea without Pilot Charts. Ask for them by name. Mark the great circles routes with a yellow hi-liter and transcribe them onto your regular charts.

Stay awake when crossing shipping lanes. Set several alarms, especially if you are singlehanded. A thermos of the blackest coffee is called for here. Don't fall asleep, as Shane did. In the thirty minutes that you are dozing a container ship the size of an aircraft carrier can appear out of one horizon, run you

down, and disappear into the other. Cross shipping lanes quickly, at right angles, and give them a wide berth before deploying sea anchors.

Deployment: Safety First

Offshore safety is many things, but first and foremost it is that conservative attitude of mind that never takes anything for granted. In particular, never take your sea anchor for granted. Take note that sea anchors are capable of pulling loads measured in tons. All lines must be properly flaked or coiled beforehand. **Stand clear of coils when the rope is paying out.**

If deployment is imminent *always have the sea anchor in the water and properly set well before dark.* Don't wait until the last minute! Monitor the forecasts and keep an eye on the barometer. A rapidly falling barometer means you are being overtaken by a huge atmospheric vacuum. Where there is a vacuum, air rushes in to stabilize the system. Rushing air means high winds and big waves. Pay attention to your barometer. Watch for wind clouds and learn to read the signs in the sea and sky. The Pardeys provide practical tips for doing so in *Storm Tactics*.

They also provide many useful tips about *when* to heave-to. Lin and Larry have made the equivalent of five circumnavigations and their advice is to heave-to early. Deploy the para-anchor early on in the game, before the bottom falls out of the barometer, before things get completely out of hand. Think about heaving-to before fatigue robs you of the ability to think clearly. The human mind is fragile and unless it can relax with some remission the force of its tension, it may snap and cease rendering good judgments. This is precisely why the Pardeys equate heaving-to with a *safety valve*.

Standing Set

The safest method of deploying a sea anchor is to allow the boat's drift to pay out the rode. The step by step scenario is as follows:

1. Head up into the wind, allow sails to luff and the boat to stall. Use the engine if you need to.

2. Lower/furl all sail.

3. Secure the rudder amidships.

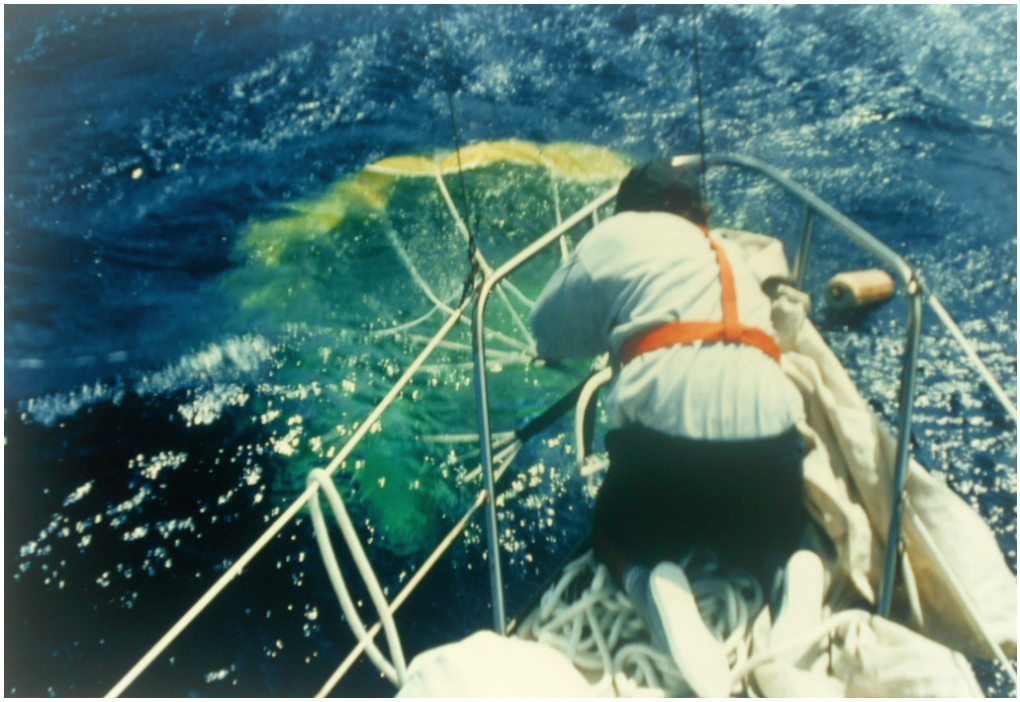
4. Heave the float over board *on the windward side* and pay out the float line. The float line has been known to foul the parachute and its lines. Make certain it doesn't.

5. Slam dunk the sea anchor (or Deployment Bag) also on the WINDWARD side - never on the lee side, where the boat may drift over and foul.

6. As the boat drifts away from the para-anchor, snub the line early to help the chute open, and begin

paying out the line/s. The float will be getting pulled into the water at this stage. DO NOT FULLY CLEAT THE LINE WITH ONLY A SHORT RODE OUT - give it half a turn on the cleat so you can slacken off quickly if necessary.

7. Secure the tether or bridle, apply chafing gear, go down below and take a coffee break.



Snubbing the parachute so that it fills. At this stage it is then gradually paid out as the boat drifts downwind from the inflated canopy.

The above method, called *standing set*, is the method that the authors recommend for heavy weather deployment. It is somewhat slow, and lines have a way of wanting to get under the boat initially (some sailors tie small fishing weights to the rode so that it will sink directly and not foul). But it is the safest method in heavy weather, especially for the novice. The alternative method, used by commercial fishermen and expert sailors is known as the *flying set*.

Flying Set

1. Bring the container of sea anchor and rode into the stern cockpit.

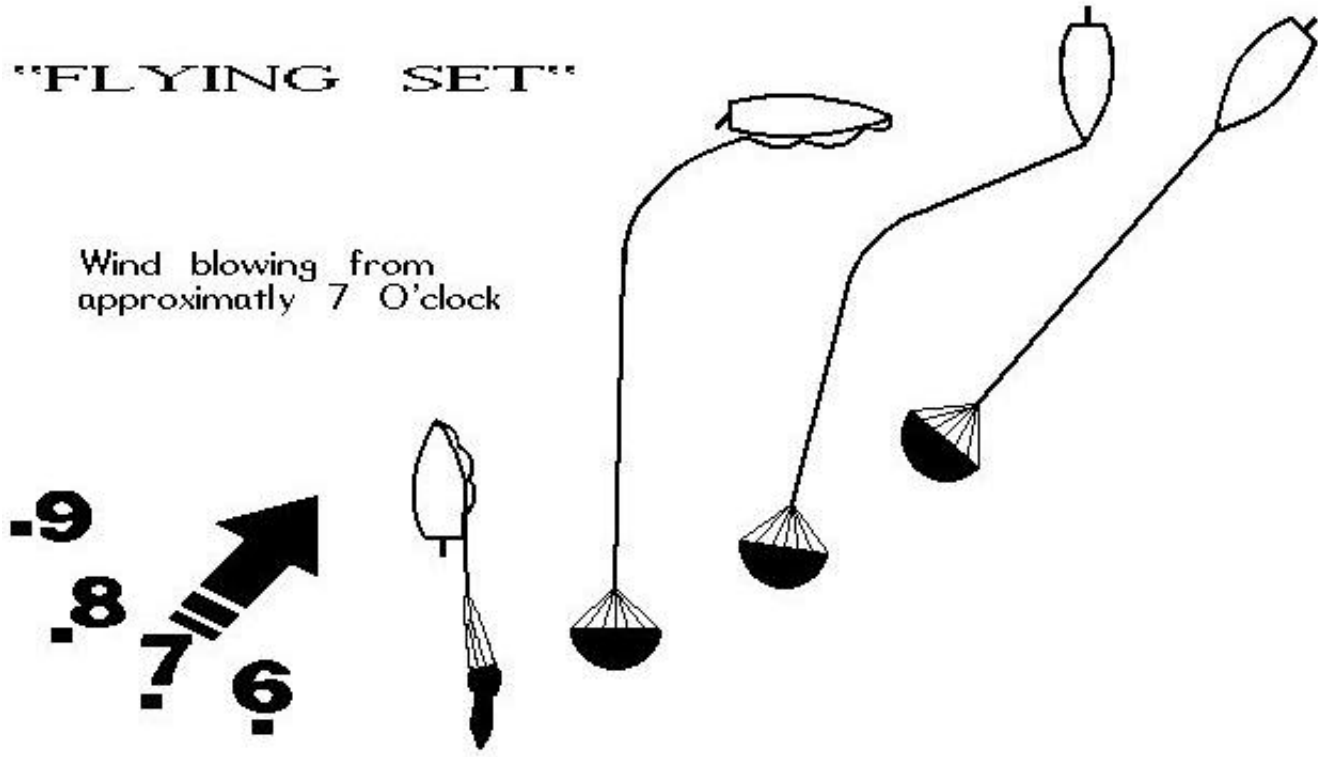
2. Take the bitter end of the rode, lead it outside all stays, rails, stanchions, etc., and secure it to the bow cleat (this can be done beforehand).

3. Furl all sail (do not attempt this maneuver with the mainsail up). Place engine in slow forward and steer a course with the wind at 7 o'clock.

4. Heave the float, and again, wait for the float line to pay out, then slam dunk the sea anchor off the stern quarter.

6. Keep moving the transmission in and out of slow forward, allowing the coils of rope to safely pay out behind the boat. (Expert sailors can use the storm jib instead of the engine).

7. With all but the last coils paid out, take the engine out of gear (or let the storm jib luff) and put the helm down - "RIGHT FULL RUDDER!" Wait for the wind to bring the bow around into the seas.



Flying Set: Wind on the stern quarter, blowing from approximately 7 O'clock. Deploy with extreme prejudice and precaution if this is the first time. STAY CLEAR OF ALL COILS AS THEY PAY OUT! Anticipate and time the final turn carefully! Try to put the helm down in the trough area, where the rudder is most effective.

CAUTION: Because of the shock loads involved in attempting to stop a heavy boat that is moving downwind at some speed, Flying Set is not recommended in storm situations.

Although setting a large diameter parachute on the fly is quicker and much more positive, it is a tricky business, requiring much practice. Some sailors leave it too late, end up having to set the sea anchor on the fly, and it is usually a hair-raising experience.

If this is your last remaining option the author's advice is as follows: *Carry out the maneuver with extreme effort!* A half-hearted, sloppy effort just won't do here. Once you have decided to set the sea anchor on the fly you must act on that decision with single-minded resolve and determination.

Stay away from the coils of rope as they smoke out, and have a sharp knife ready just in case. Turning the boat around may be the most critical maneuver. One has to time the move precisely. Try to put the helm down *behind* a wave, in the trough area, where the rudder is most effective.

The Casanovas always set big parachutes on the fly. They practiced all the moves and could go through the motions instinctively. It is fast and efficient, but is a difficult and hazardous maneuver, especially in a pitch black night. It is far safer to deploy early on in the game, using the *standing set.*

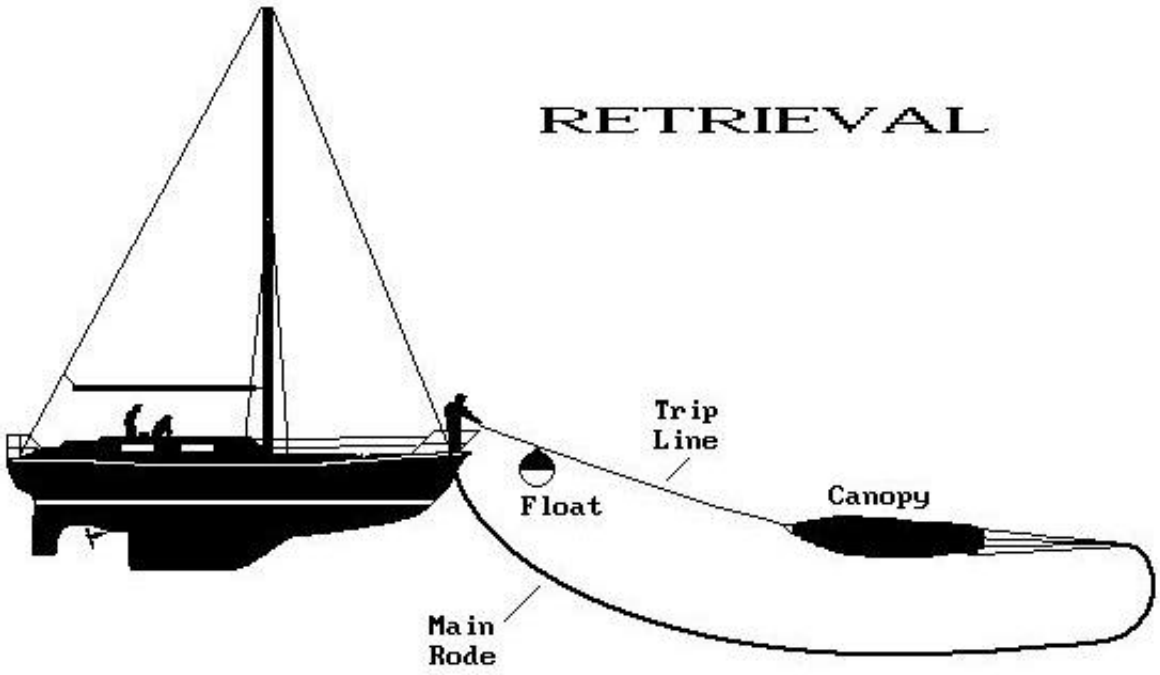
Retrieval

The largest para-anchor can be easily emptied out and retrieved by means of a tripping line connected to the center of the canopy (usually part of the package). Even so, allow plenty of time for retrieval, and try not to force anything. Remember, when retrieving a sea anchor one does not pull the sea anchor to the boat, rather the boat has to be pulled up to the sea anchor, even if that boat weighs ten tons.

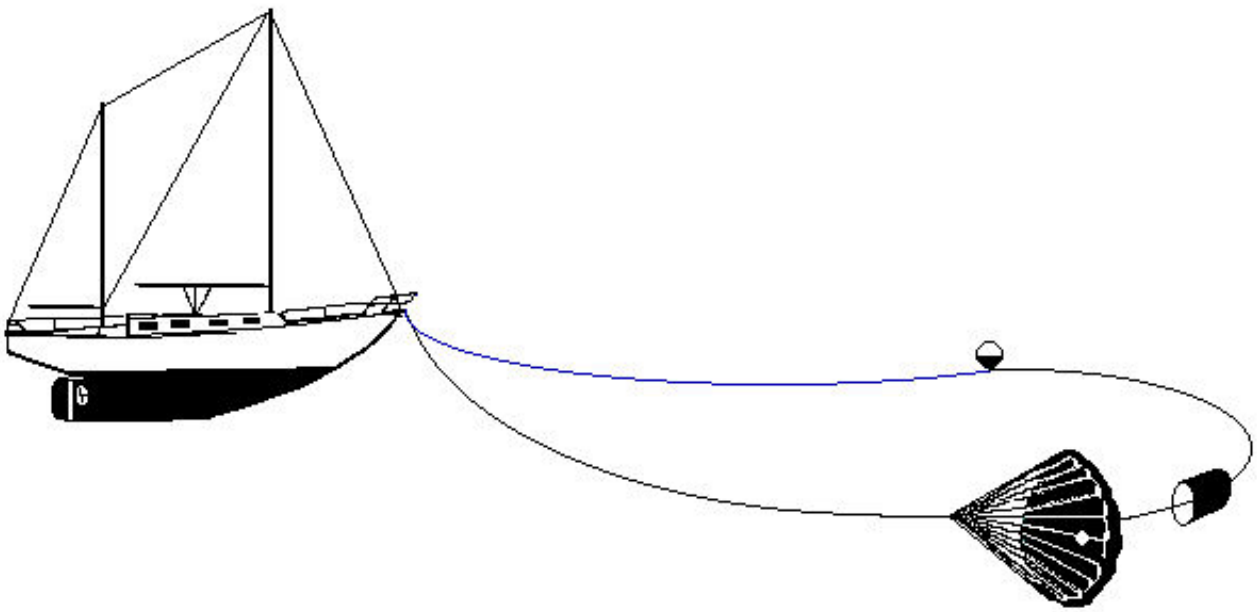
Some sailors, among them the Pardeys, prefer not to use any tripping line or even float line at all - one less thing that might foul. In retrieving the sea anchor they wait until the seas calm down, then use a winch - or an engine - to bring the boat slowly up to it. When the parachute is within reach, they then grab hold of one or two shroud lines and pull, by so doing spilling the water out of the canopy. Once the canopy has been emptied it turns into a "limp rag" and can be brought on deck with relative ease.

This method of retrieval is fine, unless large swells are running, and that is when one can get into the divergence problems associated with orbital rotation - the problem the Monterey fisherman ran into.

Remember, as you are hauling the boat up to the sea anchor you will eventually arrive at the precarious juncture where the heavy boat is moving *backward* on a crest while the sea anchor is moving *forward* in the trough up ahead. As the two heavy objects diverge forces are brought to bear that can damage hardware or rip the sea anchor itself. You can avoid this potential hazard by the use of a tripping-line.



Full Trip Line: A full trip line starts at the crown of the parachute and comes all the way back to the boat. Although cumbersome and more prone to fouling, a full trip line allows one to quickly spill the water out of the parachute (useful in tight quarters). Full trip lines should be kept fairly taut. *There should be no excess slack hanging down in the sea to foul the main rode*. Be sure to use a small swivel at the juncture of the float as well. Once the sea anchor is properly set, pick up the trip line and take in the excess slack, almost to tripping point, then slacken off a few feet. Remember: If the wind force increases during the night the main rode will elongate, necessitating that the trip line be slackened off as well.



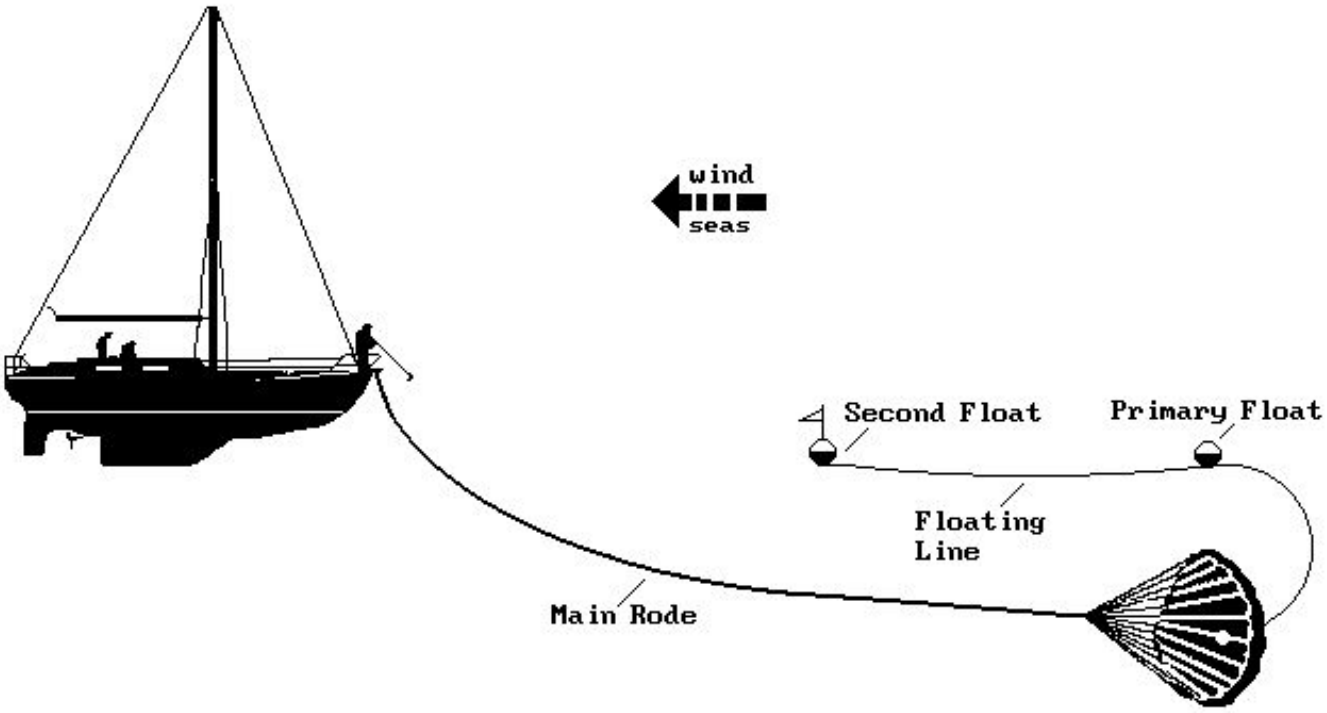
Full trip line: make sure that the line is kept tight so that it does not get wrapped around the main tether. Make sure also that a swivel is included between the parachute and the float. (In this diagram there is also a deployment bag next to the canopy)

Partial Trip Line: Many sailors don't like the idea of a full trip line, fearing that it may foul the sea anchor and render it inoperative (a fouled trip line is thought to have led to the capsize of the trimaran *Rose-Noëlle* in File S/T-7). A *partial* trip line is the next best thing.

As the name implies, a partial trip line does not come all the way back to the boat. It floats freely out there on two floats. Use about 70 feet of floating - polypropylene - line between the first and second floats. Ordinarily the wind will keep the floats aligned and all one needs to do is fetch up on the second float to trip the canopy.

Tripping a chute is like breaking a Danforth out of the bottom. No sooner it is tripped than the bow of the boat will want to fall off the wind. Try to anticipate which side it will fall off on. If the tether is on the starboard side of the forestay then wait until the boat is on a port tack before tripping the chute. Take care that slack lines don't get fouled under the boat. A lead-line can be used to get a fouled line off a keel or rudder. As the lead sinks it should pull the fouled line off the keel.

If the sea anchor came with a Deployment Bag, stuffing it back in should be an easy matter. Notwithstanding, one usually ends up with a mess of lines after retrieval, and there is little sense in worrying about it. Just secure things the best way that you can for the time being and get underway. You can tidy up later.



PARTIAL TRIP LINE
Pull the boat up to the second float, bring it on deck and trip the chute, inverting the canopy.

USEFUL TIP: Do not detach the rode from the sea anchor until canopy and shroud lines have been bagged and things are better organized. Leave the rode connected to the parachute terminal for the time being. Like loose hammocks, loose parachute lines have a way of fouling themselves. If they are connected to the rode they can't foul each other.

Don't worry about the wet chute in the bag. Leave it wet, so that abrasive salt crystals cannot form. Yes, it is a good idea to rinse the sea anchor with fresh water, but all in good time, in port. In washing your sea anchor take care again that the lines don't foul. Keep the parachute terminal separate and clear at all times, and never drop it carelessly on the rest of the "spaghetti."

NEVER DRY YOUR PARA-ANCHOR IN DIRECT SUNLIGHT. Tests conducted by the military and the industry have shown that direct exposure to the ultraviolet rays of the sun can rapidly degrade nylon materials.

Drogues

Bow & Stern Exposure

Large diameter parachute sea anchors are deployed off the bow, in deference to the way in which naval architects design hulls. Most naval architects design hulls to part the waves with pointed, low-buoyancy bows. Very few sailboats can part the waves with their sterns. In fact, with the exception of Polynesian Proas, no sailboat can sail backwards efficiently. The basic shape does not allow it. The design of the hull encourages forward motion relative to waves. It discourages backward motion relative to waves.

A large diameter parachute sea anchor is not intended for use off the stern, at least not in storms. Why not? Because in this case the pointed, low-buoyancy bow, designed to penetrate and drive through a wave, is usually replaced by a blunt, wide, high-buoyancy "barn door" transom. Think of the boat as a knife, and the wave as a huge tomato. It is easy for the tip of the knife to push through the tomato. But if the tomato strikes the blunt handle instead, the knife may get thrown end over end. On page 67 of *The Sea Anchor & Drogue Handbook*, Shewmon uses formulae to show that the green water behind a 50-ft. tumbling breaker may be expected to exert a ton of force on each square foot of flat transom area, adding the following:

> *For example if a relatively slow sailboat being overtaken by the above breaker has a stern area of 20 sq ft, the vessel would be subjected to a force of 40,000 lbs, or 20 tons.... Even for vessels towing drogue-type devices, the sudden acceleration of their sterns by an average ocean breaker must result in snapped ropes, failed hardware, or the destruction of the drogue, not to mention further vessel destruction from being so struck.* **(*The Sea Anchor & Drogue Handbook*, 1995 Edition, copyrighted - by Daniel C. Shewmon.)**

Bungee Jumping

What happens when a yacht is anchored to a large parachute off the stern and ten tons of water - moving at 30 knots - slam into the buoyant and flat surfaces that make up the transom and cockpit?

Quite likely the yacht will be blasted forward like a golf ball off the tee. At this critical moment, a small *drogue* might get pulled through the sea for a few seconds. The large parachute, on the other hand, is not going to budge. Something will have to give, usually the nylon rode, which may stretch to breaking point or beyond the limits of its elastic recoverability.

If the rode doesn't snap - and if the breaking wave doesn't smash through the companionway and flood the interior with tons of water - there is a possibility that the boat will be slingshotted backward into the next wave. In short, she may engage in some dangerous "bungee jumping."

Theme park bungee jumps are designed for safety. One usually gets released from a height, stretches the bungee, and springs back up. Bungee jumping to a large sea anchor in a storm can be dangerous for a yacht however. Why? Because the vessel may run into another breaking wave on the rebound.

One can imagine the scenario. A huge wave lifts up the stern and breaks squarely on the transom. The boat gets sledge-hammered into a free fall. The nylon rode stretches to the limit, arrests the free fall and begins to recover. The boat gets slingshotted backwards and slams into another breaking wave on the rebound.

With her stern pointed to the seas the yacht wants to race ahead. Anytime the line goes slack (per orbital convergence, for example) she will try to take off on a sprint. If a wave breaks while she is gathering speed, she will be blasted forward, and the inertial loading on the cleats, the rode and the sea anchor (for the most part a product of the mass of the boat and its acceleration) may very well exceed the limits of those of components. If they don't, the yacht will start "bungee jumping," for better or for worse.

Shock Loading

Imagine a 1000 lb. iron weight hanging from a crane. The load swings from side to side: this is analogous to the boat swinging on a big parachute off the bow.

The entire dynamic changes when a large parachute anchor is used off the stern. Here the load is no longer merely swinging: *It is being dropped as well.*

Now the drum is released, the load dropped ten feet, and the brakes applied again: this is analogous to using the same parachute off the stern.

Question: How much force does the crane have to absorb when a load of 1000 lbs. is dropped ten feet? Given a normal stopping distance, about 10,000 lbs. The force is about ten times greater when the load drops than when it is held firm and merely swinging.

When a large parachute is used off the stern one ends up working at cross purposes to the intent of the naval architect who designed the yacht. One is now faced with the possibility of extreme shock loads, precisely the sort one is trying to avoid. Literature published by the Cordage Institute of America (*350 Lincoln Street, Hingham, Massachusetts 02043*), includes the following paragraphs on dynamic loading:

> *Avoid sudden strains - shock loads can exceed breaking strength. Shock loading can cause failure of a rope normally strong enough to handle the load. Working loads are not applicable when rope is subject to significant dynamic loading. Whenever a load is picked up, stopped, moved or swung, there is an increased force due to dynamic loading. The more rapidly or suddenly such actions occur, the greater this increase will be. In extreme cases, the force put on the rope may be two, three, or even more times the normal load involved....*
>
> *Examples could be picking up a tow on a slack line or using a rope to stop a falling object....*

> *Users should be aware that dynamic effects are greater on a low elongation rope than on a high elongation rope, and greater on a shorter rope than on a longer one. Excessive dynamic loading of a high elongation rope is equally dangerous, because of stored energy which will cause the rope to recoil dangerously if it breaks....*
>
> *The load must be handled slowly and smoothly to minimize dynamic forces....*

Large para-anchors are designed to stop, orient and align small craft bow-on. If one desires to stabilize the attitude of a yacht while running, one has to use the partial braking mechanism of a *drogue* instead.

Drogues

Drogues fall into two basic categories: **low-pull** and **medium-pull.** Low-pull drogues are designed to be constantly towed off the stern as *speed-limiting devices.* Medium-pull drogues are also designed to be used off the stern, but they cannot be constantly towed: they bring the boat to a near stand-still and place it "on standby," being pulled through the sea only when the yacht gets struck by a breaking wave.

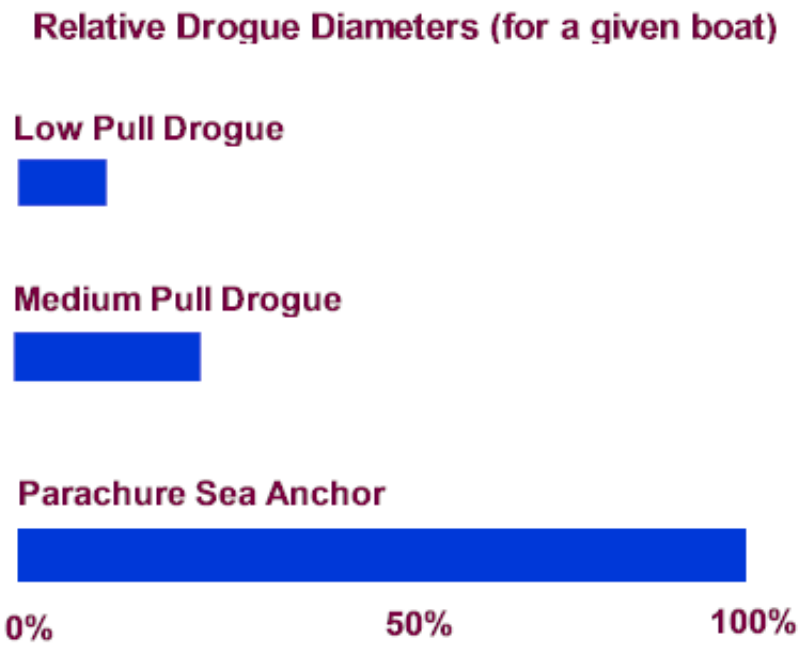
In making a calculated decision as to which drag device to use in a given situation, a sailor has *three* different choices:

(1) Parachute sea anchor.

(2) Medium-pull drogue.

(3) Low-pull drogue.

A parachute sea anchor does not get dragged through the sea. A medium-pull drogue does, *but only when the yacht is struck by a breaking wave.* A low-pull drogue gets dragged - towed - through the sea all the time. The table below is intended to give a rough idea of how the three different types of drag device relate one another in terms of diameter.

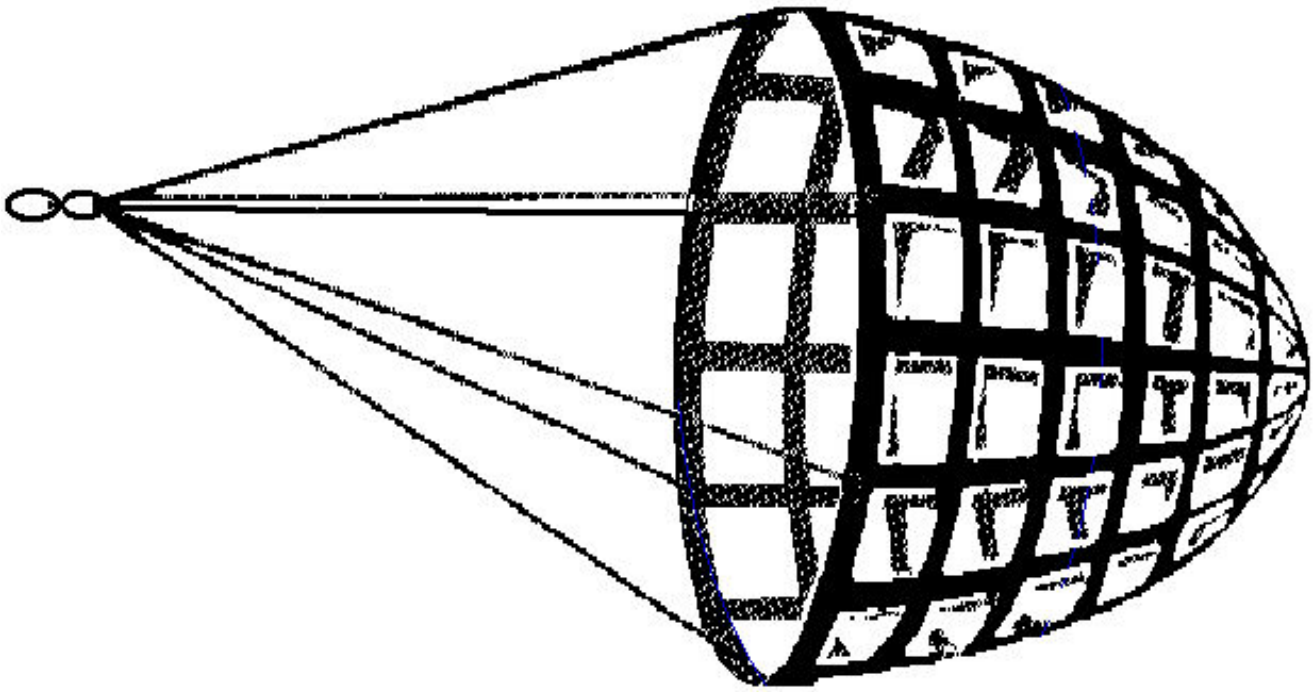


Note, for example, that if the recommended Para-Tech sea anchor for a 40-ft., 20,000 lb. vessel has a diameter of 18 feet, then the vessel would require a medium pull drogue (cone or parachute) with a diameter of about 4.5 feet (25%), and a low-pull drogue (cone or parachute) with a diameter of about 26 inches (12%).

Speed-Limiting Drogue

A low-pull speed-limiting drogue is towed off the stern to help keep the boat aligned in strong following seas. Its partial braking mechanism limits the speed of the boat and her angle of yaw. In this category fall the various items that may be towed behind a boat to reduce its speed down to a safe and sane 3-6 knots.

Warps, bites of chain, automobile tires, bells, buckets and small drags of all shapes and sizes. And, of course, modern speed-limiting drogues designed specifically for that purpose, such as the Galerider.



Galerider drogue produced by Hathaway, Reiser and Raymond

A speed-limiting drogue produces a fraction of the drag that a para-anchor does. Yes, in some respects it is a scaled down sea anchor, but that's where the similarity ends.

Speed-limiting drogues must posses certain additional virtues that one would not ordinarily require of large parachutes. Why not? Because large parachutes cannot ordinarily be *towed* through the sea, whereas speed-limiting drogues have to be. Indeed, a speed-limiting drogue must possess certain "missionary" virtues. It must pursue a straight course, without wandering off to either side. It must track fairly straight, without "kiting," zig-zagging and porpoising. And it must be faithful in retaining its shape as well: *It must not get turned inside out*. This poses a problem, especially with textile fabrications. But there have been many clever solutions.

One cannot merely scale down a parachute and use it as a speed-limiting drogue. A large - 18-ft. diameter - para-anchor is inherently stable because the vessel that it is intended for cannot tow it through the sea. A 2-ft. diameter parachute is another matter.

Unless properly designed, small textile drogues and parachutes are very much prone to instability. They misbehave under tow. They yaw. They zig-zag. They flutter. They are subject to surface action. They dive and surface like a porpoise. And they have another unforgivable vice: they tend to get turned inside out in slack cycles, and pop violently open when the load is taken up again.

An illustration: A speedboat is barreling along at 30 knots on a lake when the operator suddenly cuts the throttle. What happens? The boat gets overtaken and swamped by its own wake.

Towed drogues run into a similar problem - they tend to be overtaken and swamped by their own wakes when the load suddenly drops to zero. This particular vice - partial inversion, followed by a violent re-opening - is mentioned in two official reports on drag devices, namely the U.S. Coast Guard's *Investigation Of The Use Of Drogues To Improve The Safety Of Sailing Yachts*, and the Wolfson Report, commissioned by the RORC to assess *The Use Of Drogues And Similar Devices To Prevent Yacht Capsize In Breaking Waves*. The Coast Guard report puts it this way:

> *This behavior results from the fact that the mass of water in the wake behind the drogue continues to move forward, after the tow line force has dropped to zero. This wake can collapse and even tumble the drogue.*

The Wolfson Report states it thus:

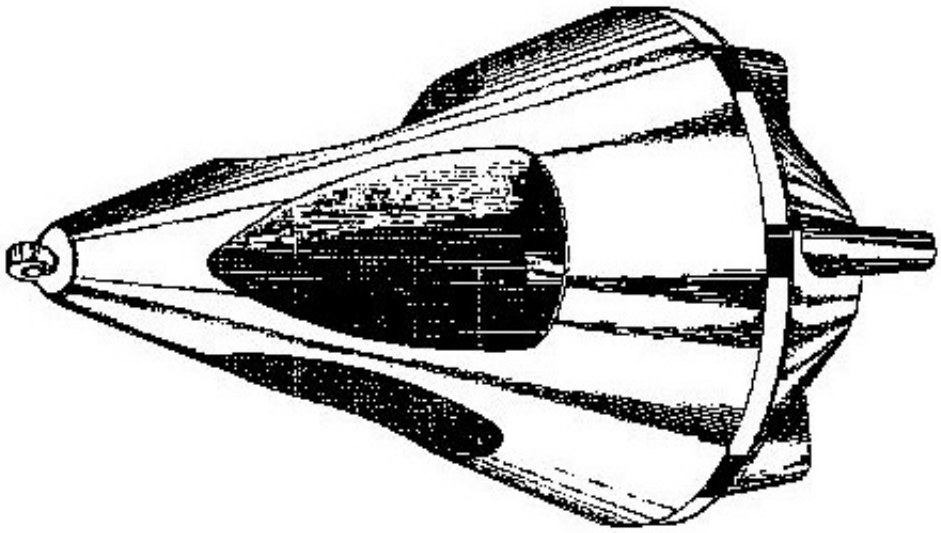
> *Under cyclic loading, drogues and small parachutes can collapse and start to tumble so that they either cause themselves structural damage or tangle so badly as to be rendered ineffective. Large parachutes can avoid collapse by virtue of their higher drag causing the tow line to stretch rather than to pull the parachute through the water.*

Stability Under Tow

The problem relating to drogue stability can be approached from a number of different directions. One solution, for example, would be to design and construct solid drogues made of ABS plastic and/or aluminum.

This was the initial approach taken by John Abernethy, inventor of the Australian *Seabrake*. Obviously solid drogues have no problem retaining their shapes, and they can be made to track like torpedoes as

well. The disadvantage of a solid drogue, of course, lies in its weight and storage volume. Weight and storage volume are important considerations on small cruising boats.



SEABRAKE HSD 300

Drogues manufactured from modern textiles provide more strength and drag per pound of weight or storage volume than solid drag devices. They fold up into a small size and are easy to store.

The trade off again has to do with stability and shape retention. Existing textile cones, for example, are notoriously unstable under tow. The principle cause of their instability has to do with the non-uniform wake - vortex trail - that forms at the separation edges of the cone. In short, the flow of water around and through the cone is not uniform at high speeds: it fluctuates, producing changes in the cone's "angle of attack," which disturb the wake, which produces oscillations, which produces unstable side to side, or up and down moments.

How does one solve this problem? What does it take for a textile drogue to remain directionally and structurally stable under tow?

The parachute industry has been wrestling with the same problem for decades and has come up with various stable drogue configurations. Indeed the legacy of Messrs. Smith, Ball, Russel and Irwin (those of the original 1919 McCook Field group that were responsible for most of the parachute development of the next thirty years) is now a highly articulated component of Defense and Aerospace industries.

By way of a brief digression we should take note of the fact that Parachute Recovery Systems have reached a high degree of reliability, as documented by the 31 consecutive successful manned spacecraft

landings. Huge *Ringsail* drogues were used as the main descent parachutes for the Mercury, Gemini, and Apollo spacecraft. *Guide surface*, *Ribbon* and *Ballute* drogues have been used successfully at speeds in excess of Mach 4.0 at altitudes up to the limits of the atmosphere, and at dynamic pressures to 15,000 psi. *Disc-Gap-Band* parachutes were used to land Viking and Pathfinder spacecraft on Mars, and to lower the Galileo probe into the gaseous atmosphere of Jupiter.

Nowadays *Conical Ribbon* drogues, larger than football fields, are routinely used to recover the Space Shuttle's reusable SRBs (solid rocket boosters). The recovery sequence starts at 349.4 seconds after launch when the 11-ft. diameter pilot chute is deployed as the spent booster is jettisoned. This is followed by the deployment of a 54-ft. diameter drogue chute, going through three inflation stages in 12 seconds - accomplished by the use of explosive reefing line cutters. At T + 371 seconds "main parachute cluster" deployment occurs when the three 136-ft. diameter *Conical Ribbon* chutes go through three inflation stages, sequentially slowing the 185,000 lb. SRB down to a 45 miles per hour splashdown near a recovery ship, which brings it back for re-use on another mission.

Millions of dollars have been spent by Defense and Aerospace to develop a wide variety of stable drogue systems, the technical aspects of all of which can be found in a thick book called *Parachute Recovery Systems* (T.W. Knacke, 1992, *Para-Publishing*). See also the Wikipedia article on parachutes.

How were the problems solved? By two basic tricks:

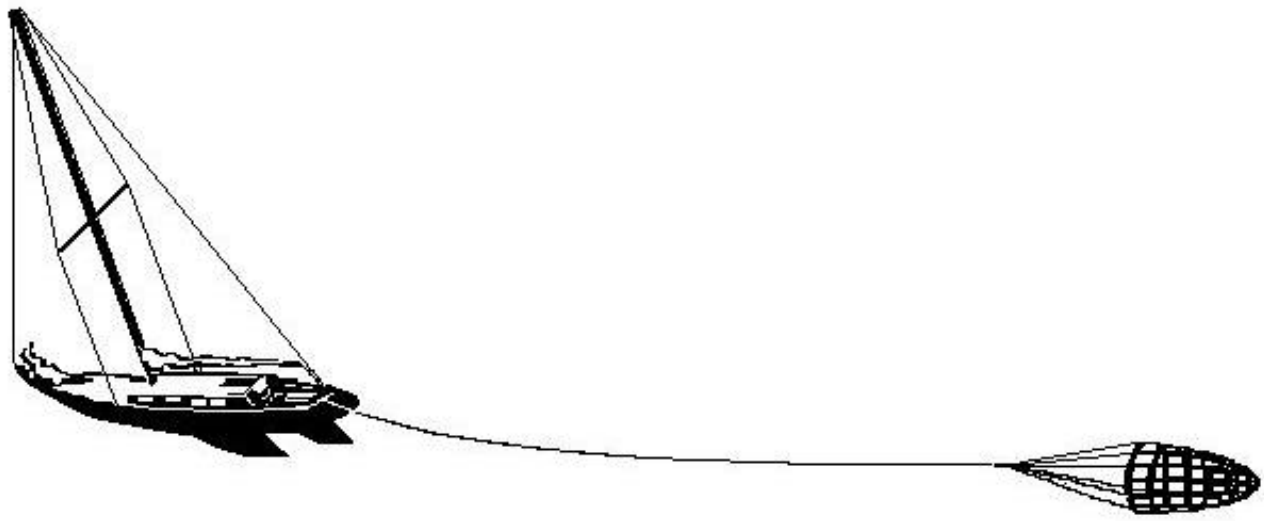
(1) Increased Porosity.

(2) Guide Surface Principle.

Increased Porosity: Very few of the exotic drogues used by Defense and Aerospace are of solid construction. Most are slotted, or fabricated from open weave materials. Some are gapped. Others have open areas. Others still have multiple vent holes.

In short, all have relatively high *geometric porosity* (defined as the ratio of total open area to total canopy area). All are designed to allow considerable *flow-through* of air. The greater portion of the air flows *through*, instead of *around*. This reduces the non-uniform vortex trail at separations boundaries, in turn reducing the side-to-side oscillations that lead to instability.

Typhoon deploying a ringslot parachute drogue



Sailboat being slowed down by a towed drogue

Drogues with high geometric porosity produce stable drag force to decelerate airplanes and sailboats alike.

In many respects the *Ringslot* parachute used to decelerate a Typhoon fighter on a runway has a great deal in common with the popular *Galerider* drogue. Both achieve stability through a marked increase in geometric porosity. *Galerider* is the brainchild of Frank V. Snyder, Vice Commodore of the New York Yacht Club. Snyder put the original prototype together with the help of Skip Raymond, of the sail making firm of *Hathaway, Reiser and Raymond*.

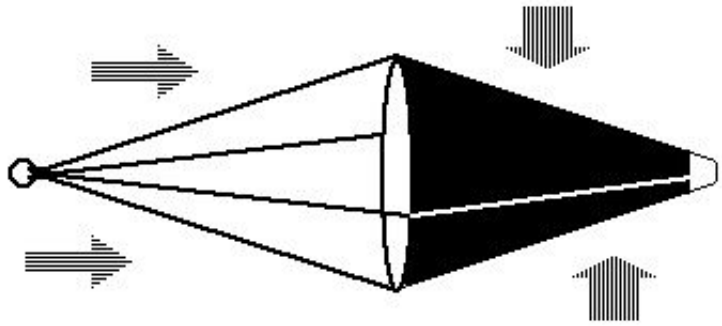
Galerider is made from heavy two-inch nylon webbing. It has a collapsible stainless steel wire hoop sewn into the skirt to keep the mouth open, and comes with a swivel termination to compensate for any rotation. It is stable under tow and its parabolic shape would be very difficult to turn inside out - scoring high points where it counts. See File D/M-3 about how the *Galerider* was first made and put to use.

Guide Surface Principle: The second way of achieving drogue stability has to do with addition of a *guide surface*. Guide surface drogues are among the most stable in existence - the ones most often relied on for initial extractions.

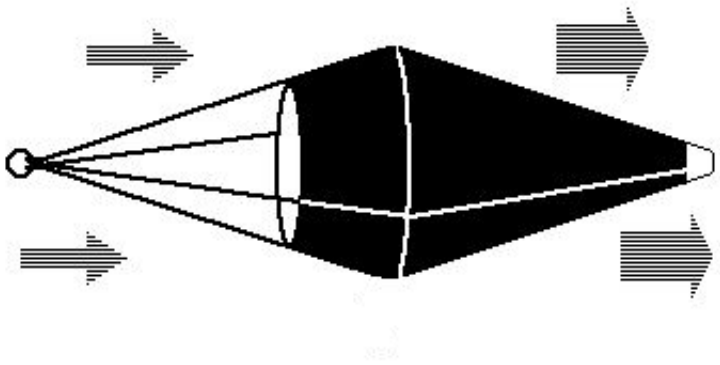
When a billion dollar bomber lands on a runway the little pilot chute that extracts the big *ringslot* parachute may be of guide surface fabrication. Many of the drogues used to recover missile components and test instrumentation are likewise of guide surface fabrication.

Although the term *guide surface* smacks of technical jargon it involves a very simple idea. A "guide surface" is something that is sewn to the leading edge of a drogue to create a strong, uniform airflow separation around the edges (the same principle that lends credence to the use of spoilers on race cars).

The addition of the guide surface smooths the airflow around the drogue, reducing unstable moments and increasing directional stability at lower speeds. And those angled leading edges create a massive normalizing force at higher speeds as well. This normalizing force combines with the stable drag force to create extraordinary righting moment when the drogue is displaced from its zero angle of attack position.



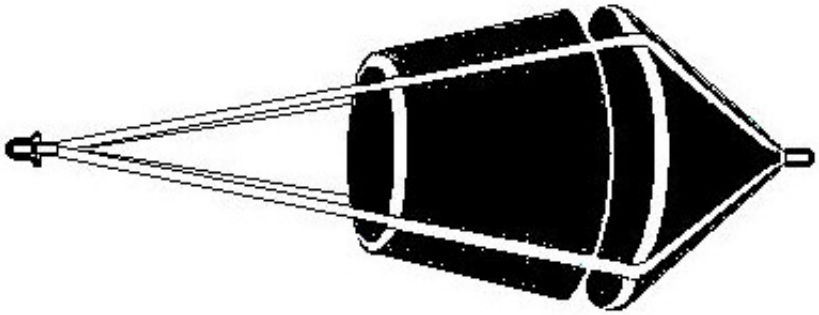
ORDINARY CONE
The flow around an ordinary cone is disturbed by its changing angle of attack, producing unstable side to side or up and down moments.



GUIDE SURFACE CONE
The addition of the "guide surface" smooths the flow around the cone, reducing oscillations

The diagrams above show the addition of a "guide surface" to an ordinary cone. Textile drogues manufactured by *Para-Tech* and *Seabrake* have a great deal in common with Defense and Aerospace guide surface fabrications. They use the same basic principle to create a more uniform water flow around leading edges.

Note the textile "guide surface" positioned ahead of the conical drag element of the Seabrake *GP-24*.

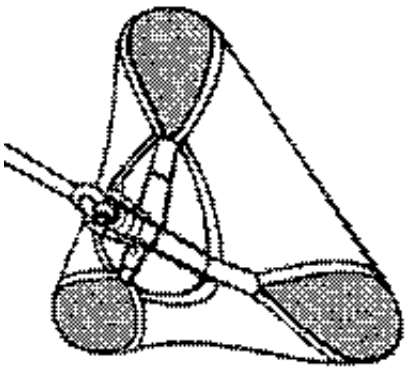


SEABRAKE'S GP-24

Inventor John Abernethy told Victor Shane that in addition to increasing stability, the interaction between the guide surface and the conical element produces a "staged" effect as well, somewhat similar to the spring-loaded mechanism that "kicks in" on his solid *Seabrake MK I* (spring-loaded gates open at seven knots to increase drag by about 70%).

The *GP-24* is heavily constructed, and does not spin, obviating the need for a swivel. It is stable under tow and would be difficult to turn inside out, also scoring high marks where it counts. See File D/M-10 for more on the story of how Seabrake was conceived in Australia's Bass Strait.

Para-Tech's *Delta Drogue* is simple in both design and construction. It has a triangular - *Delta* - shape with angled leading edges that utilize the same "guide surface" principle to provide uniform flow. It makes partial use of the "ballute" principle as well - use of interior water pressure for shape retention. And its three radial slots have the effect of increasing drag as the speed increases.



PARA-TECH'S DELTA DROGUE

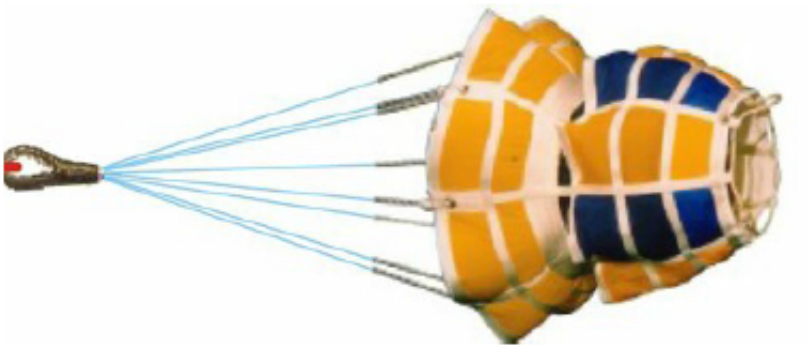
The ***Delta Drogue*** by Para-Tech Engineering is heavily constructed and comes with a swivel termination to allow for rotation. It is stable under tow, and its small mouth makes it all but impossible for it to get turned inside out, also scoring high points where it counts.

There are other interesting drogue concepts on the market presently, and others will no doubt follow.

Shewmon came up with a *Variable Pull* drogue whose drag could be adjusted by means of a secondary line leading to the crown of the drogue - see Dan Shewmon's *Sea Anchor and Drogue Handbook* for details. The idea of a drogue whose pull can be varied on the fly is very desirable, even though the concept is difficult to perfect, especially with textile fabrications that are prone to inversion in heavier storms. Unfortunately it seems that Shewmon's drogues are no longer available on the market.

Neil Attenborough of the UK invented a stainless steel "mine sweeper" drogue. The angled louvers of the *Attenborough Sea Drogue* make the device want to dive, increasing resistance in proportion to speed.

Australians Gavin Le Sueur and Alby McCracken have similarly experimented with solid and textile fabrications, creating a para-drogue along the lines of a ringslot parachute.



The para-drogue developed by Para-anchors Australia

No doubt over time there will be other variations that appear.

Heavy Weather Uses

(Speed-Limiting Drogue)

Reducing Storm Time: If a gale is moving steadily, one might use a large parachute to anchor the yacht and allow the system to pass overhead more quickly, cutting down on "storm time." While most gales do traverse oceans quickly and predictably, some other systems are downright fickle.

Tropical depressions, for example, are notorious for moving about erratically, and it is not at all uncommon for a tropical storm to get stalled in place for a day or two. To be trapped in the dangerous quadrant of such a stalled system will obviously increase storm time. Since most tropical disturbances have relatively small diameters - typically seventy miles - a distance of even forty miles may mean the difference between thirty and fifty knots of sustained wind.

In view of this, a skilled shore-based route forecaster may, after carefully assessing a particular situation, advise the owner of the yacht to crowd sail and try to distance the vessel from the developing system.

While it makes sense to try to escape the clutches of a tropical depression that has very rudely parked itself overhead, we have already ascertained that running full bore in certain conditions may be hazardous. The vessel may broach, capsize, or fall off waves.

A red-blooded sailor may say: "No problem! Leave it to me! I'll just strap myself in the cockpit and use the rudder to keep her from broaching!" Unfortunately small craft cannot always be kept in alignment by means of the rudder alone.

The fact is that the rudders of big ships have been known to be lifted out of the water in storms, and we have already alluded to the difficulties involved in steering a boat that's being swept along on river rapids. Trying to keep the boat out of trouble by means of the rudder is not as easy as one would imagine.

This is not to say that it cannot be done. Many legendary sailors - among them Vito Dumas and Bernard Moitessier - have managed to pull it off, and for them the near miss may have been "as good as a mile." The rest of us may not be as skilled - or as lucky.

In the case of a yacht that is running downwind, the orbital rotation of the waves causes helm control to increase in a trough, but decrease on a crest. As the boat is picked up and accelerated by a wave crest, the flow of water past the rudder diminishes and the helm goes limp for a few seconds (as it would on a fast-flowing river).

Those few seconds can amount to a large window of vulnerability. If the yacht is out of alignment when she gets struck, the wave-induced yawing moment may be greater than the restoring moment available from the rudder, and she may broach or capsize.

This is where the directional restraint of a drogue - situated elsewhere on the wave train - is called for. The drogue helps keep the vessel aligned in the few seconds when the rudder is useless. The drogue may not be able to close the window of vulnerability entirely, but it can reduces its size. Speed-limiting drogues can therefore be of immense value when running before strong following seas.

If running through or from a storm system is the last remaining option, a speed-limiting drogue - properly positioned on the wave trains - can increase the odds of successful escape.

Just dumping the drogue into the sea and hoping for the best may not be enough, however. *Positioning* the drogue properly might be quite important because for one thing the drogue is itself subject to orbital rotation. If it becomes abundantly clear that the yacht and the drogue are working against one another on the wave trains, one should try repositioning the two. Fortunately this is not too difficult. One lets out or

takes up the rode, a few feet at a time, to obtain a more uniform pull - reduce jerkiness, excessive slack and "bungee jumping."

In this connection there are a number of additional drogue options and combinations that sailors should clearly understand and apply to further improve the odds of a safe run downwind. ***Do not gloss over the following points. Read and study them carefully. Your life may depend on it.***

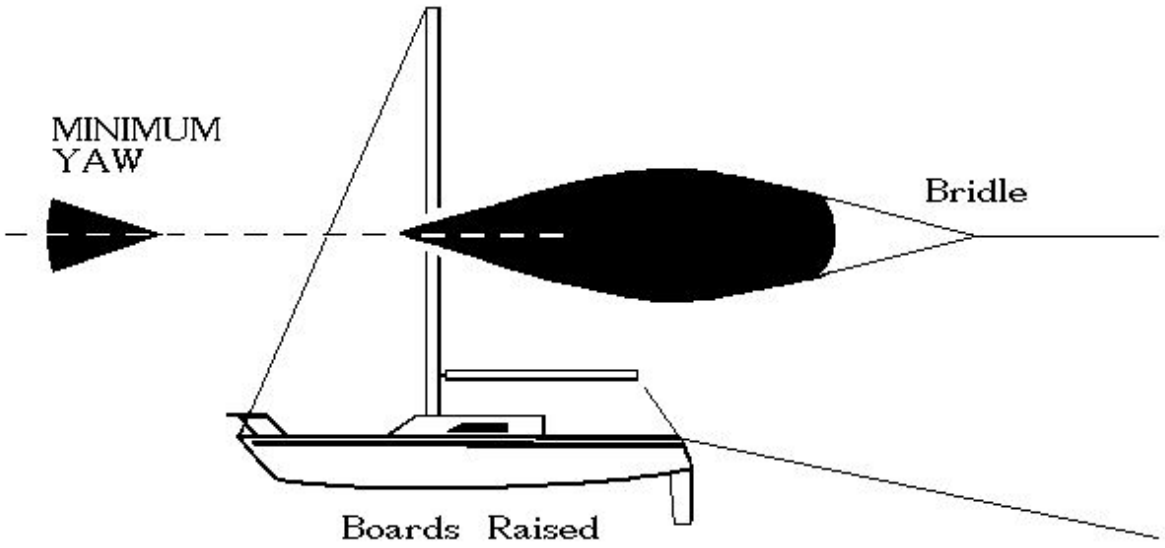
Speed Adjustment: If the boat is obviously moving too fast (beginning to broach now and then), try paying out more rode. If we can ignore the effects of orbital rotation for a moment, the general rule is as follows: **The longer the rode, the higher the pull. The shorter the rode, the lower the pull.** If the boat is obviously moving too slow try taking in some rode. If winching in a hundred feet of rode is out of the question (and usually it is), try hoisting a storm jib. And don't forget that the engine provides one more option as well.

Options are the stuff of survival! ***Always know your options.*** Visualize, number and prioritize them in your mind. At the same time don't be overzealous in applying every single one. "If it ain't broke don't try to fix it." No boat feels completely safe in heavy weather. If she seems to be doing all right and there are no obvious problems, leave well enough alone. Rogue waves and chafe notwithstanding, you stand a good chance of coming through in fair shape.

Try to conserve your own physical and mental resources. You may need them later on. Repeatedly going on deck to fuss with this and that may sap your strength, and if the boat does get thrown by a rogue wave you may not have the strength to make it through a search and rescue operation. You should always leave enough strength to deal with that eventuality. The boat is replaceable. You are not.

Minimum Steering: If you are running *squarely* downwind, if you are tired or shorthanded, if you want to try to get the drogue to "take over" and do most of the steering for you, then use a bridle off the corners of the transom (Fig. 22). Multihulls use a bridle off the extreme outboard ends of the amas. Adjust the bridle for the safest ride.

Raise all swing keels and board/s. If necessary, use the storm jib as a weather vane - hoist it on the forestay and sheet it in tightly amidships, so that it looks like the flat rudder of an airplane. In this case the jib does not fill and pull. It acts as a vane, to weathercock and align the boat. You may be able to leave the helm unattended by using this formula. *NOTE: This formula will not allow the boat to be freely*

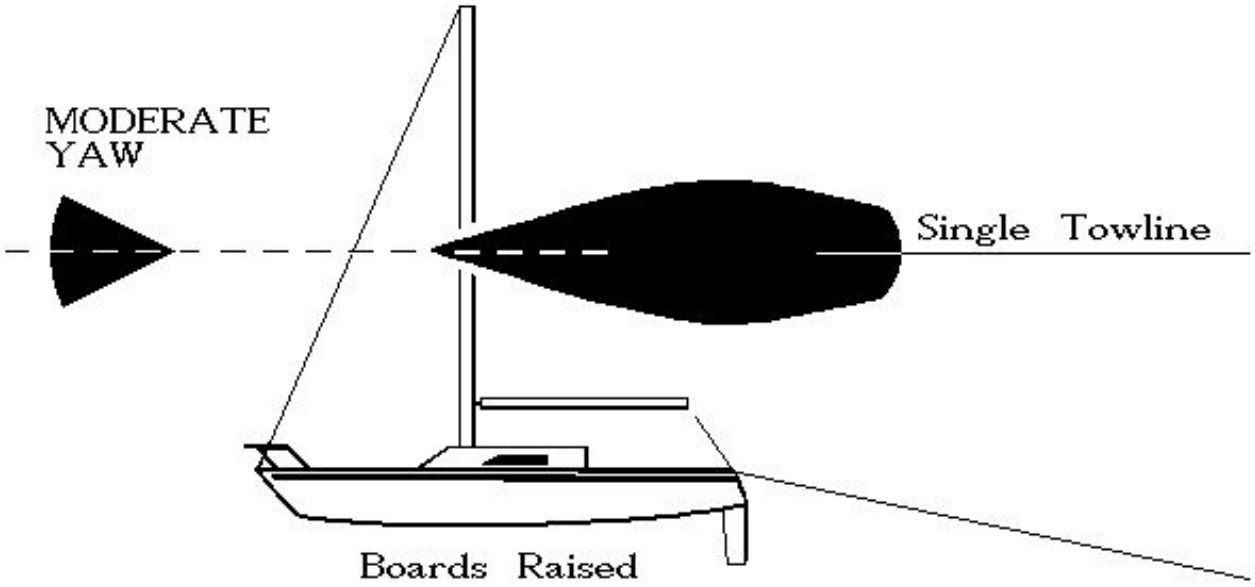


steered.

MINIMUM MANUAL STEERING - boards raised and bridle attached

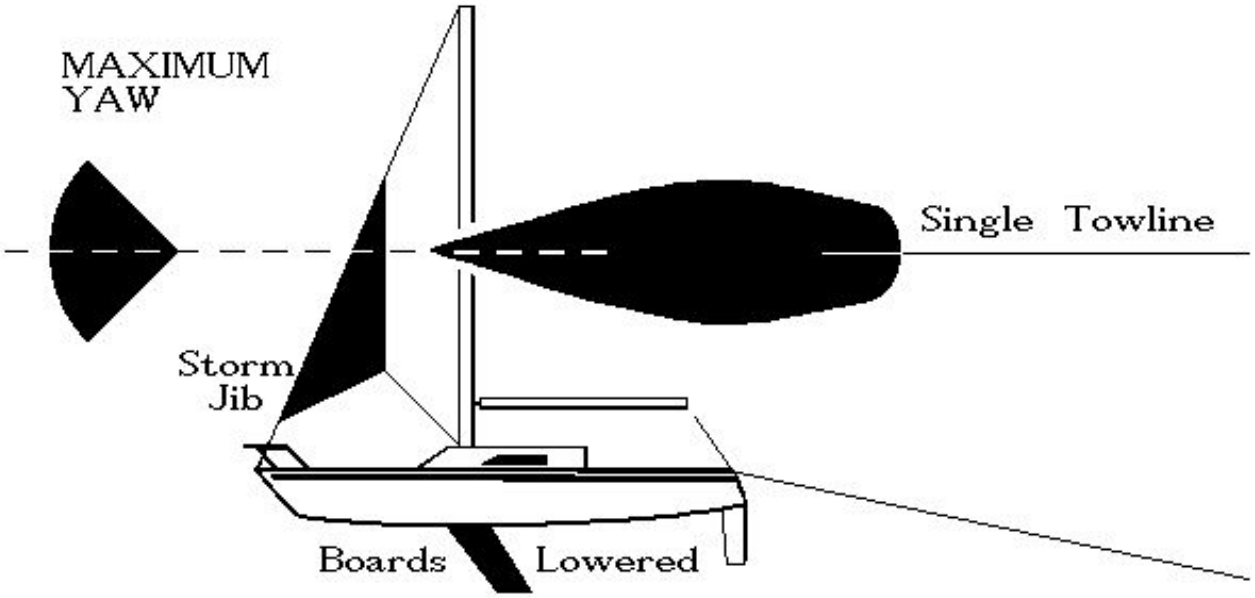
Moderate Steering: If you are not running squarely downwind, if you prefer to steer manually, if you prefer to quarter the seas the way that Dumas and Moitessier did, or if you must steer in order to dodge nasty waves, then do not use a bridle. **Bring a single tow line to a stern cleat instead**. Still too much interference from the drogue? Need even more helm override? **Bring the tow line to a cleat or winch well forward of the rudder.**

Have you ever tried to tow another boat? If so you know that it can reduce your own maneuverability, that is, unless you bring the tow line to a cleat or winch well-forward of the rudder. Have you ever noted the location of the big sampson post on an ocean tug? It is not on the transom, is it? No, it would be impossible for the tug to maneuver with a ship in tow if the bollard were on the transom. Rather it is situated in the middle of the after deck, well forward of the rudder. Moral: **The attachment point of the drogue has a great bearing on the maneuverability of the yacht.** Aft of the rudder = less steering control. Forward of the rudder = more steering control.



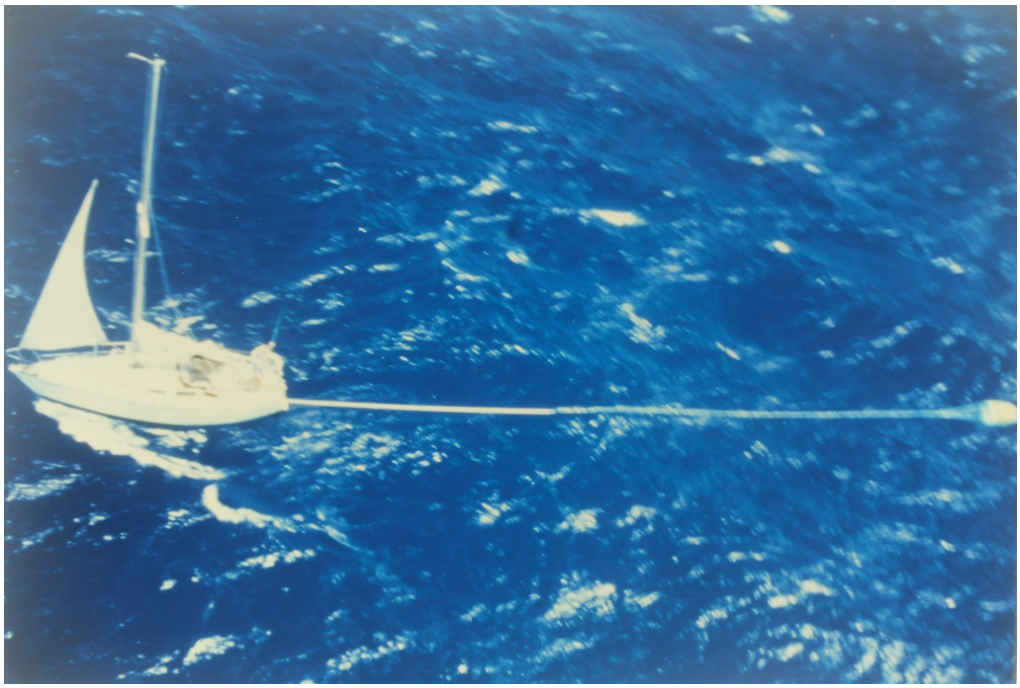
MODERATE STEERING ABILITY - boards raised, but no bridle used

Maximum Manual Steering: Need still more helm control? **Lower swing keels and board/s**.
CAUTION*: Lowering board/s and keels, or lowering them all the way, may give the yacht something to trip over. By and large, and as an important rule of seamanship, boards and keels should be raised while running so that the yacht can "slip-slide," and not have something to trip over.*

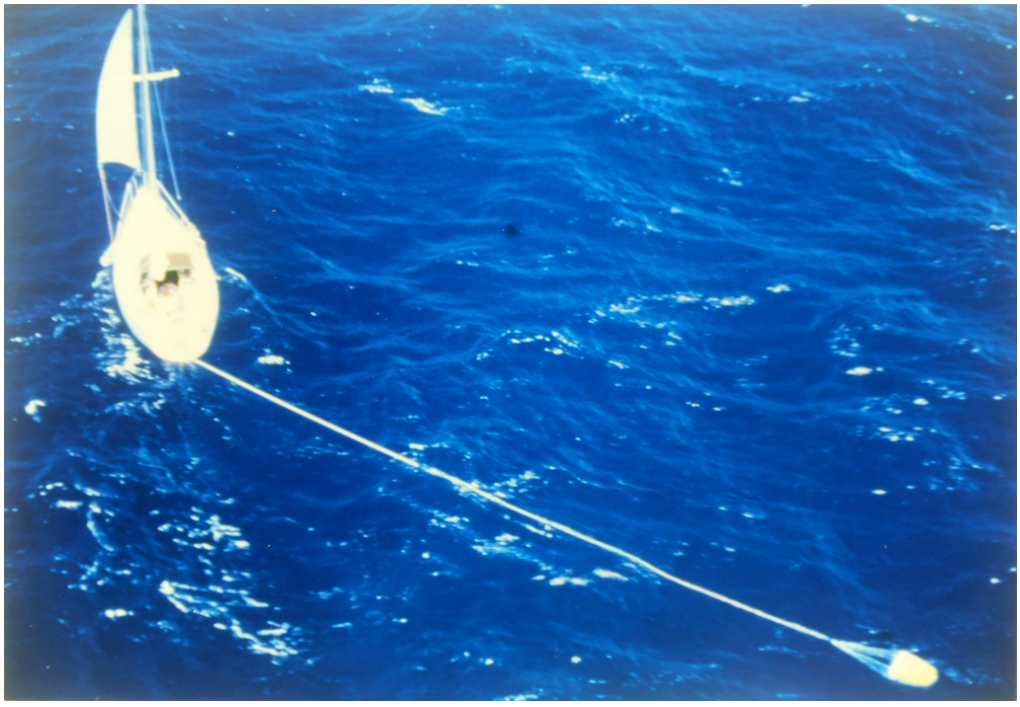


MAXIMUM MANUAL STEERING - boards partially lowered, single tow line attached forward of the rudder

Need even more steerability? Raise the storm jib, only this time let it fill and pull like a spinnaker - do not sheet it in amidships. You should then be able to steer the boat through an arc of 90°, usually enough to help you avoid navigational obstacles, and/or play dodgem with the nastier waves.



A helicopter view of a Ranger 29 towing a Galerider in Force 6 conditions. Victor Shane and Earl Hinz were on board. The drogue had an immediate stabilizing effect on yaw, pitch and roll rates.



In this photo you can see the extent to which the yacht could be steered with the drogue in tow (Don Whilldin photos)

Options are the stuff of survival. These are your options. There are ten of them. Here they are again

(memorize them):

- Adjust the rode

- Use a bridle

- Use a single tow line

- Attach tow line aft of rudder

- Attach tow line forward of rudder

- Use the storm jib as a vane

- Use the storm jib as spinnaker

- Raise swing keels or boards

- Lower swing keels or boards (CAUTION)

- Use the engine

If running is your only option, if there is plenty of searoom to run in, and if your boat is well-crewed, these are the combinations that you can tinker with in order to optimize your chances.

Bear in mind, also, that the above options can be used in various combinations to improve the performance of a makeshift drogue as well. If the line chafes through and you loose the Galerider, don't panic. Use an anchor, some parceled up chain, a spinnaker pole, a bit of sail, a submerged dinghy - or the kitchen sink - as makeshift drogues. Then tinker with the ten options listed above to get your money's worth and maximize your chances.

General Uses *(Speed-Limiting Drogues*)

Speed-limiting drogues have a number of other uses, any one of which can justify the money spent in buying one. Some of those uses are listed below.

Trade Wind Use: On a downwind leg in stiff trades, a speed-limiting drogue can turn an uncomfortable roller-coaster ride into a "Sunday afternoon sail."

We all rely on the 'engine' of the trade winds to power our sails when we embark on major ocean

passages. Unfortunately, the seas are quite large and lumpy in the trade wind belts. The wind itself blows around the clock, and is occasionally reinforced by a vicious squall or two. Suddenly it's gusting thirty-five at midnight, and the over-canvassed yacht is careening out of control.

Multihulls in particular have a way of "going ballistic" in such conditions. They do some madcap surfing, and have been known to spin out dangerously. While a spell of controlled surfing can be exhilarating, chaotic midnight surfs can be downright dangerous.

This is where the partial braking mechanism of a speed-limiting drogue can make all the difference. And the transition from chaos to control is nothing short of miraculous. No sooner the drogue takes hold than everything calms down. Suddenly one can relax, go down below and try to regain one's composure and sanity. Victor Shane speaks from firsthand experience on his tiny trimaran in which he sailed from Maui to California.

Bars And Narrow Entrances: A speed-limiting drogue can help maintain directional stability and control while negotiating dangerous bars and narrow harbor entrances. Some of the harbors lining Australia's Bass Straight are notorious in this respect, and it should come as no surprise to find that *Seabrake* was born there. Inventor John Abernethy, speaking from a lifetime of firsthand experience, recommends that the drogue be towed off the *windward quarter* to facilitate safe entry. The drogue will help keep that quarter from slewing around, making the job of the helmsman much easier.

Emergency Steering Device: Towed off the stern with an adjustable bridle tied to corner cleats, a speed-limiting drogue may be used as an emergency steering device in the event of normal steering failure. Get the drogue properly positioned in the wave trains and then shorten one bridle arm and lengthen the other until the boat is pointing in the direction you want to go.

Safe Tow: A great many vessels are damaged when they are taken in tow by a tug or a ship in heavy seas, usually because the ship and the yacht are diverging and converging on the wave trains. At any rate the tension in the tow line is seldom constant. It has a way of grabbing and letting go, sometimes producing a dangerous whiplash effect. If your vessel ends up needing a tow in mature seas, you can make that tow much safer by deploying a speed-limiting drogue behind your own boat. Properly positioned, the drogue will immediately smooth out the ride and eliminate "whiplash."

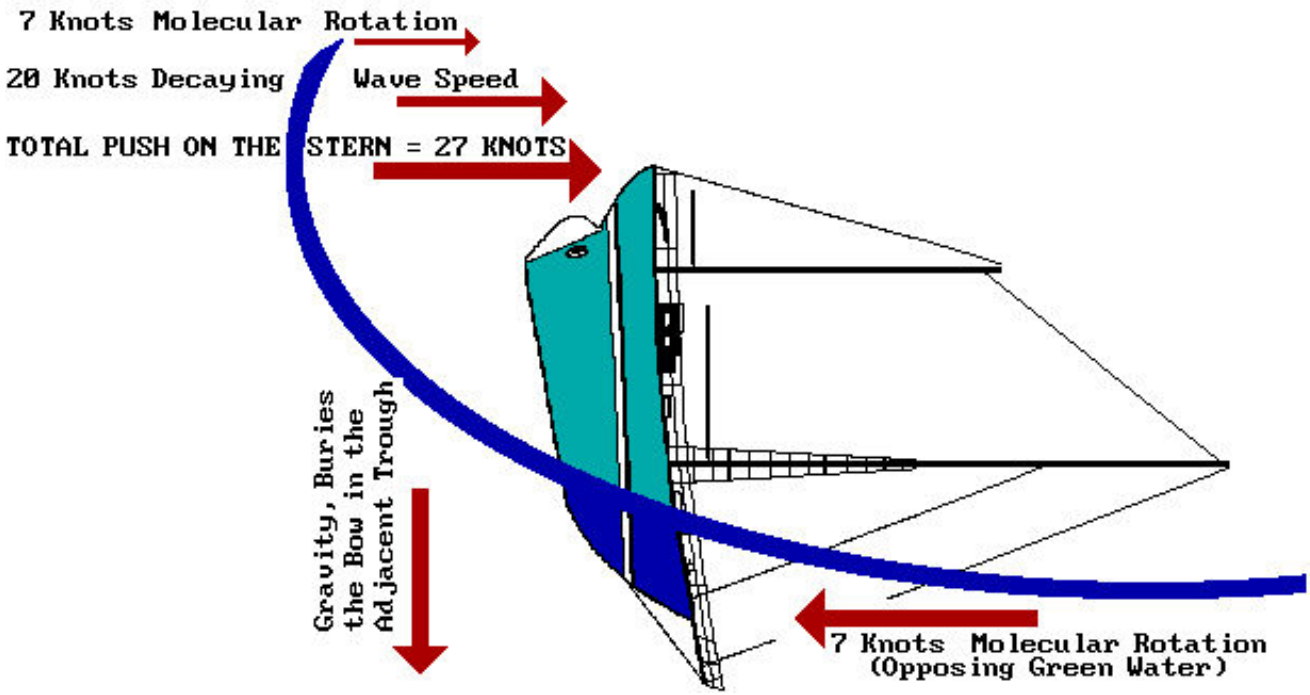
Autopilot Assist: Deployed off a quarter, and properly positioned on the wave trains, a speed-limiting drogue can significantly increase the efficiency of your autopilot when the wind is off the beam. It may enable a weaker autopilot to take over the job of steering your boat, allowing you to go down below and get some rest. This is especially true of mechanical windvanes on downwind legs, where the wind needed to activate the vane decreases in proportion to the speed of the boat. The faster the boat sails, the less the

apparent wind - and the more sluggish the windvane. Use the drogue to slow the boat down, and instantly the wind-vane's performance increases.

"Catch-22"

The criterion that sets a speed-limiting drogue apart from other drag devices is that its low pull allows a significant amount of directional control through the helm. It is an interactive - *steering-assist* - device, in some sense doing the job of a long steering oar trailing far behind the boat. You can - and may have to - steer the boat while towing the drogue.

All of which brings us to a certain "catch-22": *The same low drag that allows for steering control may allow the boat to broach, capsize and even pitchpole in a once-in-a-lifetime storm.* The forces that pitchpole yachts are so explosive that they may just yank the drogue through the water as they are throwing the yacht end over end.



Formula for Disaster

The mathematics of this "catch-22" were dealt with by Donald Jordan in the research that he undertook for the US Coast Guard, culminating in the development of the *series drogue*. In a letter to Victor Shane, Jordan explained it in this way (reproduced by permission):

> *I would like to emphasize that the drogue must have a certain minimum drag - equivalent to a 3 to*

5 ft. diameter chute. The conventional 21-inch cone or trailing warps, etc., are ineffective. With the proper size drogue the boat lies essentially dead in the water.... However, in the event of a large breaking wave strike, the drogue is pulled through the water for several seconds.... The motion of the drogue reduces the peak loads - although the load can still be very high, of the order of the displacement of the boat.

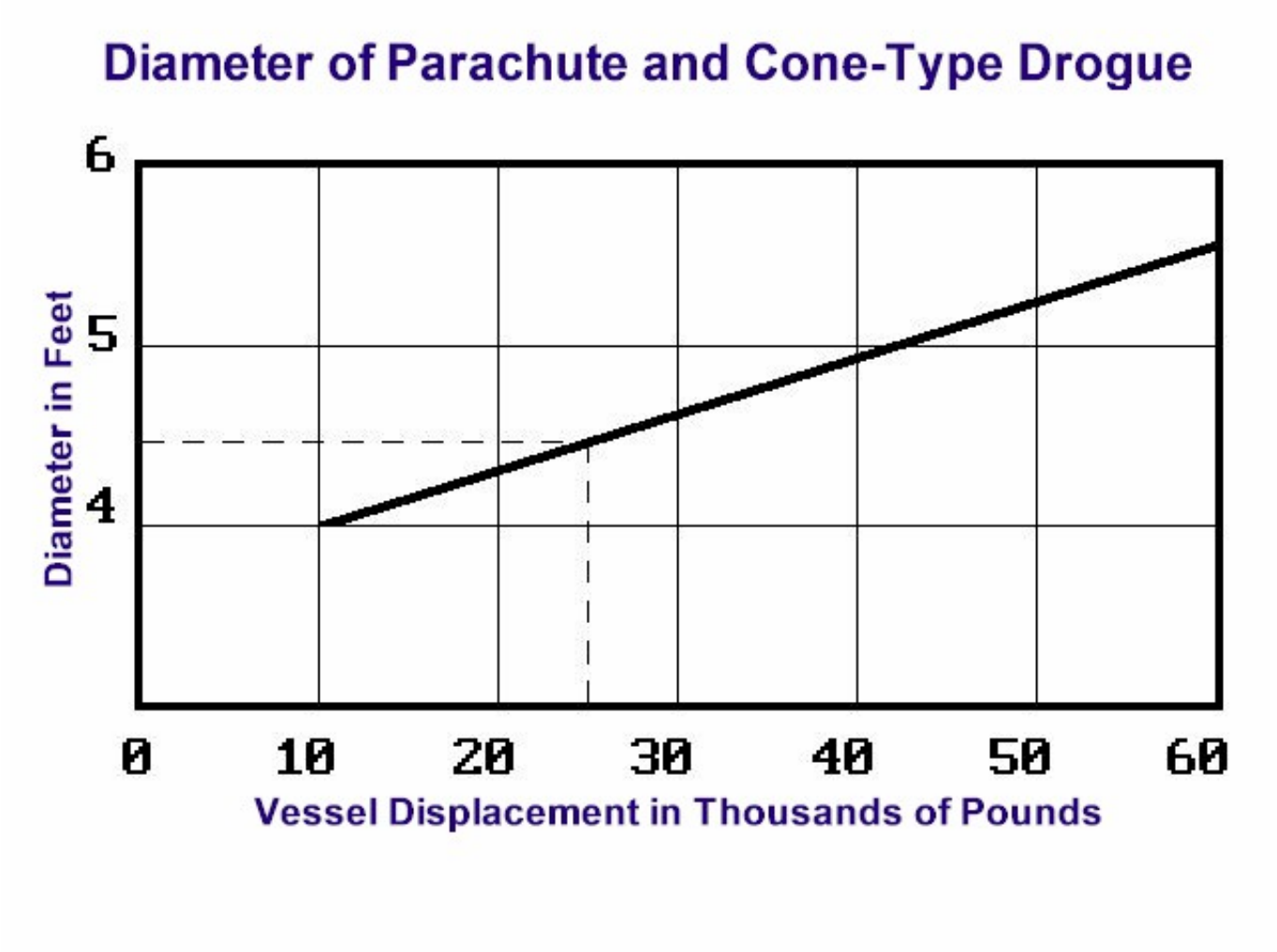
Medium-Pull Drogue

The table below is taken from the Coast Guard Report (CG-D-20-87) co-authored by Donald Jordan. It shows the single-element drogue needed to produce the effect he describes above. A 25,000 lb. boat, for example, will require a cone or parachute with a diameter of about 4.5 feet.

With this, the boat will lie essentially dead in the water - no steering involved or possible, the crew inside and "strapped in by aircraft type seat belts." When the boat is struck by a breaking wave the drogue will get pulled through the sea for several seconds, (a) reducing peak loads, (b) keeping the vessel aligned and (c) gradually pulling it free of the wave.

Here is the ten second play-by-play: The yacht is stationary... she gets struck by a breaking wave... she accelerates to wave speed briefly... she is held in alignment by the building resistance of the drogue... the resistance reaches a peak... the yacht decelerates, working herself free from the mass of moving water... now she is stationary once again, ready to negotiate the next breaking wave.

Recommended Size



MEDIUM PULL DROGUE: Recommended Size

Jordan's Coast Guard research and the research conducted by Barry Deakin at the University of Southampton have both shown that the use of a single-element - medium-pull - drogue leaves a great deal to be desired in breaking seas.

For one thing there is again a good chance that the smallish cone or parachute will foul itself, or get turned inside out.

Another basic disadvantage has to do with the potential delay between wave strike and drogue reaction. When the boat is lying to a single-element drogue at the end of a long line, she may get "derailed" in the few seconds that it takes for the drogue to react.

If the cone or parachute is not positioned properly, orbital rotation may induce enough slack to open a window of vulnerability, perhaps allowing the load to be "dropped" on its side. And since the boat is swinging on the end of a long pendulum, the jeopardy increases if rogue waves - from a secondary storm

system - are intersecting the existing wave trains at an angle. If, by some stroke of luck, the resulting breaker/s strike the boat squarely on the transom, the yacht may do a bungee jump and somehow survive. But if the avalanche strikes her at an angle, she may get smashed down on her side before the pendulum can finish its swing.

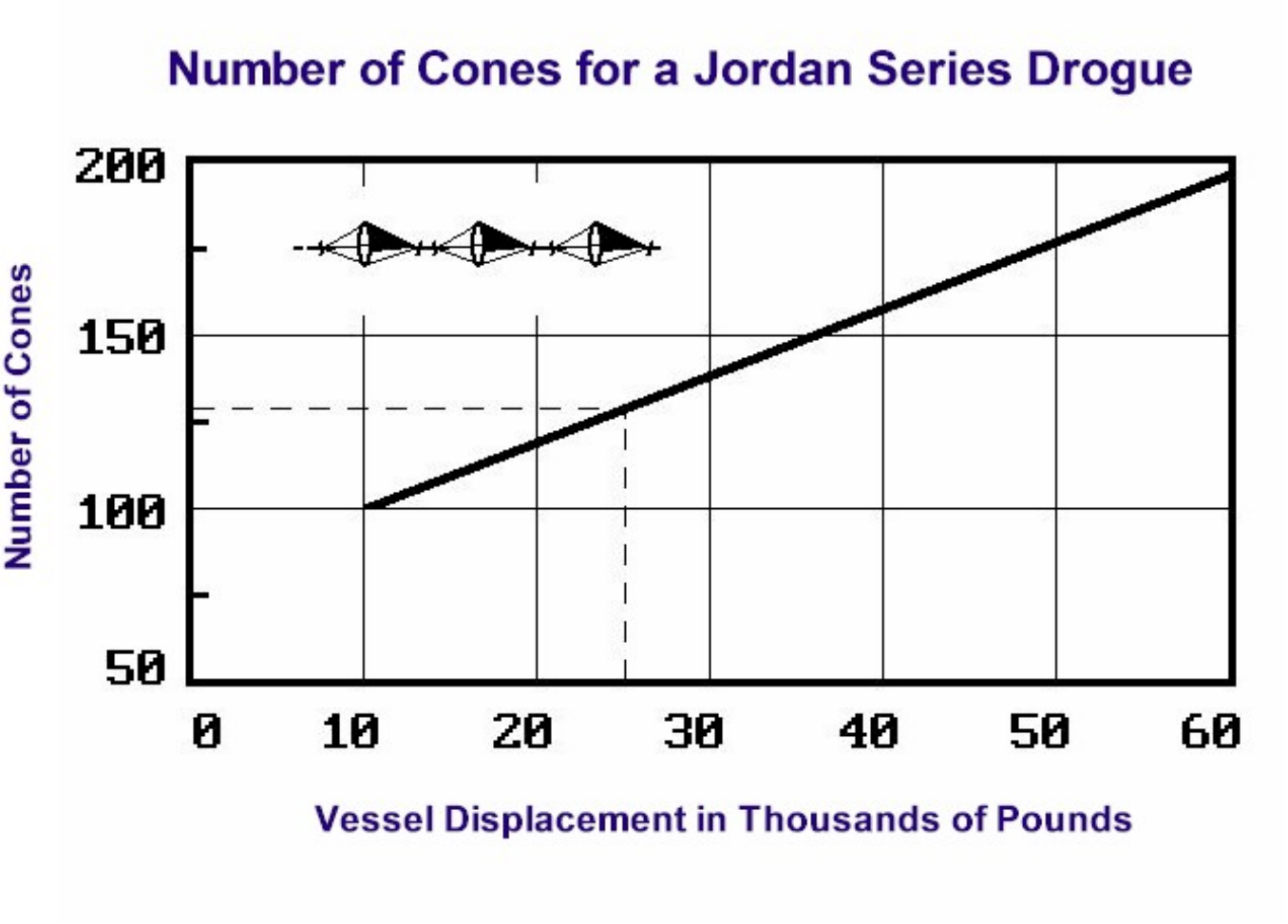
Jordan Series Drogue

To do away with these disadvantages and still retain the benefits of the medium-pull concept, Donald Jordan conceived an articulated drogue, better known as the *series drogue.*

Depending on the displacement of the boat, 90 or more 5-inch diameter cones are spliced into a 300-ft. tow line at 20-inch intervals, their combined drag being the equivalent of a single 3-5 ft. diameter cone or parachute.

Jordan Series Drogue

The figure below, also courtesy of the US Coast Guard, shows the number of 5-inch cones required to produce the effect Jordan described in his letter to Shane. Note that a 25,000 lb. boat will need about 130 cones.



SERIES DROGUE: Recommended number of cones

A 35 lb. weight (usually an anchor or chain) is attached to the end of the array, causing the system to hang down at an angle.

The whole of the array should ordinarily remain well submerged and for the most part unaffected by orbital rotation. Upon moderate wave impact some of the cones may surface. In a severe wave strike many - or all - of the cones may surface.

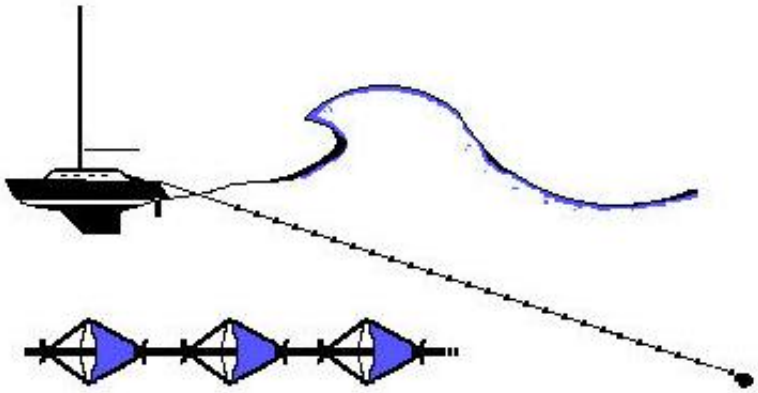
One can imagine what it might feel like to be in a storm with the series drogue deployed off the stern and a wave breaks: one feels a brief acceleration... one feels a pronounced deceleration. The sensation should be very much like that of a theme park bungee jump. This particular bungee jump should be a relatively safe one. Jordan engineered it that way.

Unlike the concept of a long tow line with a single-element drogue at the end, which in effect puts all the eggs in one basket, the series drogue spreads the drag over 90-150 cones and about 300 feet of tow line, usually enough to span two wave lengths.

In theory the heavy weight at the end of the array should always be sinking, pulling the drogue away from the boat, reducing the possibility of excessive slack - and a large window of vulnerability; and the existence of cones *near* the boat means that the pendulum doesn't have to swing so far to render assistance.

If a rogue wave is approaching from an angle, there will be cones near the boat where tow line stretch is low. Those cones will build up load much faster than a single-element drogue at the end of a long pendulum. Jordan's own research - a computer study - indicates that two seconds after wave strike the series drogue will develop 40% more load than an equivalent single element drogue.

As promising as it appears to be, the series drogue has an obvious disadvantage in that it exposes the relatively vulnerable stern of the boat to the mega-force of breaking seas. In some respects it tries to make capital of the vice of a boat and, in a scientifically calculated, ingenious way, turn that vice into a virtue. No small accomplishment. There is caution due, nevertheless. The truth is that many production boats just cannot handle mammoth breaking seas on their sterns.



SERIES DROGUE
90-150 Five-inch cones, spliced at 20" intervals into 300 feet of double braid nylon tow line (see inset) with 35 lb. weight at the end of the array to keep the cones submerged.

Jordan himself was quick to point out that the wide open, exposed and vulnerable stern areas on such boats must be reinforced and waterproofed to accommodate the series drogue.

A somber reminder: In chapter sixteen of Coles's *Heavy Weather Sailing* (third edition) we read how that

the yacht *Marie Galante II* was running under bare poles "with two warps streamed aft, but at about 1800 hrs.... she was struck by three heavy breaking seas. The first smashed the transom and stove in the cabin doors and flooded her."

Note that *Marie Galante II* was running, and not standing still. Even so, the first breaking wave smashed in her transom, broke through the companionway and flooded her interior.

Understandably, many sailors are reluctant to expose the vulnerable sterns of their yachts to the mega-force of breaking waves. Indeed many an existing production sailboat is in a compromising position when her stern is exposed to a storm. And it is sobering to note that *Marie Galante II* did not survive the deathblows to her stern. The second wave capsized the yacht and broke her mast. The third caused her to fill and quickly sink, with loss of one life.

Ask yourself some questions. How would your boat fare if she were positioned stern to a twenty foot fall in the rapids of the Colorado, with her transom bridled to shore rocks with thick bungee cords? Would she be able to withstand the tons of water falling onto her stern for twenty-four hours? Would the attachment cleats be able to handle the loads, or would they need major reinforcement? Would the hatch boards withstand the battering ram of tons of moving water, or would they need major reinforcement as well? Have you visualized the cockpit looking like a perpetual swimming pool? Have you ever plugged the drain holes and deliberately filled it to the brim to see what it might look like?

Breaking waves are rare. One may spend a lifetime crossing oceans in a wise and deliberate manner, and never run into one. But if one does, the series drogue will keep one's sailboat optimally aligned. Purely in terms of vessel alignment, the Jordan series drogue excels other drag devices. Is it panacea? Hardly. There is no such thing at sea. Only human ingenuity, coupled with the discipline of seamanship.

In, of and by itself, alignment is not necessarily the be-all and end-all of sea-state tolerance. Ultimately our goal is to improve the survivability of the vessel and the crew, not to see who can come up with a better way of keeping a yacht aligned.

We have already inferred that people can somehow survive inside modern sailboats, as long as the hull/s can be kept afloat; and we have examples galore, in Fastnet '79, the Queen's Birthday Storm and in later storm reports, of boats that were prematurely abandoned only to be found floating afterwards.

So then, if a drogue in some way increases the risk of sinking, that risk has to be weighed in a proper balance. And it goes without saying that the orientation of the boat prior to sinking will be immaterial to the crew that ends up in a life raft. Whether the dear old girl sank because she was rolled while lying a-hull, or whether she sank because a wave broke through the companionway while she was being held in perfect alignment by a series drogue is besides the point.

Things You Will Need ***(Speed-Limiting Low Pull Drogue)***

Drogue: See Appendix III at the back of this publication for a list of manufacturers. Refer to manufacturer's recommendations for sizing. Drogue sizing is not a precise art.

A grossly undersized speed-limiting drogue has a peculiar advantage in that it can be routinely deployed in the course of ordinary passages. After all, if it enhances off-the-wind helm control at the expense of a knot or two of speed, there's nothing wrong with that is there?

On the other hand, a grossly oversized drogue has a reciprocal advantage in that it can come closer to producing the medium-pull effect described by Donald Jordan.

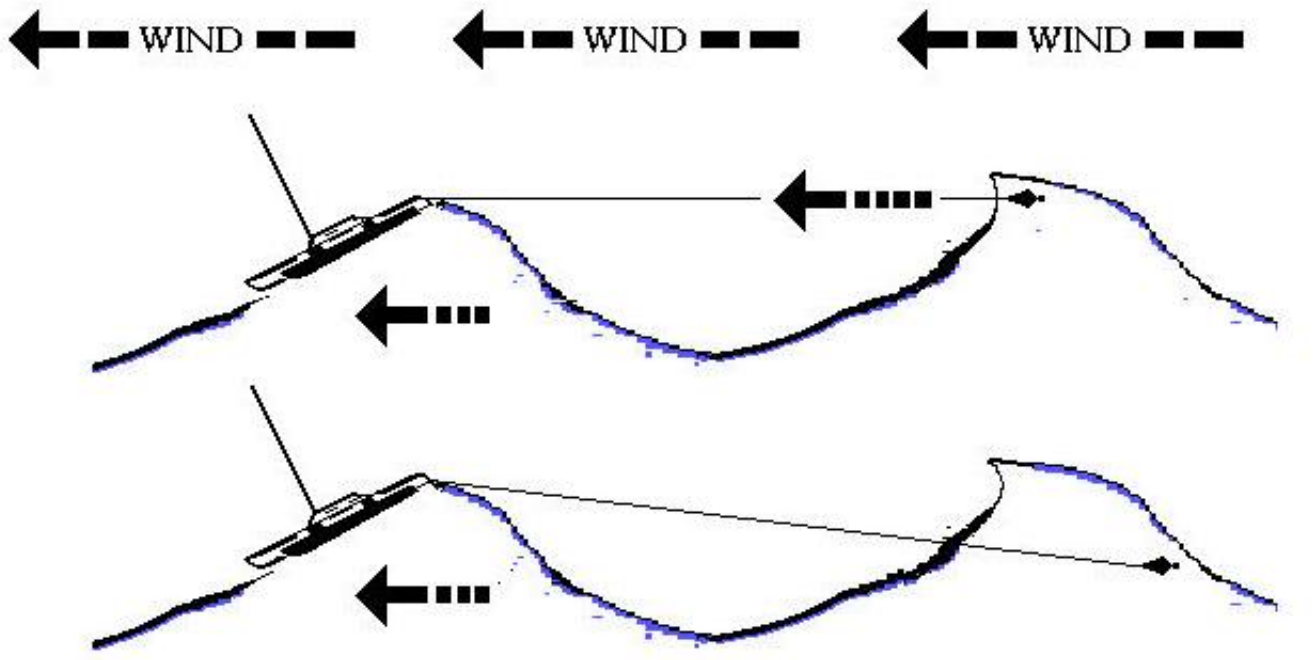
Notwithstanding, the "standard" for sizing, if it can be called that, says that a yacht should average 3-6 knots with a speed-limiting drogue in tow. This seems to be the general consensus among the more experienced drogue users interviewed by Shane.

Rode: For speed-limiting drogues it makes a little more sense to use a low-stretch tow line (less chance of bungee jumping if the load happens to get dropped). All the same, most of the sailors who submitted drogue files to this publication used nylon tow lines. Refer to manufacturer's specific recommendations.

Chain: Most speed-limiting drogues ride near the surface of the sea where they are prone to surface action. In fact they may loose much of their "bite" if they surface in certain conditions. The use of a short length of chain will help minimize this. Fifteen or twenty feet of chain, attached to the drogue itself, will help to keep it better submerged. It will also help keep it from being pulled out into thin air on steep wave faces. Refer to manufacturer's recommendations.

Rode Length: Positioning the drogue is quite important because of the possible effects of orbital divergence and convergence. In some cases, convergence may allow the vessel to turn sideways in the troughs. A little rode adjustment will usually smooth things out. Ordinarily one lets the rode out, a few feet at a time. One does this only if the yacht and the drogue are very obviously "out of synch" on the wave trains. Otherwise one leaves well enough alone.

Proper positioning is important for another reason: again, if the drogue is being used in steep, wall-like seas it may get pulled out into thin air. Peter Blake ran into this problem on *Steinlager II* - see File D/T-1.



POSITIONING THE DROGUE
If the drogue is on one steep wave face when the yacht is surfing down another, it may get pulled out into thin air. It can be positioned on the "meatier" part of the wave to prevent it from doing so.

One should try to position the drogue in the "meaty" part of the wave so that it can't be pulled out of one wave face when the boat is surfing down another. The general consensus among the more experienced drogue users interviewed by Shane goes something like this: **Try to position the drogue so that it is on the back of the second wave when the boat is on a crest.**

Chafe protection: Same as sea anchors - refer back to the sea anchor section. All things considered, chafe is the remaining monkey wrench in the whole works. Never take anything for granted about chafe. Let there be no doubt in your mind that after you have done all the difficult work of deploying, adjusting and properly positioning that expensive drogue, you stand in constant jeopardy of losing the whole rig to Murphy and the little green chafe demon in his hire. For your information this little devil gets paid overtime in storms, in addition to which he gets an extra bonus every time he succeeds in getting a line to chafe completely through.

Things You Will Need ***(Series Drogue)***

Drogue: At the time of this writing there are a few companies around the world that will either make up a complete series drogue for you, or provide you with an easy to assemble kit (see Appendix III). Pay meticulous attention to Donald Jordan's guidelines as to how many cones you will need, and how the

whole system should be rigged. For starters, you should find out how much your boat will weigh when she is fully loaded, in order determine how many five-inch cones you will need (refer back to diagram).

The cones themselves are easy to make. A few resourceful sailors have bribed their wives to put the household sewing machine to work. Jordan's Coast Guard fatigue tests have shown that the individual cones need not be heavily constructed. Since the load is divided over so many cones, the bulk of the array should continue to function even if a few individual cones fail. The series drogue is easy to make albeit time consuming. It can be made out of spinnaker cloth and a few rolls of 3/4" nylon tape, using a household sewing machine and a pair of scissors.

Many years ago Victor Shane obtained a single five-inch cone from Donald Jordan, made up some prototypes, and later a number of complete series drogues. In early trials he soon found that he could not load a single five-inch cone for anything more than 250 lbs. no matter how hard he tried.

Victor Shane testing the drag produced by a single Jordan cone

In one sea trial a single cone was spliced to a weighted line, lowered off the transom of a stationary test boat and allowed to hang fifty feet straight down in calm water. The 360 hp Mercruiser was then punched full bore and the performance of the cone measured on a calibrated Dillon Dynamometer as the boat sped up to 30 knots. In the course of two dozen controlled runs the load always peaked just before the cone could surface, and it was never anything more than 225 lbs.

Full power with a Mercruiser 360hp and a dynamometer to test the Jordan cone - a maximum pull of 225lb was achieved before the cone pulled out of the water

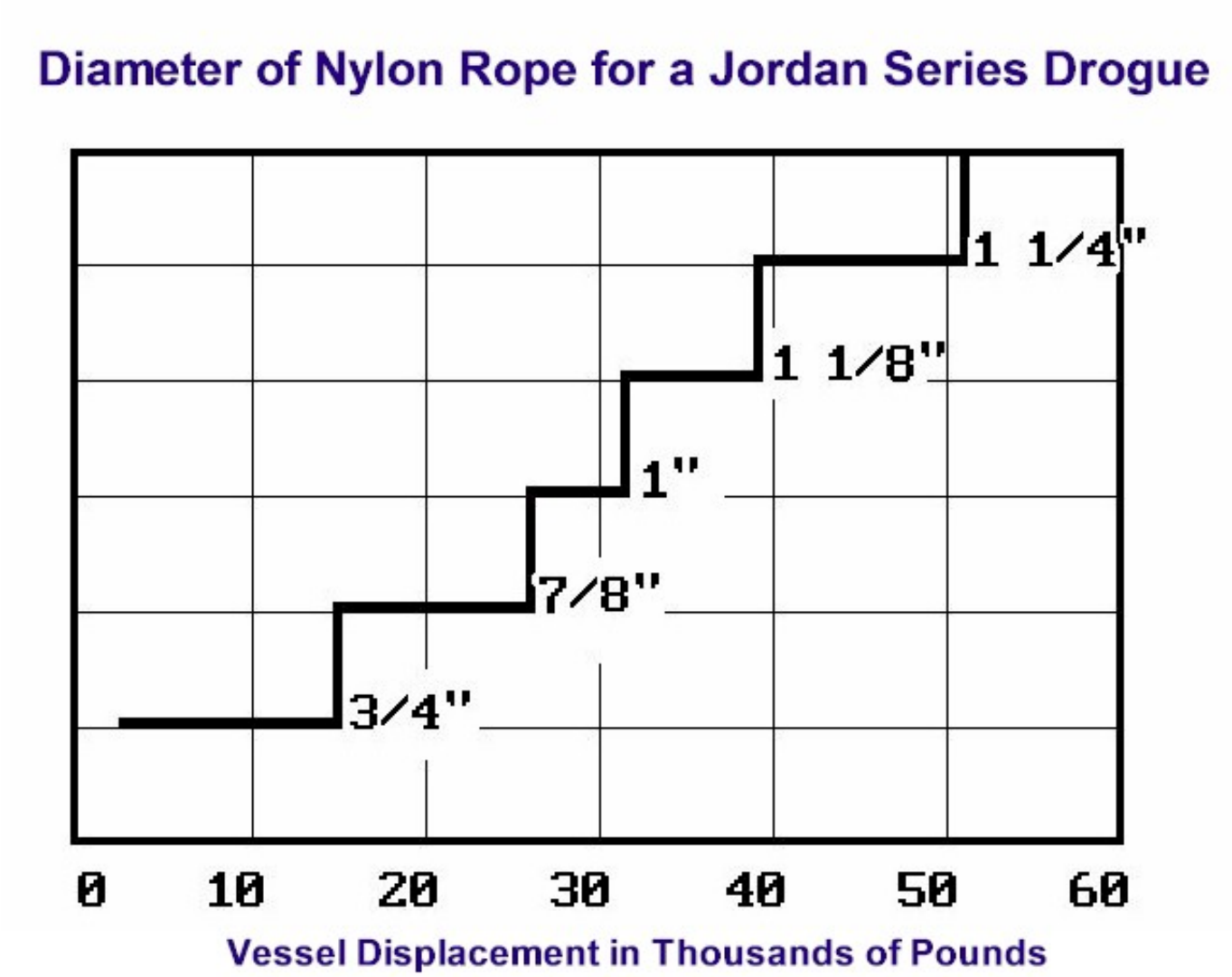
It is important to understand that the series drogue must be well-submerged to do the job it was intended to do, whence the need for the heavy weight at the end of the array. These tiny cones all but lose their purchase once they surface.

By way of a digression, Shane once approached Donald Jordan with the idea of a multi-purpose series drogue. The clever idea went something like this: "What about letting out just a few cones to get the effect of a speed-limiting drogue, and then letting out additional ones as the storm builds?"

Jordan's answer was an unequivocal "NO!" It seems he has designed the series drogue for one thing only: capsize prevention in breaking seas. He did not design it for partial use as a speed-limiting drogue. Besides, the tiny cones all but lose their bite once they have surfaced.

There is a great deal of redundancy built into the series drogue. If a single cone can easily pull 200 lbs. then a hundred cones should easily pull 20,000 lbs. So the individual cones need not be fabricated from ballistic nylon. Even spinnaker cloth rip stop will do (one sailor made up a series drogue from an old spinnaker). The pattern of the cone is easy to cut with scissors. And even easier if you have a $15 *Eastman Wheel Cutter* (model ST-810) and a $20 cutting pad (both available from most sewing outlets).

If the cloth has a good coating on it the edges of the cone need not be hemmed, which cuts the sewing job down in half. In Shane's experience, hemming the curved edges of the cones was the hardest part of the sewing - a nightmare, given the tight radius. Coated cloth is therefore highly recommended. *Otherwise the newly cut edges should be basted with some sort of fabric glue to keep them from fraying.*



RECOMMENDED TOW LINE (SERIES DROGUE): Diameter of Nylon Double Braid.

Note that non-stretchable floating Dyneema can also be used for the tow-line. It's main advantage is that the overall weight of the drogue becomes much lighter and so is much easier to man-handle on board.

Series Drogue Assembly: Ordinarily one would buy the cones already manufactured - in kit form - and splice them into one's own tow line. Splicing a hundred or more cones - six attachments per cone - is easy but time consuming. This is why the labor cost of a ready-made series drogue can double the cost. Assembling an entire series drogue is not the sort of thing that can be done in a few hours. One should allow several relaxed weekends. A large, clean work bench, a little music and a bottle or two of refreshments will make the job more pleasant. Make yourself comfortable and start attaching the cones to the tow line size recommended by Donald Jordan as per the diagram above.

A specialty splicing tool conceived by Donald Jordan is usually included in the kit. There are six easy splices on each cone. Using the splicing tool, one physically inserts each tape through the outer braid of the rope and ties a knot at the end. These knots have not been known to pull out of the rope under load

(remember the rope will be bar tight when a wave breaks).

IMPORTANT*: The attached cones should hang loose on the tow rope.* When attaching the cones fore and aft, a loose fit is paramount. The aft attachments are relatively unimportant (the only thing they do is to keep the cone from getting turned inside out by its own wake). If the fore and aft attachments are too far apart the cone will get stretched, as though on a rack, and the mouth may not be able fully to open under load.

Always attach the front three tapes first, and when attaching the rear ones *leave enough slack so the mouth can fully open.* The result should have a limp look about it, the fore and aft tapes hanging rather loose - not pulling on each other.

USEFUL TIP: After attaching the very first cone, stuff it with crumpled up newspaper so that it looks as though it is wide open and under full load. Stretch the tow rope, and then check the rear tape tensions on the cone. They should still be loose. Bear something else in mind: the nylon tow rope will itself be stretching under load as well. Three hundred of the splices of the first series drogue made up by Shane had to be disassembled and redone because the cones had been fastened onto the tow rope too tightly!

Drogue Deployment

Never take anything for granted when it comes to deploying any sort of drag device, even a low-pull speed-limiting drogue. All lines must be properly organized, flaked out, coiled etc. *Keep arms and ankles out of the coils as the line goes out.* This is easier said than done, especially at night, and especially in the case of a madly surfing multihull. Multihulls running at higher speeds should brace for a jerk when the drogue takes hold. In the case of a Westsail 32 running at seven knots there should be no jerk when the drogue takes hold. In the case of a 60-ft. Newick trimaran screaming along at fifteen knots there may very well be one. Here is the same good advice you've heard before: *Don't leave it too late.*

Series drogue deployment is not difficult, but may take a while. Most of the users interviewed by Shane said they let the series drogue out a little at a time - meaning they didn't just dump the entire three hundred foot array into the sea.

Taken in the waters off Punta Arenas, Chile. Mark Eichenberger test-deploying the Jordan series drogue supplied by Victor Shane of Ned Gillete's Antarctic row - see File S/R-1 *(Ned Gillete photo)*

To be fully effective, the series drogue must be attached to the stern via a bridle (same diameter rope). Make certain that this bridle will clear all stern objects - pulpits, davits, windvanes, solar panels, etc. *Remove all removable stern objects, or the sea will remove them for you.*

Drogue Retrieval

Unless the wind and seas have completely died down, retrieving any sort of a drogue while underway can quickly sap the strength of the stoutest sailor. After half a day of deploying and retrieving drag devices in windy conditions off Diamond Head, Hawaii, Shane's arms began cramping to the point of uselessness. This was in spite of the fact that a cockpit winch was being used, and in spite of the fact that he was being partially assisted by two other able sailors, one of them Earl Hinz himself.

Winching a drogue in off the stern, with the boat underway, is like working against the pull of a tractor. This method of retrieval may be unavoidable at times. Usually, however, it is a lot easier to "switch cleats" and bring the drogue in off the bow. Switching cleats is recommended if conditions allow it.

One merely leads the bitter end of the tow rope around and outside all stays, stanchions, etc. and attaches it to the bow-cleat. One then comes back to the cockpit and takes the drogue line off the stern cleat. The boat should then round up ninety degrees, stop, and lie broadsides.

With the drogue now leading off the bow, it can be pulled in with relative ease (no more fighting the tractor), although one should allow plenty of time for this as well. Don't force anything. Don't strain your wrist as one sailor did. Give the rode half a turn around a cleat and wait for slack. Pull in a few feet and repeat until the drogue is in hand.

The Database: Purpose & Guiding Principles

If instead of sending the observations of able seamen to able mathematicians on land, the land would send able mathematicians to sea, it would signify much more to the improvement... of the safety of men's lives on that element.

Sir Isaac Newton

Pushing Back The Envelope

It was once thought that man could only sail so far before he fell off the edge - "beyond this point there be demons only." Magellan sailed beyond the edge and didn't fall off. It was once thought that man could only fly so fast before he fell off the edge. Chuck Yeager flew faster than the speed of sound and didn't fall off.

These two men succeeded in "pushing back the envelope" - going the limit, and then a little farther. How? Through risk taking, enterprise and courage? Well yes, but there was more to it than that. There was *method* in the way these two men went about their business. Magellan was well versed in the disciplines of seamanship and knew ships inside out. Yeager was well versed in the principles of flight and knew airplanes inside out.

The forces that generate weather anomalies at sea originate within the thermonuclear mass of the sun. While there is little hope of being able to survive such things as extreme hurricanes and typhoons without some land-born assistance, there is nevertheless a great hope and possibility of being able to push back the envelope of survivability in a Force 10 gale.

We want to enlarge the envelope so that cruising yachts don't "fall off the edge" when the wind rises to Force 10. If we are to succeed we too must avail ourselves of some sort of *methodology*. Individual courage, individual enterprise and individual seamanship may push back the envelope for one yacht, but unless the lessons learned on that yacht are documented and published they may go to waste. It takes a mutual fund of information to prevent this sort of waste. A database.

We want to push back the envelope for cruising sailboats. This is easier said than done. It varies from boat to boat. It varies from hull shape to hull shape, from keel-type to keel-type, from monohull to multihull. Certain vessels are inherently seaworthy. Others are handicapped the day they roll off the assembly line.

In general, vessels sixty feet and over have more generous envelopes by virtue of their size alone. These bigger boats can push back their limits a little further by means of drag devices. But where sea anchors and drogues can really make a difference seems to be in the 28-48 ft. size range - the class that makes up 90% of the cruising fleet around the world.

While no drag device can make any of these smaller boats fully invincible, the right one deployed at the right time can definitely push back the envelope. For some it may push it back a little. For others a lot. For the majority, however, our goal is to establish a beachhead at the Force 10 mark. No matter, even if a

drag device can push the envelope back by a single inch it may make the difference between living to tell the tale or disappearing without a trace.

This fleet of cruising yachts is in need of methodology - a formal database that will contain accurate information about the use of drag devices in heavy weather. An ever-growing resource such as this stands a good chance of pushing back the envelope for the class that took the greatest hit in Fastnet 79, the Queen's Birthday Storm and indeed in every storm in the history of offshore sailing.

We would all like to learn how to push back the envelope on our own cruising boats. But there is a learning curve standing in our way. While there is no substitute for blue water miles and hands-on heavy weather experience, there is much to be said for the process of vicarious learning as well. We can each go out, chase down storms, and try to learn lessons solely on our own. Or we can learn a lesson or two from those who have already been in storms. We can go it alone like Slocum, Voss and Dumas, learning - or perishing - by our own mistakes.

Or, we can learn from the experiences of others.This is the objective of the *Drag Device Data Base*. The sailors featured in this publication provide the enterprise, the daring, the courage and the "combat experience." The authors provide a method of organizing the information.

In the Footsteps of K. Adlard Coles

Adlard Coles and his era may have passed away, but his legendary masterpiece *Heavy Weather Sailing* will always be a best seller. What is so remarkable about *Heavy Weather Sailing* is that in it Coles laid down a foundation for the *methodical* comparisons of different tactics used by small craft. It was Coles himself who got us off on the right foot. He was an enterprising seaman with many gales under his belt. He knew sailboats inside out. But the ingredient that set his work apart was the methodical way in which he compiled, documented, and analyzed case histories.

Coles avoided dogmatism. He stayed away from second hand accounts, unsubstantiated claims and idle speculation, relying on real life observations, evidence and data instead. He let the facts speak for themselves, searched for compelling logic and was quick to nail it down when he found some. And yet he was in most respects slow to speak from a posture of certainty. He kept his mind open, avoided overcompensation and was willing to learn new lessons. He understood the subject of heavy weather tactics to be complex and did not wish to draw false inferences or jump to conclusions. He purposely left many questions, in particular the one relating to the uses of sea anchor and drogues, open to future resolution.

Statistical Reliability

Someone once said, "testimonials are bad science," implying that they are steeped in emotion and lack the element of dispassionate comparison which is the essence of the scientific process. While it is true that there will always be some degree of subjectivity and exaggeration mixed in with the story of a little boat

that has been through a frightening storm at sea, testimony is valuable all the same because it can broaden the base of information. Much of science derives itself from statistics. Indeed quantum mechanics itself uses statistical abstractions to measure probability.

A heavy weather testimonial may be laced with emotion and exaggeration, but it may broaden the base of information nevertheless.

An illustration: A sailor uses a parachute sea anchor in a gale. He is the first sailor in history to have done so. He comes back extolling the virtues of sea anchors. He says it saved his boat and his life. He says "it is the only way to go." What does this testimonial tell us? Maybe not much. Perhaps his boat was a fifty foot steel schooner with significant windage aft and a perfectly symmetrical hull shape. Perhaps he just got lucky or he paid out sixty feet of rode and the waves just happened to be sixty feet from crest to crest.

A second sailor goes out and uses a sea anchor in a gale. He comes back with a negative report. He says, "sea anchors don't work." This testimonial may not tell us much either. Perhaps the sea anchor was too small; his boat was cat-rigged - tremendous windage forward; the keel had some strange configuration to it; he just got unlucky; he paid out two hundred feet of rode and the waves happened to be exactly three hundred feet apart, producing divergence and convergence.

Any arbitrary assessment of these two testimonials is bound to reek of bad science. But just you place them side by side in the same database and suddenly you have the beginnings of good science. You have control mechanisms; there opens up a possibility of a whole range of methodical comparisons.

Place ten documented case histories in the same database and an outline begins to emerge. Increase the number to a hundred, and you begin to see a certain pattern. Three hundred, and now you can all but rule out coincidence and the influence of Lady Luck. Five hundred, and now you have a large number of observations from which general rules can be inferred. Increase it to a thousand, and now you have a statistically reliable tool of heavy weather prognosis.

The DDDB was instituted to do just that - obtain a statistically reliable tool of heavy weather prognosis.

Needless to say, however, it takes a great deal of cooperation and communication to make the DDDB a success. Cooperation and communication among drag device manufacturers, for one thing; among safety experts and magazine editors, for another; most importantly, among cruisers themselves.

Fortunately the advent of the world wide web makes such cooperation and communication a lot easier. Whereas previously the database was published only as a hard-copy book, now manufacturers and safety experts on land and sailors on high seas are able to download from or submit to the database in real time. As a result the mutual fund of knowledge should increase by leaps and bounds.

It is not the authors' intent that the DDDB should ever become a substitute for real seamanship, or that it should ever become a crutch.

From the onset sailors must understand that there is no substitute for individual initiative and self-reliance in a storm - this point cannot be overemphasized. Better to throw the abstractions and the theories away and take full control of one's own situation at sea, than to lean on such things as though they were

crutches.

The files in this publication are mere pointers - signposts. The time may very well come when the reader will have to choose his or her own route. If there is a lesson to be learned from the Pardey success story it is this: *Never rely on others when you can rely on yourself*. By all means study up on the available information. But know this: When the wind rises to Force 10 you must assert yourself against the sea and make unique decisions of your own.

Participation in the DDDB should never compromise individual initiative and self-reliance at sea. Those strong individuals who prefer to keep to themselves need never feel compromised by participating in the DDDB. If they learn an important lesson in a gale they can pass it along anonymously if they wish. There is no individual freedom lost by such participation and everything to be gained by it. Very often it is the rugged individual who is on the cutting edge of the learning experience out there. Indeed the history of seamanship has been written by strong individuals.

Some cooperation is productive - and necessary - among drag device manufacturers. Many years ago Victor Shane persuaded Don Whilldin, president of *Para-Tech Engineering*, to participate in the DDDB. As a result we now have a wealth of documentation - greater statistical reliability - relating to bow-deployed sea anchors. Many of the case histories in this publication relate to the use of Para-Tech sea anchors. To the skeptic this may come across as conflict of interest. But to those who are "out there doing it," the compilation has always been a treasure trove of useful information.

Para-Tech's participation in the DDDB has been productive in terms of design improvement as well, many Para-Tech improvements being direct results of that participation. Some sailors, for example, had had problems with the wind inflating parachutes on deck. The DDDB feedback that Victor Shane passed on to Don Whilldin resulted in the development of a DSB (deployable stowage bag). One no longer has to take a Para-Tech sea anchor out of the bag. One simply throws the bag into the sea, and the parachute self-deploys from the bag. Another development was the incorporation of a separate recovery bridle for attaching the float line to the parachute vent hole - see File S/P-5.

Other drag device manufacturers have agreed to participate in the DDDB but some have not, preferring to treat the feedback they receive as proprietary. This regrettably reduces the available information. There is an implicit relationship between drag devices and offshore safety. If drag device manufacturers learn something new from their customers, we hope they will publish it, either in the clearing house of the DDDB, or in some other public forum. We can learn much by the mistakes of others, but only if we are made aware of them.

A few of the files contained in the DDDB were derived from books and magazines, the rest from documentation provided by owners and delivery skippers. In each case the standardized DDDB form was used, allowing for observations, opinions, concerns, suggestions and advice. Space does not permit the publication of the actual completed DDDB forms, but the reader can have copies by sending a SASE and requesting the file by designated number (see address below).

In some cases the authors have provided the reader with their own explanation of what may have happened. They have found it necessary to editorialize in this respect, either because they have had additional feedback from the participant in the form of long telephone conversations, or because they

have received information from other parties and sources. Irrelevant and personal comments have been omitted, but the authors have tried not to change anything. The facts speak for themselves.

Requests for feedback have been published in the letters to the editor sections of domestic and foreign boating magazines. Safety experts, writers and editors have all been alerted to the ongoing DDDB program. All have been supportive, and many have gone the extra mile to give their vote of confidence in the form of an endorsement. The more people who contribute, the greater the benefit to all sailors.

It is the authors' hope that the *Drag Device Data Base* will in time yield crucial insights and answer some of the difficult questions raised by Adlard Coles in *Heavy Weather Sailing*. The pieces of the puzzle are coming together and we may yet see the composite in our own lifetime. It is therefore paramount that sailors with "combat experience" participate. It matters not whether the experience was hum-drum routine or life-and-death sensational. It doesn't matter either if the experience seems to be very similar to a previous report; quite the contrary in fact!The very fact that it confirms some features or tactics is what makes the report so valuable to future sailors.

Previously the DDDB has included only accounts of storm experiences using drag devices. However, it seems that in doing so we are missing out on some valuable lessons that could be learned about storm survival. So, **if you have a storm experience - even if you did not use any kind of drag device - please take a few moments to write it up and** send it in to us**.**

If you are able to comment one what you felt worked, what didn't, and what might have, had you had that option available to you, please do include that in your account.

The important thing is to broaden the statistical base of the information. **We need a large number of files from which reliable generalities can be inferred.** Participation is in every respect easy and painless. Simply fill out, sign and date the standardized DDDB form. You can do this online here, or you can print out the hardcopy version and send it by snail mail. Or send an email. If you have a handwritten account you can either snail mail it to us, or take a photo of it and email it. Addresses, telephone numbers and other personal information will be kept confidential.

IMPORTANT: In addition to filling out the form a few paragraphs of written feedback are required to create a coherent storyline and put everything in a proper perspective. Queen's English is not necessary, and the feedback need not be typewritten. Longhand is acceptable and in some cases preferable - it allows a sailor to put recollections down on paper while the memory is still fresh. Where were you sailing to when the wind came up? Why was the drag device used? Was deployment easy? How did the boat behave? Any major concerns? Chafe? Divergence and convergence? Any weather anomalies? Thunderstorm activity? Microbursts? Rogue waves? Tidal flows? Currents? Shoals? Include any and all general opinions, observations, suggestions, lessons learned and/or things you would avoid in the future. What about the rate of drift? Was it GPS-confirmed? What about retrieval? Was it easy? Was it difficult?

Participants should "tell it like it was" and never feel that they have to protect anyone. Accuracy is highly desirable, as long as it does not become an obsession. When in doubt about such things as wave lengths, wave periods, depth of water, barometer, etc., simply put down a question mark. When in doubt about latitude and longitude simply write "so many miles west of such and such place." The important thing is to participate so we can broaden the base of information and obtain statistical reliability.

Drag Device Database

Abstract

It is not possible to replicate heavy weather conditions in a laboratory. There are no "safe storms" to go out and experiment in. It follows that the experiences of those sailors who have used sea anchors and drogues in heavy weather should not be allowed to go to waste. These experiences should be documented and cataloged for the benefit of other sailors. This argument was the driving force behind Heavy Weather Sailing. *It is the idea behind the modern* Drag Device Data Base *(DDDB for short).*

Intent

- *To establish a more comprehensive methodology and protocol for documenting experiences involving the use of drag devices in heavy weather...*
- *To act as a clearing house for such information...*
- *To compile, catalog and publish the information so that patterns of predictability can be inferred, among them patterns of risk, patterns of failure, patterns of success - WHAT MORE?*

Guiding Principles

- *Beware of subjectivity in filtering the data...*
- *Avoid exaggeration...*
- *Avoid premature conclusions...*
- *Take a cautious approach with respect to determinism, with the understanding that nothing can be taken for granted at sea, and that a tactic that appears to have worked well on a particular vessel in a particular sea state may not be suitable for other vessels in other sea states...*
- *Try to keep an open mind in the reading of the data and be willing to learn valuable new lessons, while not losing sight of equally valuable old ones...*
- *Attempt to integrate opinion and feedback in such a way that theory can be reconciled with observation...*
- *Pursue this objective without prejudice until such a time that the survival envelope of cruising sailboats can be pushed out as far as is humanly possible.*

Record Groups

The records of this publication are categorized by drag device and vessel type. For example, monohull sailboats using sea anchors off the bow make up one category of records, monohull sailboats using drogues off the stern make up another. Likewise with the classes of multihulls and powered vessels.

For the purposes of this publication the term *sea anchor* is taken to mean a drag device used off the bow. Conversely, the term *drogue* is taken to mean a drag device used off the stern. There may be exceptions to this general rule.

File Parameters

Files are listed and numbered by their two parameters. The first parameter identifies the DRAG DEVICE,

while the second identifies the VESSEL TYPE. These two parameters are delimited by a "/" (forward slash). The convention used to identify a file is: DRAG DEVICE / VESSEL TYPE - FILE NUMBER. Parameters are as follows:

S *Sea Anchor (drag device used off the bow).*

D *Drogue (drag device used off the stern).*

N *No drag device of any kind was used.*

M *Monohull (conventional sailboat).*

T *Trimaran (triple-hulled sailboat).*

C *Catamaran (twin-hulled sailboat).*

P *Power (powered vessel, fishing vessel (F/V), pleasure, etc.).*

R *Rowing boat (including boats that are paddled).*

Examples

S/M-7: *File #7 in the records relating to monohulls using sea anchors off the bow.*

S/T-3: *File #3 in the records relating to trimarans using sea anchors off the bow.*

D/M-5: *File #5 in the records relating to monohulls using drogues off the stern.*

D/C-1: *File #1 in the records relating to catamarans using drogues off the stern.*

Warning & Disclaimer

This book is designed to provide the authors' findings and opinions based on research and analysis of the subject matter covered. This information is intended to serve as but one aid to seamanship, among a host of other aids. This information is not provided for purposes of rendering specific advice regarding a tactic of choice for use by a specific vessel in a specific sea state.

Every effort has been made to make this publication as accurate as possible. However, there may be errors both typographical and in content. Therefore, this text should be used only as a general guide, and not as the ultimate source of heavy weather tactics information. Furthermore, this publication contains information on drag devices only up to the printing date.

The individual reader should therefore take care to determine prior to use that a particular tactic is suitable, adequate or safe for his or her particular vessel in any specified sea state. Since individual use cases are subject to great variation, the author and Para-Anchors International shall have neither liability nor responsibility to any person or entity with respect to any injury, loss or damage caused, or alleged to be caused, directly or indirectly, by the information contained in this book. If you do not wish to be bound by the above terms and conditions, you may return this book to the publisher for a full refund.

There is nothing about the sea that can be taken for granted. Before venturing offshore in small craft the reader should reflect on the words of the last paragraph of the official RORC inquiry into the events of Fastnet '79: **"In the 1979 race the sea showed that it can be a deadly enemy and that those who go to sea for pleasure must do so in the full knowledge that they may encounter dangers of the highest order."**

Section 2: The Practice: Actual Case Histories

The Practice: Actual Case Histories

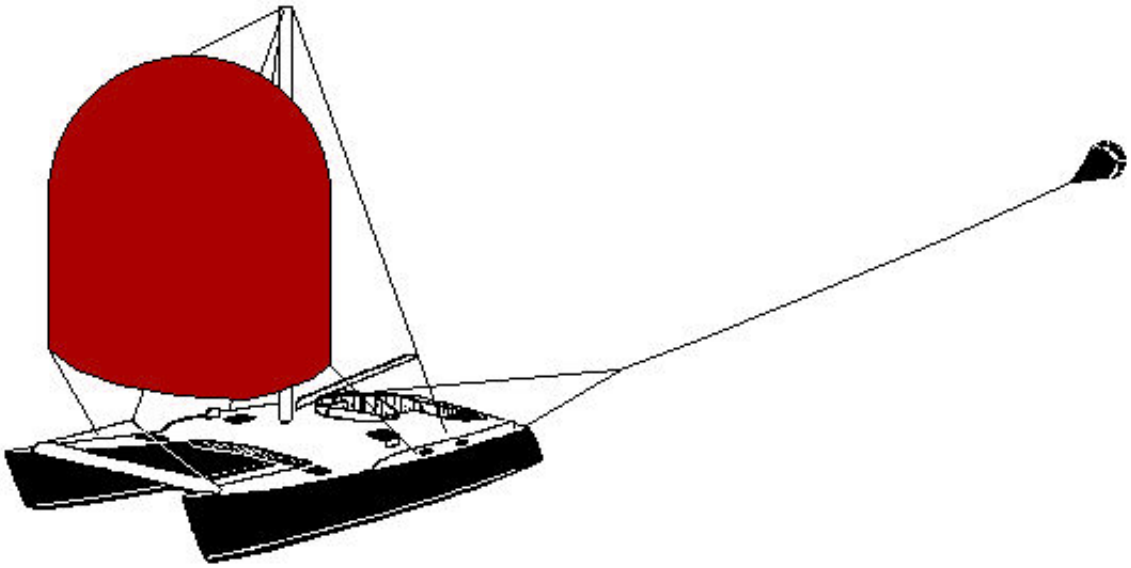
Drogues on Catamarans

D/C

D/C

Files Relating to Drogues

Used by Catamaran Sailboats off the Stern



"Part of the problem with running is that you are already moving, very much at the mercy of the wave. You can say, 'Well, I can steer by hand,' but you really can't - you can't do much of anything when you're overwhelmed."

Walter Greene,
quoted by Chris White in *The Cruising Multihull*
(Courtesy of International Marine Publishing Co.)

D/C-1 Catamaran, "Sebago"

Catamaran, "Sebago"

50' x 30' x 5 Tons

4-Ft. Dia. Shewmon

Force 9-10 Conditions

File D/C-1, obtained from Walter Greene, Yarmouth, ME. - Vessel name *Sebago*, ocean racing catamaran, designed by Walter Greene, LOA 50' x Beam 30' x Draft 7' (2' boards up) x 5 Tons - Drogue: 4-ft. diameter Shewmon (sea anchor) on 250' x 3/4" nylon braid tether, with bridle arms of 50' each and 1/2" galvanized swivel - Deployed in a whole gale in 100 fathoms in the English Channel with winds of 40-50 knots and seas of 20-30 ft. - Vessel's stern yawed 10° .

This is the second file obtained from Walter Greene (see also S/C-5). The same 4-ft. diameter *Shewmon* sea anchor was used on the same boat, *Sebago*, only this time in drogue fashion, off the stern. Her stern stayed fairly snubbed into the seas, yawing no more than 10° off to each side. (The bows yawed in excess of 45° in file S/C-5). This deployment took place in 100 fathoms of water in the English Channel. Conditions were atrocious - 40-50 knot winds and average seas of 20 ft. with much bigger waves now and then. The 160 sq. ft. wingmast on *Sebago* was a complicating factor. In an article appearing in the August/September 1988 issue of *Multihulls Magazine*, Greene was interviewed by Jack Petith about living with a wing mast in storms and provided the following opinions and observations (reproduced by permission):

> *The wing mast being in the center of the boat, does funny things with your center of effort.... Sailing to France we were, altogether, five days with no sail on the boat.... Sometimes we were hove-to and going backwards.... One time we put the sea anchor out for two days* [off the stern]*; but the sea anchor really beat the hell out of the boat - deck gear and waves crashing on the boat. I can see it working with a traditional mast. In fact, I don't think you could capsize a reasonable sized multihull with one.*

D/C-2 Catamaran, Rifflart

Catamaran, Rifflart

31' x 16' x 4 Tons

9-Ft. Dia. BUORD

Force 9-10 Conditions

File D/C-2, obtained from John Kettlewell, Middle Grove, NY. - Vessel name *Echo*, catamaran, designed by Mark Louis Rifflart, LOA 31' 6" x Beam 16' x Draft 2' 8" x 4 Tons - Drogue: 9-Ft. diameter BUORD on 400' x 1/2" nylon three strand tether, with bridle arms of 25' each and 1/2" galvanized swivel - Deployed in a gale in deep water about 400 miles SW of Bermuda with winds of 40-50 knots and seas of 18-25 ft. - Vessel's stern yawed 10° - Drift was estimated to be about 30 nm during 20 hours of deployment.

Echo was en route to San Juan, Puerto Rico, from Beaufort, NC., when she ran into a gale. Her owner John Kettlewell is a marine consultant with a good deal of cruising experience. He has written numerous articles and was acquisitions editor for International Marine Publications for a while. (See also his article entitled, *Rough Passage To San Juan* appearing in the November/December 1991 issue of *Multihulls Magazine*).

Echo ran downwind for a while until it became unsafe to do so. She lay a-hull for a short period thereafter and Kettlewell deemed that just as unsafe - the occasional breaker would knock the bow off and she would surf sideways out of control.

He then deployed a 9-ft. BUORD parachute off the bow, his wife Leslie assisting. The 400 feet of line smoked out so quickly that they were barely able to cleat it before it reached the end. The 9-ft. diameter Naval Ordnance parachute (porous canopy) did not produce enough drag to keep the bows pointed into the seas - they were yawing up to 90° off to each side. So Kettlewell decided to switch ends and use it as a drogue off the stern instead.

This accomplished, the parachute then kept the stern pointed into the seas in a satisfactory way, with no further steering required. The crew was able to go down below and get some rest on the floor of the saloon area. Transcript:

> *In general we were very pleased with the performance of the drogue. As I stated previously we*

could not lie bow into the wind with this size chute. I wonder if we had removed our roller furling jib we could have laid bow to.... In any case I'm sure I would now prefer to run before the seas on this boat. Our cockpit is well protected with a strong door and great drainage due to the motorwell for the outboard. I think it is useful to give with the punches of the waves. We even raised our rudders to take the strain off of them from wave hits.... With a bridle to each stern the drogue held us straight on to the sea and we did not have to steer.

I am very wary of using a trip line as I find storms tend to make amazing tangles of even the simplest rigs. On the other hand, if something were to disable the chute suddenly, it would be very difficult to get it in and untangled during the height of a storm. However, even though it was extremely tiring and difficult to retrieve I still would not rig a trip line. We had some success using the motor to slowly power up to the drogue.

We had no problems with the line kinking or chafing. I used two 5/8" braided bridle lines led through clear PVC water tubing. Our rode consisted of 2 x 200' lengths of 1/2" nylon connected by a large shackle in the middle. I feel your length recommendations (i.e., LOA x 10) may be a bit short. I was certainly happy I had 400' of rode!

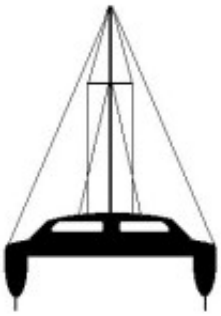
D/C-3 Catamaran, Prout

Catamaran, Prout

34' x 16' x 5.5 Tons

9-Ft. Dia. BUORD

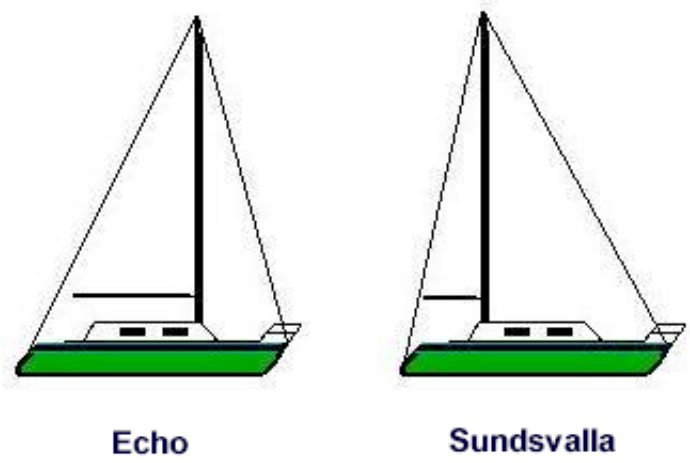
Force 9 Conditions



File D/C-3, obtained from Thomas W. Kintz, Groton, CT. - Vessel name *Sundsvalla*, hailing port East Lyme, MA, Snowgoose catamaran designed by the Prout brothers, LOA 34' x Beam 15' 8" x Draft 3' x 5.5 Tons - Drogue: 9-ft. diameter BUORD on 350' x 3/4" nylon three strand tether, with bridle arms of 45' each and 1/2" galvanized swivel - Deployed in a gale about 60 miles west of Cape Finisterre, Spain, with winds of 40-45 knots and seas of 20-25 ft. - Vessel's stern yawed up to 90° off to each side - Drogue was eventually tumbled and rendered useless - Drift was about 30 nm during 18 hours of deployment.

Sundsvalla crossed the Atlantic in August 1987. On her way down the Iberian Peninsula she ran into a northeasterly gale about sixty miles west of Cape Finisterre. She used the same parachute drogue used by *Echo* in the previous file (D/C-2). The behavior of *Echo* was satisfactory. The behavior of *Sundsvalla* was anything but satisfactory. She would not lie to the relatively large drogue by herself. She had to be steered manually down the steep wave faces. And she kept doing the same thing that *Galliard* did in file D/T-2, i.e., surge forward and then snap back on the elastic rode. Later on, when the line had temporarily gone slack, a breaking wave threw the drogue and tangled it around itself.

What was the big difference between *Echo* and *Sundsvalla*? *Sundsvalla* has her mast stepped aft (most Prouts catamarans do). Any sailboat with her mast stepped aft will behave relatively well when using a sea anchor off the bow, but relatively poorly when using a drogue off the stern. The opposite is also true, of course: any sailboat with her mast stepped well forward - cat-rigged - will behave relatively poorly when using a sea anchor off the bow and relatively well when using a drogue off the stern. Transcript:



Echo (previous file) behaved quite well with a 9-ft. BUORD off the stern. Sundsvalla did not. Sundsvalla has her mast stepped aft, as do many Prout catamarans.

On passage from the south coast of England to Bayona, Spain. Encountered "dry" gale from the northeast. Sailed in rising wind/seas all day under staysail alone. Near dusk, wind rose to Force 9 and occasional seas began to break. Took down all sail and deployed BUORD off stern. No problem with deployment, but vessel would not lie to the parachute by itself - it had to be steered. Line would go slack periodically. Could not keep bows pointed downwind all the time. Finally, a breaking wave caught the drogue and tangled it around itself. We left it deployed, but effectively lay a-hull all night and into the next day. Took several breaking waves over the boat - not recommended! Recovered BUORD after gale subsided and continued to Bayena.

PROBLEM: The Prout Snowgoose 34 catamaran has the mast stepped way aft. I believe that this is what caused our problem. The center of effort of the boat's aerodynamic drag was so far aft that it would yaw from side to side. This allowed the tether to go slack and ultimately tangle.

SOLUTION? The next time on a vessel of this type, I would use a storm jib hanked onto the forestay and sheeted athwartships. I believe that this would keep the bows pointed downwind by moving the center of effort forward. This would allow the helm to be untended and the tether to remain taut. Although I haven't tried it, a large para-anchor deployed from the bow should work very well because the aft mast position would increase yaw stability. [Note that a large diameter para-anchor did work well off the bow of the Prout Snowgoose, *Rhayader*, in File S/C-3.]

D/C-4 Catamaran, Lagoon

D/C-4

Catamaran, Lagoon

46' x 25' x 11 Tons

48" Dia. Galerider

Force 9 Conditions

File D/C-4, obtained from Dr. Tim King, Elkhart, IN. - Vessel name *Ariel*, hailing port Juneau, Alaska, Lagoon catamaran designed by Jeanneau, LOA 46' 3" x Beam 24' 11" x Draft 3' 11" x 11 Tons - Drogue: 48" Diameter *Galerider* on 350' x 5/8" nylon braid tether, with bridle arms of 70' each and stainless steel 5/8" swivel - Deployed in a gale in deep water about 300 miles SW of Cape Finisterre, Spain, with winds of 40-45 knots and seas of 20 ft. - Vessel's stern yawed 10° - Speed was reduced to about 3 knots during 24 hours of deployment.

Dr. Tim King had a Valiant 41 monohull named *Foggy Mountain*. In June 1989 *Foggy Mountain* won a fifteen-round bare knuckle fight with a life-threatening storm in the Gulf of Alaska. No drag devices were used. It was a survival saga, with fatigue and hypothermia playing significant roles. At the height of the storm King and crew witnessed enormous "holes and pyramids" on the surface of the sea. In an article appearing in the Jan/Feb 1990 issue *Ocean Navigator* Tim King wrote that some of these "holes" were 30 feet deep. They were barreling along at 30 knots and it was only by blind luck that the boat didn't fall into one. Dr. King has since sold the Valiant and purchased a Jeanneau Lagoon 47 catamaran. In March 1992 he and crew took delivery of *Ariel* in France and set sail for the U.S. The boat was equipped with an 18-ft. diameter Para-Tech sea anchor and a 48" Galerider drogue. En route to the Canary Islands they ran into a gale and used the Galerider to slow the boat down. There was a copy of the *Drag Device Data Base* on board and crew members took turns reading it during the gale! Transcript:

> *Like all catamarans,* Ariel *tends to be very fast on all points off the wind. Specifically her fine entry and rapid flaring of the hulls allows her to surf without difficulty. The majority of the steering, even during surfing, was handled by the Autohelm autopilot. After 48 hours of building wind conditions, we found ourselves sailing under a broad reach with maturing seas. Our speeds were consistently 15-20 kts. under jib and/or triple-reefed main. The ride was relatively smooth except for the slamming of occasional waves under the bridge deck. The boat handled exceptionally well during prolonged surfs under autopilot control.*
>
> *At 0600 (on the beginning of the 3rd day of the gale), before sunrise, the boat was lifted by the stern on the crest of a very large wave. There was a slight hesitation as the boat approached the crest, whereupon a second wave apparently augmented the first one and lifted us even higher up the new crest. (This second wave must have come from about 30-60° off the prevailing wave*

direction). Three things then occurred. First, the now confused breaking wave crest broke over the dinghy davits (the dinghy was stored upside down on top of the davits) and crashed chaotically into the cockpit (which rapidly drained off due to a well-designed drain system). Secondly, the boat was turned sideways and heeled some (10-25° ?) to starboard. The boat apparently then slid sideways for a short distance, being carried on the breaking crest of the wave, until the leeward hull and keel finally dug in. Thirdly, poised as she was at the crest of a larger than normal wave, she took off at an angle down the face of the wave and reached a speed clearly in excess of 20 kts. (We did not see the knot meter, but judged the speed from the vibration of the hull/rudder system.)

It was at this point that it was decided to deploy the Galerider in order to slow the boat down and prevent uncontrolled surfing. The Galerider was deployed via a bridle and 2 x 100' lengths of rode. Extreme care was taken in its deployment, but there were no injuries or hardware problems (remember, it was still dark). The result was that the vessel immediately slowed to 2-4 kts. and no surfing occurred at speeds greater than 5 kts. This slower speed allowed cross wave patterns to more easily catch up to us and pass by, thus creating more bridgedeck slamming and leeward hull pounding, but NOT with the intensity that had occurred while surfing. The boat would not self-steer in these conditions and continued to require an active autopilot. She was, however, well-balanced under bare poles and the autopilot did not have to work very hard.

Daylight showed us a sea with multiple well-developed wave trains coming at angles off the beam and stern. During the next 12 hours we saw several wave interactions that could have accounted for our early morning incident. However, it was never repeated while under drogue. Speed and steering were well under control. The yellow drogue could be seen (fully submerged at all times) under the surface about two full wave trains behind. After 24 hrs. it was winched in without incident and we proceeded under jib and triple-reefed main in 28-30 kts. of wind.

I think in retrospect a slightly longer rode would have prevented some of the bridle's vertical "slapping" of the waves as the rode stretched and contracted. There were, however, no chafe or hardware problems. We were well-prepared with the proper equipment, shackles and rodes. Therein lies the key to success.

D/C-5 Catamaran, Catalac

D/C-5

Catamaran, Catalac

41' x 18' x 8.5 Tons

5-Ft. Diameter Hybrid Parachute

Force 12 Conditions

File D/C-5, obtained from Darryl and Diviana Wheeler, Auckland NZ. - Vessel name *Heart Light,* Catalac catamaran designed by Tom Lack, LOA 41' x Beam 18' x Draft 3' x 8.5 Tons - Drogue: 5-ft. Diameter hybrid parachute on 70' x 3/8" chain tether with bridle arms of 150' each (3/4" nylon braid) and 1/2" swivel - Deployed in the Queen's Birthday Storm (June 1994) in deep water about 400 miles south of Fiji, with winds of 80 knots and seas of 80 ft. - Vessel's stern yawed 30° with owner steering with the rudders and the engines - Speed exceeded 10 knots at times.

In 1987 Darryl and Diviana Wheeler sold their house in America and purchased *Heart Light*, a 41-ft. Catalac catamaran. They put out to sea, learning to sail as they went. They made it through the Panama Canal and across the Pacific to the Marquesas and Tahiti, arriving in New Zealand in November 1989, where Darryl worked for a number of years as a marketing consultant. On Tuesday, 31 May 1994, in spite of Diviana's premonitions, Daryl cast off a New Zealand dock, headed north. He wanted to sail to Tonga with the Tongan fleet - an annual regatta. On board were his wife, Diviana, their son, Shane, and their daughter-in-law, Stephanie. En route to Tonga they ran straight into what has since been called the Queen's Birthday Storm. *Heart Light* found herself in the worst part of the storm, flanked by the yachts that sustained the most damage, all within a 200-mile radius - *Destiny* to her left (File D/M-12), *Pilot* and *Quartermaster* to her right, *Ramtha* and *Mary T* up ahead, *Silver Shadow* and *Sofia* behind.

What transpired on *Heart Light* between June 4 and June 6 has to be regarded as one of the most remarkable feats of manual steering in the history of multihull sailing. All the more remarkable because in 16,000 sea miles Darryl Wheeler had *never* done the steering offshore - the autopilot had always taken care of that. Now, suddenly, he found himself perched in the driver's seat in the inside steering station, his hands clasped onto the wheel, Diviana's arms clasped about him - trying to keep him from falling off the chair.

The drogue used was a hybrid parachute, about 5 feet in diameter. In the course of numerous telephone conversations Victor Shane and Darryl Wheeler ascertained that it was not a BUORD. This parachute was light blue in color and seems to have been made of much lighter, non-porous material, perhaps Nylon Taffeta, or even heavy spinnaker Rip-Stop. It had less than a dozen shroud lines. It was deployed on a 75'

chain tether, with 150' bridles made of 3/4" nylon braid. This bridle was *shackled* to heavy duty padeyes on the outboard ends of the catamaran's hulls - probably why it didn't chafe through.

As the storm built the catamaran started surfing down steep waves at speeds in excess of 10 knots with the drogue in tow. Already, in the few hours that he had been behind the wheel, Darryl had become an accomplished helmsman. And he had quickly learned how to make good use of *Heart Light*'s twin inboard engines as well. Since the propellers were positioned 18 feet apart, by cutting one throttle and punching the other one Darryl soon found he could use rudders and engines in combination to keep the yacht more or less aligned downwind, in spite of the rogue waves that were hammering her from side to side.

With the lives of his family hanging in the balance Darryl became an expert at steering the boat down 60-ft. seas. The ride must have been incredible. The 41' x 18' catamaran all but became an Olympic toboggan, hurtling down the sides of sheer slopes, slamming sideways into rogue avalanches and occasionally falling off a precipice or two. The hulls and cross-arms were flexing. So were the huge windows, letting copious amounts of water in. Stephanie was perched on the floor, hopelessly sea sick. The entire yacht was wet and trashed, littered with food items and broken glass.

Many hours later, as the ordeal drew to a conclusion, a huge wave picked up the drogue bridle and threw it at the propellers. All lines became fouled. All engines useless. *Heart Light* was now dead in the water, lying a-hull. Darryl activated the EPIRB and deployed an 18-ft. Para-Tech sea anchor off the bow. The boat remained on station until they were taken off by the ship *San Te Maru 18*.

Those interested in a blow by blow account of the life and death saga that transpired on *Heart Light* can obtain a copy of Diviana's book, *Heart Light, Rescue At Sea* (Random House New Zealand Ltd., 18 Poland Road, Glenfield, Auckland 10, New Zealand). Here is a transcript of the DDDB feedback Victor Shane obtained from Darryl & Diviana Wheeler:

> *This is a recap of our experience using a drogue and para-anchor. The drogue was with the boat when we bought it. It was a 4-6 ft. diameter nylon chute. I had a swivel connected to 70 feet of chain that I could hook a bridle to and connect to each stern. During the storm I used my 150' bridle that was made for the para-anchor. As the storm started to build we were faced with the decision to para-anchor from the bow or deploy a drogue to help us steer and slow the boat. We had a lot of large windows on two levels across the front and as the waves were building, we decided it was in our best interest to run. A decision that proved itself to be correct under the unusual circumstances we later found ourselves in. Even if we had storm windows, we would not have para-anchored bow first into this tempest.*
>
> *As soon as we deployed the drogue the boat became easier to handle. Every time she would want to broach the drogue would drag her back on course. As the wind built to a steady 77 knots gusting to 90 knots it would drive the 50 foot waves on top of one another. The faces of these monsters were vertical on both sides. In some cases the waves would stack 3 high, with the center wave becoming aerated. When you came off one of these giants the middle wave would drop out and the cat would free fall through the gap until hitting the next wave below.*
>
> *Because of the height and steepness of the waves, plus the fact that every so often a group of*

waves would come from another direction, I feel that it would have been suicide to deploy the para-anchor from the bow. The New Zealand Air Force was reporting waves over 100 feet high from this stacking problem. We were careening down 100 foot waves under bare poles, sometimes reaching 13 knots dragging the drogue, doing our best to prevent a broach - we did find ourselves flying a hull more than once! When one of these monsters would break on top of us it was like a giant hand pushing us at will in any direction it chose. The power of these waves was so intense that if we were not moving in their direction we surely would have been damaged.

On our final broach waves pushed the rode from our drogue into our props. At that climactic point my engines were stuffed by missiles of sea water and my props were wrapped tightly in the drogue lines. We became dead in the water sitting sideways to the waves. After things calmed down to a mild roar of about 60 knots and the huge waves were no longer stacking, we did deploy our para-anchor to hold us in place. However, surprisingly, the cat did much better when free falling down the waves at that point. If we had not been intent on staying in ONE spot we would have cut it loose. The problem again, was the fact that we were getting hit broadside by rogue waves instead of just the seas moving on us from the front. It was terrifying sitting there jerking around and having the sea burst down on us, causing the windows to flex inwards and dump gallons of water inside the boat. Further confirmation to us that indeed we had made the right choice in running under these particular circumstances. I still feel that a para-anchor is a great line of defense for multihulls, I have successfully used mine on various occasions. It just was not practical in these extreme conditions. I hope and pray none of your readers will ever have the misfortune of being in a storm of this nature.

In the end, I will say from personal experience that the safest craft in this storm were the two catamarans. While our ordeal was horrific it was nothing in comparison to the monohulls that were being pitchpoled and rolling 360 degrees. Setting aside our experience of the event and looking at this from a seamanship point of view, we would offer the following. Make up your mind before you get in a situation of this type as to what you are going to do. Once you commit to a tactic it is almost impossible to change tactics. Even if we had wanted to, we could not have deployed a para-anchor during the storm. It was all you could do to just hang on, let alone shackle and deploy a drag device. Work out some sort of system so that if you are dragging a drogue and using your engines for control the rode is not carried into the props. Maybe a rope cutter on the shafts would work.

D/C-6 Catamaran, Prout

D/C-6

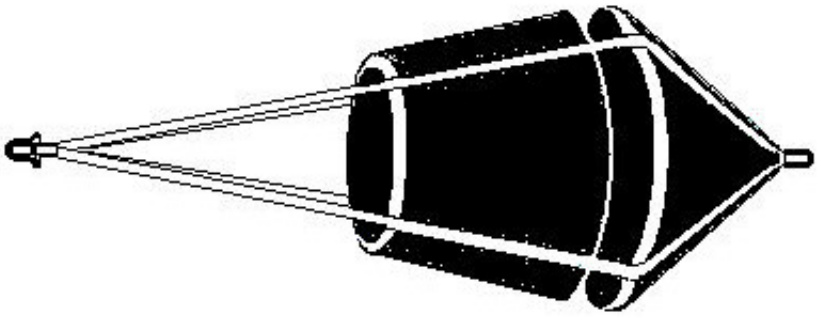
Catamaran, Prout

37' x 16' x 7.5 Tons

Seabrake GP-24

Force 7 Condition

File D/C-6, obtained from Robert Harnwell, Berwyn, PA. - Vessel name *Malaika*, hailing port Philadelphia, Snowgoose catamaran designed by the Prout brothers, LOA 37' x Beam 16' x Draft 2.8' x 7.5 Tons - Drogue: Seabrake GP-24 (24" diameter) on 100' x 5/8" nylon three strand tether - No bridle - Deployed in a gale in deep water about 200 miles WNW of Cape Finisterre (Spain) with winds of 30 knots and seas of 12-20 ft. - Vessel's stern yawed 10° - Speed was reduced to 4-5 knots during 48 hours of deployment.



Seabrake GP

Malaika was sailed from England to the Chesapeake Bay in August 1995. Like most Prout catamarans her mast is stepped aft. With her center of effort so far back she has a slight tendency to want to round up into the wind, and will yaw slightly more than other catamarans when running downwind. Taking the main down and using headsails will reduce this the yawing - and the weather helm. So will towing a speed-limiting drogue. This applies to any vessel with a mast stepped aft or a center of effort well back - schooners, for example. Transcript:

Deployed the drogue a number of times across the Atlantic. From England to the Azores the wind was straight behind. In the gale she was surfing 10-12 knots down the big ones, slewing around at the bottom. In a big, heavy boat like ours that's really fast. Deployed the drogue and it slowed the boat down to about 5 knots - like putting on the brakes. At one point had to roll out more jib to keep up speed and control the boat. We had a sail up throughout the 48 hours with the drogue. Most of the time she would track straight, slewing around only at the bottom of the waves.

No bridle, primarily because the boat is equipped with a real heavy duty cleat and roller for the stern anchor, slightly off the centerline of the boat, about 3 feet off the centerline. No noticeable difference. The wind was knocking us around and you really couldn't tell that the cleat wasn't on the centerline of the boat. Steered by hand through the worst of it. The autopilot in most cases could do a better job steering than we could, but there were times when you would get a succession of waves, of one, two, and three waves, and on the third one you knew that you had to get on the helm yourself, because you could feel that the boat was going too fast and you were going to lose control at the bottom of the wave - when you came off the bottom of the wave the autopilot wasn't going to be able to keep the boat straight so you had to take over. But she didn't yaw about significantly in those conditions. A couple of times things got thrown around down below, but that was about it.

Due to higher speeds on catamarans, use caution in deploying a drogue. We almost lost control of it when we first put it overboard. It took off so fast and it had so much drag that it almost overwhelmed both of us. My suggestion would be to practice deploying it beforehand, which is what we really should have done. We lost the polypropylene trip line due to a slipped knot and had to pull the drogue back in with a winch - it's like having a bulldog pulling against you at the other end.

[Positioning the drogue:] *The drogue grabbed anywhere it was off the stern. Sometimes it would come out of the front face of a wave, so I guess the farther back you position it the better off you are. Given the moderate conditions* [30-knot winds] *we didn't want it much more than a 100 feet off the stern, worrying about having to haul it back again. It would have worked fine 25 feet off the stern, but at a 100 feet everything was a little more stable. You need to use good chafing gear. We had the rode running through an anchor roller. Even with the roller and the nice, smooth metal surfaces, I had to let out a little line every twenty minutes or so.*

D/C-7 Catamaran, Shuttleworth

D/C-7

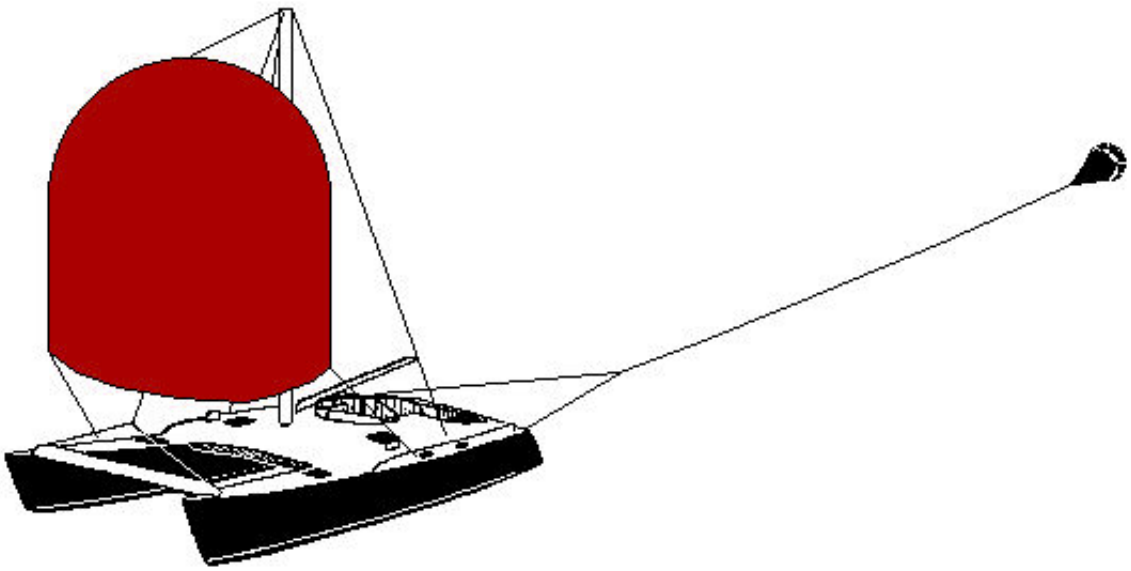
Catamaran, Shuttleworth

34' x 18' x 2 Tons

Sea Squid Drogue

Force 8 Conditions

File D/C-7, obtained from Mark J. Orr, Leigh On Sea, UK. - Vessel name *Shockwave*, hailing port Southampton, ocean racing catamaran designed by John Shuttleworth, LOA 34' x Beam 18' x Draft 18" x 2 Tons - Drogue: *Sea Squid* on 200' x 7/16" nylon three strand tether, with bridle arms of 30' each and 1/2" galvanized swivel - Deployed while racing, in a low system in deep water about 100 miles west of Cape Finisterre (Spain) with winds of 35 knots and seas of 10-15 ft. - Vessel's stern yawed 20° - Speed was reduced to about 10-12 knots with double-reefed main and half-furled Genoa.



Transoceanic racing skipper Mark J. Orr is affiliated with Prout Catamarans and has participated in numerous multihull races. In the 1995 *Azores and Back Race* he used an Australian *Sea Squid* drogue to maintain speed and stability. This feat can be accomplished with high speed plastic drogues like the discontinued *Sea Squid* or some of Seabrake's solid units - the MK I or the HSD 300. In high winds the forward pull of relatively large sails is opposed by the rearward pull of the drogue and the yacht in between is then able to move at relatively high speeds as though on railroad tracks - if the drogue doesn't fly out of the wave faces. Transcript:

Fortunately it was not our para-anchor that we had to use, but our Sea Squid drogue, which worked brilliantly. Whilst racing from Falmouth to San Miguel, Azores, in the Azores and Back Race, we had a fantastic multihull sail on the way down. After a strong beat at the start, the wind steadily came round to a reach, and then a broad reach whilst steadily building. Late on day two we were sailing with the wind angle at 110° from the starboard bow in a brisk F6-7. The seas were building and the boat was enjoying some marvelous surfing with speeds steadily in the 15-18 knot range. As the spinnaker was doused for full genoa and the mainsail reefed, the roller furling became jammed with half the genoa furled. The mainsail with 2 reefs was fine. As the surfs became longer and faster there was the occasional danger of the bow digging in too much.

Having decided that we wanted to press onto the Azores as quickly as possible, we did not want to reduce too much sail. At the same time we wanted to keep the stern down in the water and prevent the bows digging in. The drogue seemed the ideal answer. We deployed in on two 35' bridles and 200 ft. of 10mm three strand nylon. Once deployed the boat continued under 2 reefs in the mainsail and half furled genoa at 10-12 knots for the next 8 hours. Not once did the bows seriously dig in, and the stern seemed glued to the water. We hand-steered to get round waves that might slow us down, but on reflection could have used the autopilot and rested. It was amazing how secure the boat felt with the drogue out. As the boat accelerated too quickly (on a surf) there was a gentle dampening pull on the stern from the drogue that kept the acceleration gradual and within control. Lessons learned were that the bridles could have been longer, and I would have preferred a stainless steel swivel between the bridle and the tether. We had rigged up for the para-anchor off the bow and used its bridle for the drogue, which was fun to de-rig. However for the leg from the Azores back to Falmouth we rigged bridles from bow and stern so that we only had to attach the tether and the appropriated drag device. We will do this in future passages as it will speed deployment and save energy. It was the first time we had used the drogue on this boat and it was brilliant. If we had not had the drogue we would have had to slow right down. Having it on board meant that we could maintain a good racing performance in apparent safety.

D/C-8 Catamaran, Crowther

D/C-8

Catamaran, Crowther

40' x 26' x 3 Tons

Sea Squid Drogue

Force 9-10 Conditions

File D/C-8, obtained from Dr. Gavin Le Sueur, Mallacoota, Australia - Vessel name *Windswept,* hailing port Mallacoota, catamaran, designed by Lock Crowther, LOA 40' x Beam 26' x Draft 2' 6" x 3 Tons - Drogue: *Sea Squid* on 300' x 3/4" nylon braid tether, with bridle arms of 28' each - Towed in a whole gale in deep water from Perth to Adelaide with winds of 40-50 knots and seas of 20-30 ft. - Vessel's stern yawed 20° - Speed was reduced to about 4 knots.

SEA SQUID (no longer available).

Although the *Sea Squid* is no longer in production we are presenting files that involve its use because they contain invaluable insights relating to the use of speed-limiting drogues in general. Dr. Gavin Le Sueur (see also S/C-16) used Australian *Sea Squid* drogues in the rough 1988 *Two Handed Around Australia Race*, the same race in which Peter Blake participated on *Steinlager II* (File D/T-1). Transcript:

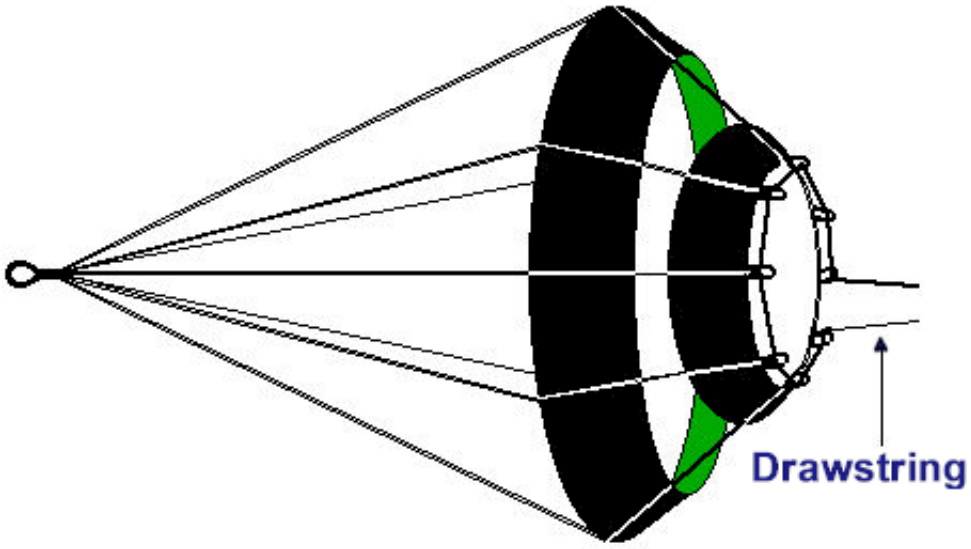
> *I was offered a 40ft Crowther catamaran to sail in the 1988 Two Handed Around Australia Race. I crossed the starting line with Catherine* [wife to be] *as my crew. We were given a plastic "Sea Squid" drogue to test during the race. The first night brought a southerly buster that capsized a 35ft trimaran (*Escapade*), sank a police launch and cost the life of a crewman on a monohull (*Boundary Rider*). We towed the Sea Squid on 300ft of 1" braided nylon. It porpoised all night* [diving in and out] *and by dawn we were just dragging rope with a small plug of plastic shackled on the end. At the first stopover we were given a second Sea Squid. This one had a reinforced head (fiberglass resin poured into the bolt attachment). After a gale in the Coral Sea*

the inlet valves of this Sea Squid had split and folded back. Again this one would leap out of the water on occasions. At Darwin we were given a third Sea Squid to test. This time the inlet valves were smaller and reinforced across the center. We added 6ft of anchor chain right next to the drogue. This stopped the porpoising.

While crossing the Southern Ocean from Perth to Adelaide all competitors went through gale after storm. We could not carry full sail for 3000 miles! We towed drogues and warps for most of the way. The last Sea Squid worked famously. With the chain, reinforcing and altered inlet valves, we had no further structural failure. It was speed limiting to approximately 7 knots. We no longer surfed down waves, and often would add sail before taking in the Squid so that we could maintain a constant 7 knots and not stall in the troughs.

The drogue bridle ran inboard from each hull to two winches so that the arms could be adjusted for steering. The tether itself continued into the cockpit and the bridle arms were spliced together and the combined end bent onto the tether with a rolling hitch with a lock. The tether was then let out until the bridle grabbed. It was secured to another winch as a backup if the bridle arms failed, or the knot came undone. This never happened. We finished the Around Australia Race in second place in the 40ft division, third multihull over the line behind Steinlager *(Peter Blake) and* Verbatim *(Cathy Hawkins and Ian Johnston). On the finish line I asked my crew to marry me and surprisingly she said yes!*

Our drogue system has continuously undergone experiment and changes. These changes are entirely experimental and apply only to our catamaran, but may be of use to others. Our first problem was the stowage of the Sea Squid, and rigging it for convenient use. It meant getting out our short length of chain off the breakfast anchor line [lunch hook]. *It usually meant digging the Squid out from the recesses of the bow. We read about textile drogues and have tried four systems since 1992. The first was a scaled down parachute. It worked out but slowed the cat to less than 3 knots in 35-knot winds. Too slow to avoid getting pooped. We then tried a "series" drogue, provided as a trial. It slowed the boat, but was a stowage mess and very impractical. We then tried a textile drogue that was fluted. It was like a normal parachute (3ft diameter) but with the middle ten inches removed and the continuous shrouds holding the two pieces of material together* [see image below]. *This fluted drogue worked as well as the parachute - 3 knots and too slow in 35-knot winds and 12ft seas. We had the drogue re-shaped by Para-Anchors Australia, the outlet hole enlarged and a rope tie put into the ends of the shrouds so that we could adjust the outlet* [as with a drawstring bag].



Adjustable pull, "fluted" drogue conceived by Australian Gavin Le Sueur is similar to drogue used by NASA to lower the Pathfinder mission onto the surface of Mars. Note the drawstring arrangement on the smaller ring, allowing the outflow diameter to be adjusted from 14" to 4" to increase or reduce pull. The optimal pull for a particular boat will have to be determined through prior trial and error and in practice runs. The drogue cannot be adjusted while in use.

With all three drogues and the Sea Squid we put out to sea for a twelve month cruise. We have used the variable outlet - fluted - drogue four times in anger, using it to control our speed, or to stop surfing, or to ease the work of the autopilot. In 37-knot gusty conditions we sailed up to 8 knots with the outlet open. We put up our storm spinnaker (a small, bulletproof racing kite with a low center of gravity) and we were unable to push the boat speed over 8 knots. With 200ft of rode it appeared that the drogue rapidly increased the turbulence as we increased the pulling power [by adding sails]. *It was as though we had hit a speed barrier. We winched it in (about ten minutes hard yakka) and then re-launched it with the outlet hole tightened up (from 10 inch diameter to 4 inches). We were then back to three knots boat speed. Again we were unable to exceed this speed. It took a bit longer to haul it in the second time but the exercise seemed fruitful. I thought it justified further development and sent a copy of the reports to Para-Anchors Australia. Why a variable drogue? Vary the outlet hole so that one drogue can work for different boats. On any boat, with practice (essential) you can "dial a speed limit." A simple system that is stowed in the cockpit without hassle. At no time did any of the textile drogues break the surface, although I would add a weight if I was to run downwind in tumbling sea conditions.*

Dr. Le Sueur's "fluted" parachute drogue is similar in concept to the *ringsail* and *disk gap-band* drogues used by NASA and the Aerospace Industry. Alby McCracken of Para-Anchors Australia has developed Dr. Le Sueur's idea - replete with drawstring drag adjustment - and is now offering models for sale (see Appendix III at the back of this publication).

D/C-9 Catamaran, Searunner

D/C-9

Catamaran, Searunner

44' x 25' x 6 Tons

Shewmon VP and Shewmon 9-Ft.

Severe Tehuantepeccer *(Hurricane-Force)*

File D/C-9, obtained from Captain Fred Yeates, Tarpon Springs, FL. - Vessel name *Anna Kay*, hailing port Gwenn Island, VA, catamaran, designed by Jim Brown, LOA 44' x Beam 25' x Draft 3' x 6 Tons - Drogues: 4-ft. diameter *Shewmon Variable Pull* & 9-ft. diameter *Shewmon* (sea anchor) on 250' x 3/4" nylon braid tether, with bridle arms of 25' each and 5/8" galvanized swivel - Deployed in a severe *Tehuantepeccer* storm in 160 fathoms of water in the Gulf of Tehuantepec with winds of 120+ knots and seas of 40 ft. and greater - Vessel was blown 100 miles offshore in 20 hours before having to be abandoned.

Situated on the Pacific side of the Mexican isthmus, the Gulf of Tehuantepec ranks among the most perilous bodies of water on the planet earth. Experienced ship captains fear the *Tehuantepec* as they fear Bengal monsoons, Caribbean hurricanes, North Atlantic icebergs, North Pacific fog and the freak waves of the Agulhas (see a list of such events by month in Appendix V at the back this publication).

Crossing the Gulf of Tehuantepec is not something to be trifled with. The weather mechanism that can generate 70-knot winds in a matter of hours can be likened to a boiling kettle from which high pressure steam has only one escape route - the spout. The kettle is the Gulf of Mexico, flanked by the Mexican Plateau and the 10,000 ft. Sierra Madre mountains.

The steam consists of the northeast tradewinds reinforced by a massive high pressure cell situated over Texas or thereabouts. The spout is the cut in the Sierra Madre Mountains (in the Isthmus of Tehuantepec) through which the wind blasts out into the Pacific.

The *Tehuantepec Demon* (as locals refer to it) is most active in the months of November, December and January, though it has been known to wake up in other months. The demon's reach may extend a few hundred miles out to sea.

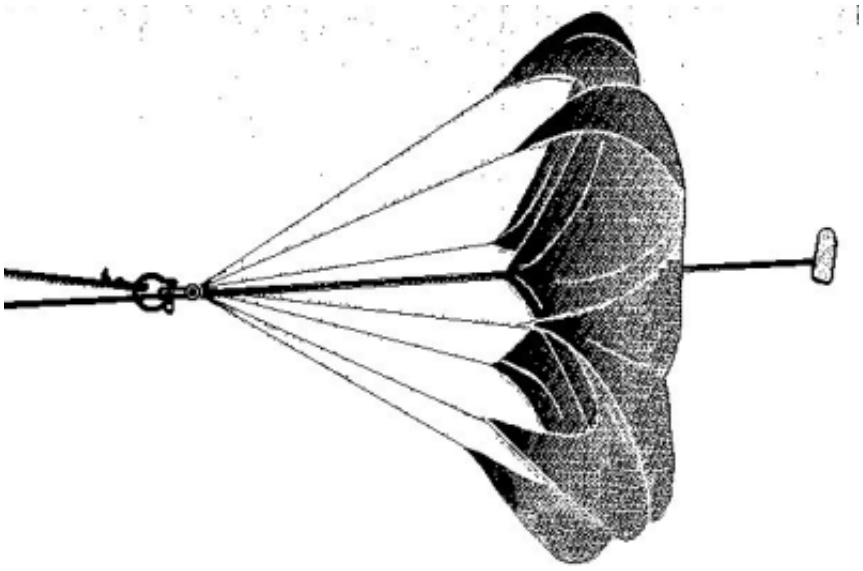
In crossing the Tehuantepec most southbound cruisers hold up in Huatulco Bay, waiting for a weather window. Northbound cruisers do the same on the other side of the Gulf of Tehuantepec, in Puerto Madero. The distance between Bahia de Huatulco and Puerto Madero is 260 miles as the crow flies

Since a strong wind must blow over a minimal distance - fetch - in order to build dangerous seas, and since the *Tehuantepeccer* blows from land out to sea, standard procedure - the highly recommended course - is to hug the beach and anchor if the *Tehuantepec* awakens, using the boat's heaviest ground tackle. Note that in doing so there are currents and other hazards that have to be watched for.

Captain Fred Yeates built *Anna Kay* with his own hands in 1984. She was the largest Jim Brown designed catamaran at the time. He spent five years cruising the Caribbean before transiting the Panama Canal in the spring of 1991. After several years in San Diego, Yeates sailed up to Santa Barbara where Victor Shane briefly met him. In the autumn of 1995 Yeates and Holly Janette Gatioan set sail out of Santa Barbara. Their destination was to be the Caribbean, via the Panama Canal. They spent several months in Mexico, arriving in Huatulco Bay in late February. *Anna Kay* waited there for two weeks. On 5 March a 48-hour window came through from the Canadian route forecaster Herb Hilgenburg via SSB. The weather fax was good and the port captain predicted safe sailing for two days. Fred and Holly set off to cross the Gulf of Tehuantepec and a nice warm breeze pushed them past Salina Cruz that night. The next

day the wind freshened and *Anna Kay* was moving along at a nice clip, hugging the beach just in case the *Tehuantepec* should awaken. In the afternoon of 7 March 1996 the *Tehuantepec* awoke with a vengeance. The wind did an abrupt right-face and started blowing offshore, building to hurricane force in two hours, wiping out the local fishing fleet and claiming dozens of lives. *Anna Kay* was blown offshore. Transcript:

> *We were sailing off the Mexican coast, on the Pacific side, in the area known as the Gulf of Tehuantepec. At 1500 hrs on the afternoon of 7 March 1996 I found myself staring at a true wonder of nature - the largest thunder cloud I had ever seen, grow and form into a massive solid black wall of wind and rain bearing down directly on* Anna Kay. *I awakened Holly from her sleep. She came up on deck and saw what was coming down. I can't repeat her first words. The cold wind and rain hit us like a sledgehammer. There were other vessels around us, large shrimp boats, with crews of four or five. We watched them struggle with the sudden buildup of wind and sea.*
>
> Anna Kay *was handling the conditions very well, the wind pushing us along the beach in the direction we wanted to go, there being no reason to anchor. In fact, by then it would have been quite difficult to do so. The bottom was too deep and the surf along the shore already quite spectacular. The wind continued to build. As we were being blasted down along the shore we witnessed one shrimp boat capsize. Clearly others were in trouble as well. With darkness falling, conditions worsening, and having no radar, I felt it would be wise to move offshore. Around 2000 hrs the wind suddenly shifted 90° and quickly built up to 75 knots! I deployed my 4' Shewmon VP* [variable pull] *drogue. Holly and I watched the last shore light disappear. We were now alone and heading out to sea.*



The Shewmon Variable Pull drogue is designed for drag adjustment while underway. The pull is varied by means of a secondary line affixed to the inside center of the drogue. This secondary line leads out of the shackle termination and comes back to the boat along with the main tether. Drag can be reduced by pulling on the secondary line. It can be increased by slacking off on it. (See Shewmon's Sea Anchor and Drogue Handbook for details)

With the drogue deployed from a stern bridle the behavior of the boat was relatively comfortable and I was able to lie down and rest for an hour or so. By midnight the confused seas had built to such an extent that the ride was getting scary. Suddenly we started moving faster, crashing-banging sounds all around. We came on deck and discovered that the drogue had twisted and tangled itself. I retrieve it, straightened it out and re-deployed it. The behavior of the boat improved. Around 0300 the drogue fouled again. In the darkness I couldn't tell why. It was a vital piece of gear and it had always worked before. About all I could do was to haul it back in and try re-deployment.

Dawn revealed an ugly sea. As the sun came up the wind increased, and with it came even larger seas. Once again the drogue fouled and I hauled it in, with Holly at the helm. By now the wind was gusting to 100. With no drag in the water we started to be picked up and thrown about by huge confused seas, cresting on both sides and to the rear. I went below and hauled out my 9-ft. Shewmon sea anchor. Everything was a mess down below, with water sloshing about my ankles. With quiet a bit of difficulty I set the bigger sea anchor [off the stern, on the fly] *and breathed a sigh of relief when it opened and held. With the big Shewmon deployed the boat slowed down and I didn't have to steer. I could leave the helm and actually go inside. I felt like resting for a while. But that was not to be. A wave washed the dinghy overboard. It was still tied and being dragged ten feet behind Anna Kay (the sea anchor being some 250' behind the boat). Big waves were breaking over our transom, trying to throw the dinghy at the catamaran. I thought about letting the dinghy sink and provide more drag. But the next wave convinced me otherwise. The dink had to go. I crawled to the transom with a knife in my teeth and cut it away.*

The wind was still increasing. As we rose to the top of a wave the sea was a white-out all around. The sea anchor was getting rolled by the steep, confused waves, from the left, then from the right. Later, as I was watching, it got caught by two cross-seas and collapsed right before my eyes. I worked very hard to retrieve it, with Holly at the helm, trying to keep the boat from broaching. The sea anchor was all tangled up but not torn. I untangled it, only to have a wave come along and tangle it again and almost sweep me overboard. After straightening out the sea anchor I carefully deployed it, trying to let it out as slowly as possible. It worked fine again for a while, before being fouled by more cross seas. I had no choice but to pull it back in again. This took some doing. The 3/4" rode was slippery and my hands were all white and wrinkled by now. My safety harness saved me many times. I felt the problem was not having a swivel. Dan Shewmon himself had told me that it was not necessary. But in this situation it was. In the chaos down below I found my heaviest ground tackle swivel. I hooked everything up - not an easy task. It took a little time. The wind was gusting way past 100 now. The gusts were so powerful that they would flatten the sea by the acre, whipping up spray that would white-out the entire ocean. I heaved the sea anchor overboard again. As I tried to ease the line out we surfed down a huge wave and I lost control. We were surfing at 15 knots. I had to let go the rope. I had to get my feet out of the way of the lines that were running out. The line reached its end and stretched. The sea anchor opened, a beautiful sight. Then it shuddered, turned into a rag and disappeared.

We had lost the sea anchor. I sat down next to Holly and kept yelling "what happened?" But this was not the time or place to cry over spilt milk. When I retrieved the rode only one new shackle was at the end [the connecting eye of the 5/8" galvanized swivel must have broken]. *I hooked up*

the 4' drogue and put it out again. Again it helped some, but didn't last long and I had to retrieve it. It was badly torn now and we couldn't tell what it had originally looked like. I asked Holly if she could sew it up. She went below looking for the sewing kit. I then put out a tire, and a couple of anchors to slow us down. I went forward and struggled with our largest anchor, trying not to look at the waves crashing all around (hope never to see such a sight again). I trailed as many things as I could off the stern to create drag and it helped a little bit. I seem to remember we managed a drink of water or juice then. I also remember seeing birds that couldn't fly, and turtles in great distress.

Late afternoon. Night was coming and there would be no moon until midnight or later. It was very cold. I had put on my Mustang immersion suit earlier, but it was open at neck, sleeves and ankles, so I was soaking wet and shivering. Holly was no better off as we screamed our commitments to each other above the noise of the wind and encouraged each other to fight on. The poor boat was trashed inside, but structurally sound. We would surf down a wave, be lifted to the top only to be sledge-hammered sideways by a cross sea. This action would launch heavy things around inside, levitating them, then causing them to hit something hard when the boat moved again. At the helm it was hang on for your life as white water tried to sweep you clean off the deck. The boat would be lifted by a crest, the bows would hang in mid-air and teeter there, before dropping one way or the other. Going over the back was much better than surfing the front, but you had to be ready for both.

Holly saw it first, pointing straight ahead, yelling "A freighter! A freighter!" It was half a mile away, a big white freighter, her bow scooping a huge sea, the wind whipping the water into a rainbow of spray that went clear over the bridge. The poor freighter looked like a canoe in the rapids. I went below and called on the VHF. I tried three times. No response. Finally they came back. I talked with the captain. He said the weather report was for conditions to get far worse. I was concerned about our lives. I was concerned about Holly. We truly love the life style, the people, the fun and the freedom of cruising, but we weren't out there to commit suicide. I issued a formal mayday. *The captain of the freighter said he would try to make a lee.*

I went down below. There was no time to gather the treasures of a lifetime, clothes, books, charts, photographs, things that can never be replaced. My wallet washed past my ankle. I picked it up, put a few other papers in my backpack and went out on deck. Holly went below to put a few things in a bag. The freighter passed by and came around behind us. Its towering bow came right on top of us, stopping in the nick of time. I saw her name, CHIQUITA BARU. We slid by and they fired rocket lines. But the wind blew them right back at the freighter. I asked Holly to cut away all the things we were dragging in the water. She was almost washed away in the process. It seemed that conditions were getting worse by the minute. I could see that the freighter was having its own problems, rolling dangerously, heavy surf crashing on deck as it lay broadside to the wind.

Anna Kay*'s motor started right up. The rudders worked fine. I tried to hold position by motoring around. Impossible. I tried reverse. No good. The freighter made another pass close by behind us, firing rocket lines that just got blown away again. We turned again. They were putting cargo nets over the side. Somehow we managed to come alongside. The catamaran's stable platform made it easier to get off. There was only time to help Holly up the ladder. She was alive, and that was all that counted. The ladder was swinging in and out, banging against the side of the huge hull. I*

urged her on, "climb, baby climb," and jumped myself. I got her moving up to strong hands that were waiting at the rails. She was taken below immediately, the conditions even on the deck of this Norwegian freighter being dangerous. The lines of the Anna Kay were let go and she drifted away. My last sight of her was a huge wave crashing over and onto the bows. She shook it off, and rose to the next, and then seemed to disappear in the stormy night.

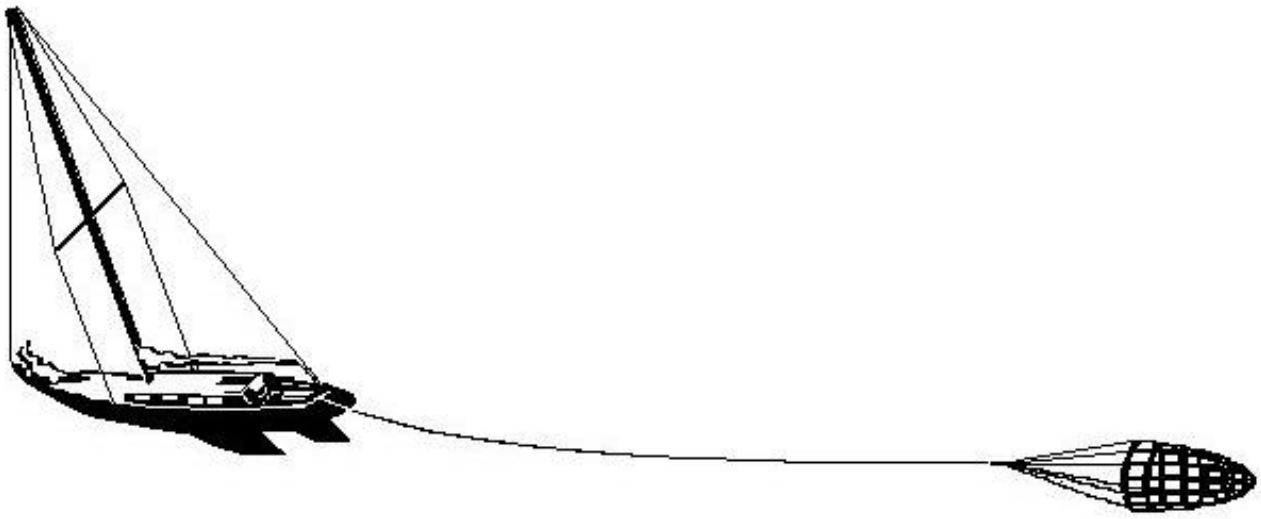
Drogues on Monohulls

D/M

D/M

Files Relating to Drogues

Used by Monohull Sailboats off the Stern



"To sum up, I have found that breaking wind waves in the open ocean become dangerous only when the vessel is driven through the water, and the faster she is traveling the more damage a sea is likely to inflict. Pooping seas, i.e., seas breaking over the stern when running, are the worst of all. "

John Voss

D/M-1 Monohull, Bermuda Ketch

Monohull, Bermuda Ketch

46' x 12 Tons, Full Keel

Warp, 60 Fathoms 3" Hawser

Force 10 Conditions

File D/M-1, derived from the writings of Miles Smeeton - Vessel name *Tzu Hang*, hailing port Victoria, B.C., monohull, Bermuda Ketch, built in Hong Kong in 1938, LOA 46' x LWL 36' x Beam 11' 6" x Draft 7' x 12 Tons - Full keel - Drogue: Warp consisting of 360' x 3-inch manila hawser - Deployed while running before a storm in the high latitudes of the Southern Ocean with winds of 50 knots and seas of 30-40 ft. - The warp had little effect in preventing the pitchpole of *Tzu Hang* about 1000 miles from Cape Horn on 14 February 1957 - The yacht was sailed under jury rig to Chile, reaching Arauco Bay 36 days later.

This is probably the classic pitchpole in all of yachting history. All the major works on the subject of heavy weather tactics make mention of it. Adlard Coles refers to the 1957 pitchpole of *Tzu Hang* six times in *Heavy Weather Sailing.* In her two celebrated attempts to round Cape Horn, *Tzu Hang* was pitchpoled the first time and rolled the second. On the first attempt she was manned by a crew of three, owner Miles Smeeton, his wife Beryl, and the renowned singlehander John Guzzwell of *Trekka* fame, (*Trekka Around The World*, John Guzzwell, 1963).

Tzu Hang had been running before mature seas in the high latitudes (50° South) of the Southern Ocean, trailing 60 fathoms of 3-inch manila hawser. Unlike nylon, manila has the sponge-like quality of soaking up water and was at one time considered to be ideal for use as warps. In this case it was not very effective, for Miles Smeeton writes, "I watched the sixty fathoms of 3-inch hawser streaming behind. It didn't seem to be making a damn of difference, although I suppose that it was helping to keep her stern on to the seas. Sometimes I could see the end being carried forward in a big bight on the top of a wave." (*Once Is Enough*, Granada Publishing, London, 1984, by permission).

As the boat continued to run before the storm, one breaking wave did come aboard, but *Tzu Hang* showed little tendency to broach. She seemed to be doing quite well in fact. "It was a dangerous sea I knew, but I had no doubt that she would carry us safely through, and as one great wave after another rushed past us, I grew more and more confident." (*Ibid.*) At the time of the incident Beryl had just relieved Miles at the helm, and was steering the boat when a great wall of water approached from the stern, so wide that she

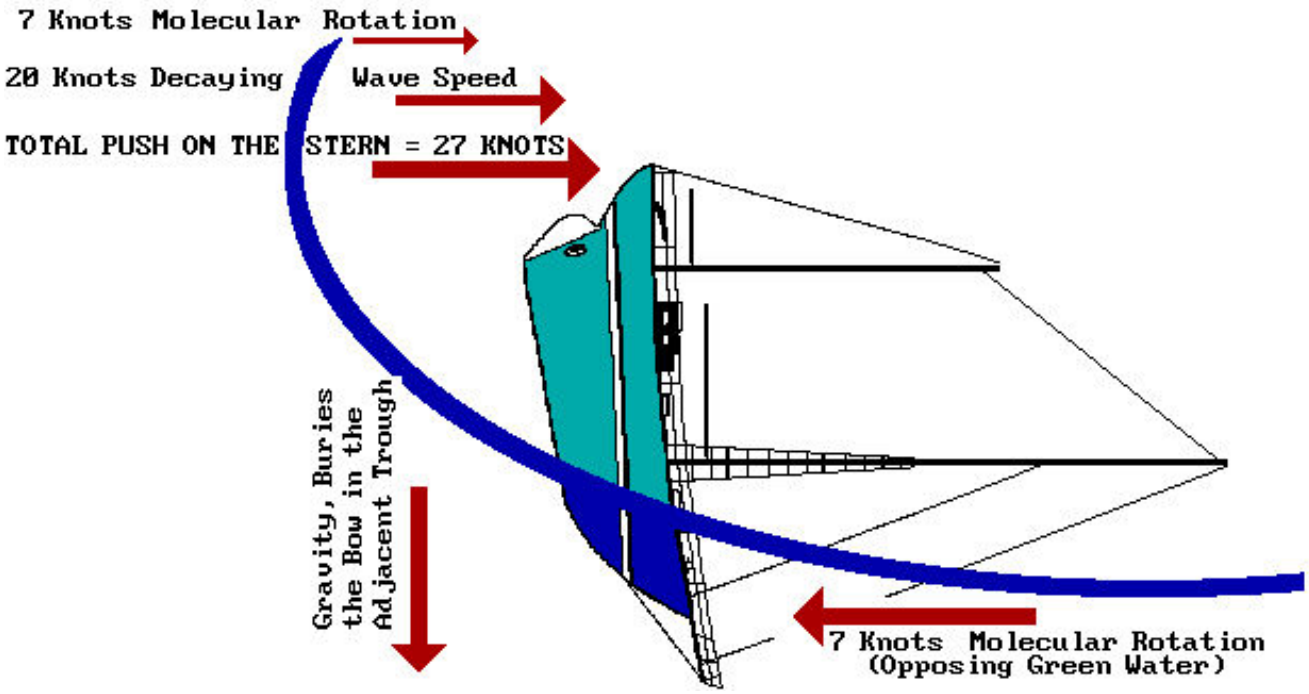
couldn't see its flanks, so high and so steep that she knew *Tzu Hang* could not ride over it. Water was cascading down its face, like a waterfall. Miles was down below, reading a book: "As I read, there was a sudden, sickening sense of disaster. I felt a great lurch and heel, and a thunder of sound filled my ears. I was conscious, in a terrified moment, of being driven into the front and side of my bunk with tremendous force. At the same time there was a tearing cracking sound, as if *Tzu Hang* was being ripped apart, and water burst solidly, raging into the cabin. There was darkness, black darkness, and pressure, and a feeling of being buried in a debris of boards, and I fought wildly to get out, thinking *Tzu Hang* had already gone down. Then suddenly I was standing again, waist deep in water, and floorboards and cushions, mattresses and books, were sloshing in wild confusion around me." (*Ibid.*)

Beryl had been catapulted out of the cockpit and into the sea, landing some 30 yards to leeward. Miraculously she was able to swim toward the trailing wreckage of the mizzen mast. Her shoulder was badly injured and it took the combined strength of the two dazed men to pull her back on board. But the situation was now critical. *Tzu Hang* had received a near death blow. Both masts were gone and there was a gaping - six foot square - hole where the doghouse had been. The weather was not getting any better and she was taking on great amounts of water. She would no doubt have gone down, had it not been for the tenacity and sheer will power of her crew.

From the onset Beryl, although in great pain, did her best to provoke, spur and cheer the two men on into life-saving action. She was the driving force that kept resignation and despair at bay. And John "Hurricane" Guzzwell would soon put his resolve, his backbone and his skills as a carpenter to keep *Tzu Hang* afloat. He patched the hole in the deck. He sawed and hammered, laminated and improvised, putting back together the pieces that would - thirty six days later - bring *Tzu Hang* safely into Arauco Bay, Chile. What transpired in those thirty six days on the wastes of the Southern Ocean should serve as an important lesson to all sailors regarding the *mindset* that is so often crucial to survival itself, the lesson being this: *Never give up.*

What exactly happened? There is much speculation about the exact movement of the boat during the mishap. Miles Smeeton is certain that it was a somersault: "When she pitchpoled a very high and exceptionally steep wave hit her, considerably higher than she was long. It must have broken as she assumed an almost vertical position on its face. The movement was extremely violent and quick. There was no sensation of being in a dangerous position with disaster threatening. Disaster was suddenly there. Whether she had been 20° to it or her stern directly presented to it, or whether she had been running at 2 or 7 knots could, in this case, have made no difference. Her stern came up and just went on going with no hesitation at all right over the bow." (*Because The Horn Is There*, Granada Publishing, London 1986, by permission).

The reader may wish to compare Smeeton's observations with the statement of Joan Casanova (File S/T-1), who survived a similar wave in the Southern Ocean: "It was the type of a wave which pitchpoles yachts in these oceans, the type which every voyager sailing in the high latitudes of the Southern Ocean fears.... We want to stress here that no vessel, multihull, monohull or freighter, could have survived such a sea unless tethered with a long line from a sea anchor...."



Formula for Disaster

Whereas a rising tide will lift a boat vertically by a force equal to her displacement (usually many tons), a steep wave will "lift" the same boat horizontally with equal displacement force (*DF*) at wave speed. Speed of molecular rotation is already about 7 knots on the crest of a 40-ft. wave (*A*). The decaying crest hurls tons of water at a wave speed of 20 knots at her transom (*B*). Force of gravity (*C*) drives the bow down into the adjacent trough where it is briefly met with 7 knots of reciprocal rotation coming from the opposite direction (*D*). Result: The stern goes flying right over the bow without any hesitation at all.

Miles Smeeton later wrote a short Postscript which may be the key to our understanding of the dynamics of pitchpole. This Postscript can be found on the last pages of *Once Is Enough* and includes the following remarks:

> *Since I wrote this book I have had a number of letters - mostly from well informed sources - on the reasons for* Tzu Hang's *two mishaps... the major cause was probably due to the orbital velocity of a big wave. I had never heard of this theory which is that, although the mass of water in a seaway, seen as a whole, is static, each particle of water moves in an orbit around the place which it would occupy at rest. If we were to throw some rubbish overboard so that it represents a particle of water on the surface, we would see it drawn back towards the approaching swell, lifted up, carried forward, and dumped in approximately its original position again; seen from the side it would trace an orbit against the background of sea and sky.*

The important thing is the speed at which the water moves in this orbit, and for a forty-foot wave with a ten second period the speed is approximately seven knots. With seven knots on the top of the wave with the wind, and seven knots against the wind at the bottom, a forty-foot ship on the point of a forty-foot wave is subjected roughly to a seven knot push one way at her stern and a seven knot push the other way at her bow, a formidable overturning couple. A longer ship is already overcoming the push at her bow by the time her stern is subjected to the maximum thrust. The answer seems to be to keep forty-foot ships out of forty-foot seas, but if forced to run before them to tow long enough lines so that there is an effective drag in spite of the forward movement of the water on the crest.... (Ibid.)

D/M-2 Monohull, Bermuda Ketch

Monohull, Bermuda Ketch

39' 6" x 13.4 Tons, Full Keel

Warps, Net and Pig Iron Drags

Force 10 Conditions

File D/M-2, derived from the writings of Bernard Moitessier - Vessel name *Joshua*, monohull, canoe-stern, center cockpit Bermuda Ketch build of steel, LOA 39' 6" x LWL 33' 9" x Beam 12' x Draft 5' 3' x 13.4 Tons - Full keel - Drogue: assorted drags used in concert, including 22 fathoms 4.5" hemp rope weighed down by 3 pigs of iron 40 lbs. each; 16 fathoms 3" hemp rope weighed down by two pigs of iron 40 lbs. each; 32 fathoms of 1.5" nylon rope trailing freely - Deployed while running before a mature storm in the high latitudes of the Southern Ocean with sustained winds of 50 knots and seas of 30 ft. - *Joshua* came near to pitchpoling several times and Moitessier elected to cut away all the drags.

Bernard Moitessier is undoubtedly one of the most extraordinary seamen that has ever lived. Fortunately he is an extraordinary writer as well. The critic Jonathan Raban once said, "I'd sooner read Moitessier than any other nautical writer alive." Indeed one never tires of reading Moitessier. He holds the imagination captive, from the first page to the last. Born in French Indo-China, Bernard's first odyssey was aboard his dilapidated junk, *Marie Therese*, which ran aground after a fifteen round - eighty five day - battle with a monsoon in the Indian Ocean. He then spent three years on the island of Mauritius, building *Marie Therese II*, which ran aground in the Antilles, after a long lonely Atlantic crossing. A few years later the resilient Moitessier had finished his book, *Vagabond des Mers du Sud*, and was in Chauffailles, France, getting married to "a little slip of a woman called Francoise" and overseeing the building of his new 39-ft. steel boat *Joshua*. In October 1963 he took Francoise "for a sail" on *Joshua* - across the Atlantic, through the Panama Canal, to the Galapagos and the South Pacific. The couple spent two happy, carefree years in Polynesia. In the winter of 1965 they "went sailing" again - Tahiti to Spain non-stop, via Cape Horn, 14,216 miles in 126 days.

It was on 13 December 1965 that *Joshua* ran into a heavy storm in the high latitudes of the Southern Ocean, mid-way between Tahiti and Cape Horn. Mindful of the experiences of Smeeton and Robinson, Moitessier deployed an array of drags to slow *Joshua* down - all told some 900 feet of heavy ropes weighed down by five 40-lb. iron pigs and a large heavy net used to load ships. Despite all the drag

devices in tow *Joshua* came very close to sharing the fate of *Tzu Hang* - going end over end. As he struggled with the helm, Moitessier began to take stock of his situation and compare it with the experiences of other "Cape Horners," among them the renowned Argentinean singlehander Vito Dumas.

In the famous episode that followed we find Moitessier engaging the ghost of the Dumas in a debate, as it were. "But what was your secret, Vito Dumas.... You did it... and *Legh II* was a small boat... you carried sail, I believe you... but you couldn't have carried any sail in this kind of seas, don't spin me that yarn, for if you had carried any sail in these seas you would have been pitchpoled like *Tzu Hang*... and like *Joshua*, almost.... And yet, you covered the three oceans...." (*Cape Horn, The Logical Route*, Grafton Books, London 1987, by permission).

Moitessier then writes that he doesn't believe in ghosts, but could have sworn that he heard a voice - that of Dumas - telling him the answer. Once he had the answer he was aft, cutting away all drags and warps, allowing *Joshua* to run unimpeded on bare poles. He noticed an enormous change in her: "She had no longer anything in common with the wretched boat of the night before which had made me think of the little hunter trying to parry the blows of a gorilla, with his feet caught in the undergrowth." (*Ibid.*) Thereafter Moitessier adopted the technique of "putting down the helm," and *Joshua* began taking the seas more safely on the quarter. Later on in the storm, as they are sitting in the inside steering station, he explains the technique to his wife Francoise:

> *I'm running dead before the wind to keep the maximum speed on the boat and make sure that she answers on the helm when she has to. Now watch carefully, you see that wave coming up* [behind]*... I am still dead before... and just before the stern lifts I turn the wheel right down... You see... she heels over and veers to the right as she ought to... she is pushed forward and a little sideways... the moment the stern settles down again, just after the wave has passed I turn the wheel* right over *in the opposite direction to bring her back again stern on; this is the best moment because the rudder is deep in the water and very effective... you see... we are back dead before the wind, and the business starts all over again. (Ibid.)*

Remarkably, Moitessier seems to be using his *instincts* to avoid pitchpole (see image in previous file). It must have been instinct because the phenomenon of orbital rotation was not well known at the time - nowhere in his writings does Moitessier refer to the orbital rotation of waves. Indeed, one can only infer that Moitessier must have been directed by some rare and spontaneous instinct peculiar to extraordinary seamen. By that, or by the ghost of Vito Dumas.

To fly dead straight down a wave face would have placed *Joshua* in the same head-over-heels predicament as *Tzu Hang* - the bow impaling itself in the approaching "current" in the trough as the stern was being hurled downwind by the motion at the crest. So, in maneuvering *across* the face of a wave (like a skier zig-zagging down a slope), Moitessier is in effect trying to cheat the pitchpole demon - trying to keep the bow from burying itself in the adjacent trough. To some extent the same principle is used by a surfer when he puts down his heel to "spin out" and disengage from the wave. Needless to say in order to

execute this maneuver with precision over and over again in a storm, the helmsman of a sailboat would require the reflexes, the skill and the stamina of a Grand Prix driver, attributes that Moitessier no doubt possessed at that time, but hardly common to all sailors. Bear in mind also that *Joshua* was made of steel, had a canoe stern, a center cockpit, and an inside steering station where the helmsmen could concentrate on what he was doing, unaffected by the cold and the wet. It is interesting to note what the late Miles Smeeton had to say about this technique:

> *When Bernard Moitessier, that fine seaman, offers an opinion, it should be well considered, because he has twice sailed* Joshua *round Cape Horn... but his answer is not necessarily the right one for all yachts, any more than mine is, and it requires a superman to steer accurately like this through a dark night.... Even if his theory is correct for other yachts, tired men and irregular waves are apt to defy it. (*Because The Horn Is There, *Granada Publishing, London, 1984 & 1985, Appendix, by permission).*

In 1982 *Joshua* was anchored in Cabo San Lucas, Mexico, when a tropical storm swept over the crowded anchorage. A large motorboat dragged down on *Joshua*, forcing her up on the beach, where numerous other yachts ended their careers as well. When the fiasco was over nothing remained of the famous boat other than her bare steel hull. Two brothers from Port Townsend, Washington bought the hull for $20 and spent two years rebuilding her, later selling her to a Seattle woman. The woman's dream of sailing *Joshua* around the world was rudely shattered by the indiscretion of her sailing partner - he turned out to be married. The French newspaper *Voiles & Voliers* heard about the affair and sent a photographer to Seattle. After the article - showing magnificent photographs of *Joshua* under sail - was published, a number of famous sailors banded together to form the *Joshua Foundation*. The French Maritime Museum then purchased the dear old boat, put it on a ship and took it to La Rochelle France, where she is on display today.

D/M-3 Monohull, Custom Ketch

D/M-3

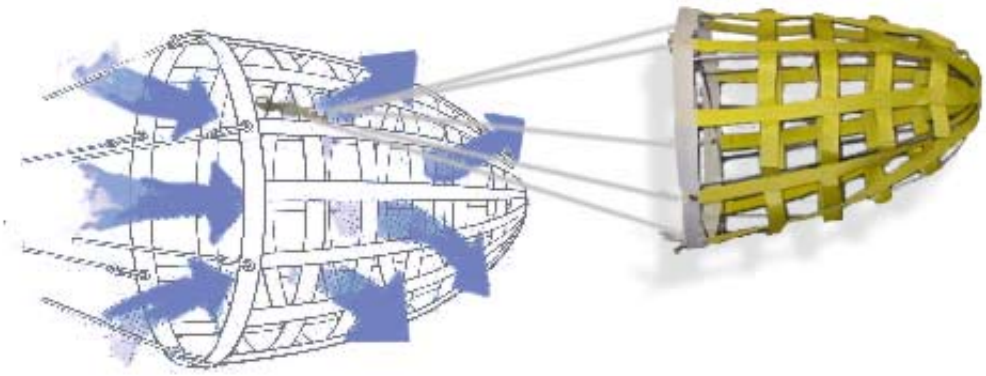
Monohull, Custom Ketch

50 x 22 Tons, Full Keel & Centerboard

36" Dia. Galerider

Force 10 Conditions

File D/M-3, obtained from Frank Snyder, Vice Commodore, New York Yacht Club - Vessel name *Southerly*, hailing port New York, monohull, center-cockpit aluminum ketch designed by Sparkman & Stephens, LOA 50' x LWL 45' x Beam 14' x Draft 5.5' x 22 Tons - Full keel & centerboard - Drogue: *Galerider* on 200' x 1¼" nylon three strand rode, with 1/2" stainless steel swivel - Deployed in low system in deep water in the Gulf Stream, with winds of 50 knots and seas of 10 ft. - Vessel's stern yawed 20° with helmsman steering - Speed was reduced to 3-4 knots.



Galerider drogue produced by Hathaway, Reiser and Raymond

Frank V. Snyder, Vice Commodore of the New York Yacht Club, ran across an article in a British magazine summarizing the results of experiments conducted by the National Maritime Institute on life rafts in heavy weather, in the North Sea. The article emphasized the importance of sea anchors - small, synthetic cones - when it came to keeping life rafts from capsizing, but revealed that the same cones were often among the first parts of the raft to fail. The article went on to say that the Institute had then designed and built new sea anchors from a close mesh netting material which, unlike their predecessors, did not fail in a second set of sea trials. One raft even lost its ballast bags but still did not flip: its sea anchor held it down.

When preparing his 55-ft. ketch *Southerly* for a late fall passage from New York to Antigua in 1984,

Commodore Snyder decided to equip her with a flow-through drogue of his own design. He approached Skip Raymond of the sailmaking firm of Hathaway, Reiser & Raymond, Inc., with his ideas. Raymond then went to work, building a small model at first, and then the full scale prototype of the first *Galerider* drogue. It was three feet in diameter and four feet long, shaped a little like a basket made from two-inch nylon webbing. On Saturday, November 17, *Southerly* departed New York Harbor and broad-reached all Saturday and Sunday morning, making better than eight knots in seas that were building. On Sunday afternoon the barometer began dropping rapidly and, by the time she entered the Gulf Stream at dusk, the wind had piped up to southwest, Force 9-10. Soon she was in very confused conditions, with two big seas crossing at an angle of 90°.

In a related article appearing in the September 1986 issue of *Yachting Magazine* entitled *Galerider Handles a Gale*, Frank Snyder wrote that despite being a big, strong, stiff and seakindly boat, *Southerly* couldn't handle the turmoil. He directed the crew to douse the trysail and they began running before it under bare poles, trying to keep the new seas slightly on the starboard quarter. But as the confused seas continued to build *Southerly* became unmanageable, now and then her speed racing up to 12 knots or more on the face of a bigger wave. To have her surging at these speeds under bare poles was alarming. The vicious cross seas would catch her on the downslide and roll her rail down under. Her hull form would then cause her to broach in the trough - dangerous if the waves got any bigger. It was time to deploy the *Galerider*. The rode, 200 feet of 1¼" nylon three strand, was attached to the drogue and the bitter end given four turns around the coffee grinder on the after deck (*Southerly* is a center-cockpit boat). In went the drogue. When it took hold there was no shock at all; in fact the crew couldn't tell for sure the precise moment when the drogue did take hold, but were soon aware that the boat was slowing down. Commodore Snyder writes that the effect of slowing the boat in that big, confused seaway was magical:

> *At one moment the boat had been charging like a mad bull, with the helmsman struggling at the wheel; in the next, she was docile and under full control. The helmsman found that* Southerly *would still answer her helm - though slowly - and that she could steer through about 90°. Everyone relaxed, and the off-watch turned in, even though the motion wasn't all that comfortable, with the cross sea still rolling us 20° either side of vertical. But the boat was safe.*
>
> *The seas continued to build for the next three hours and several big ones came aboard over the stern, though no green water reached the cockpit. Had the cockpit been aft, it would probably have filled a couple of times. At 0200, the wind veered to north and began dropping. By 0400 it was down to Force 7, and the storm was over - another of those six-hour Gulf Stream "local lows."* (*Yachting Magazine*, September 1986, by permission).

Commodore Snyder's creation has caught on and many offshore yachts now carry a *Galerider* on board. The "flow-through" concept is rugged, simple, stable, and does not get turned inside out. The stainless steel wire hoop that keeps the *Galerider*'s mouth open can be folded on itself, allowing for compact storage.

D/M-4 Monohull, Irwin 37

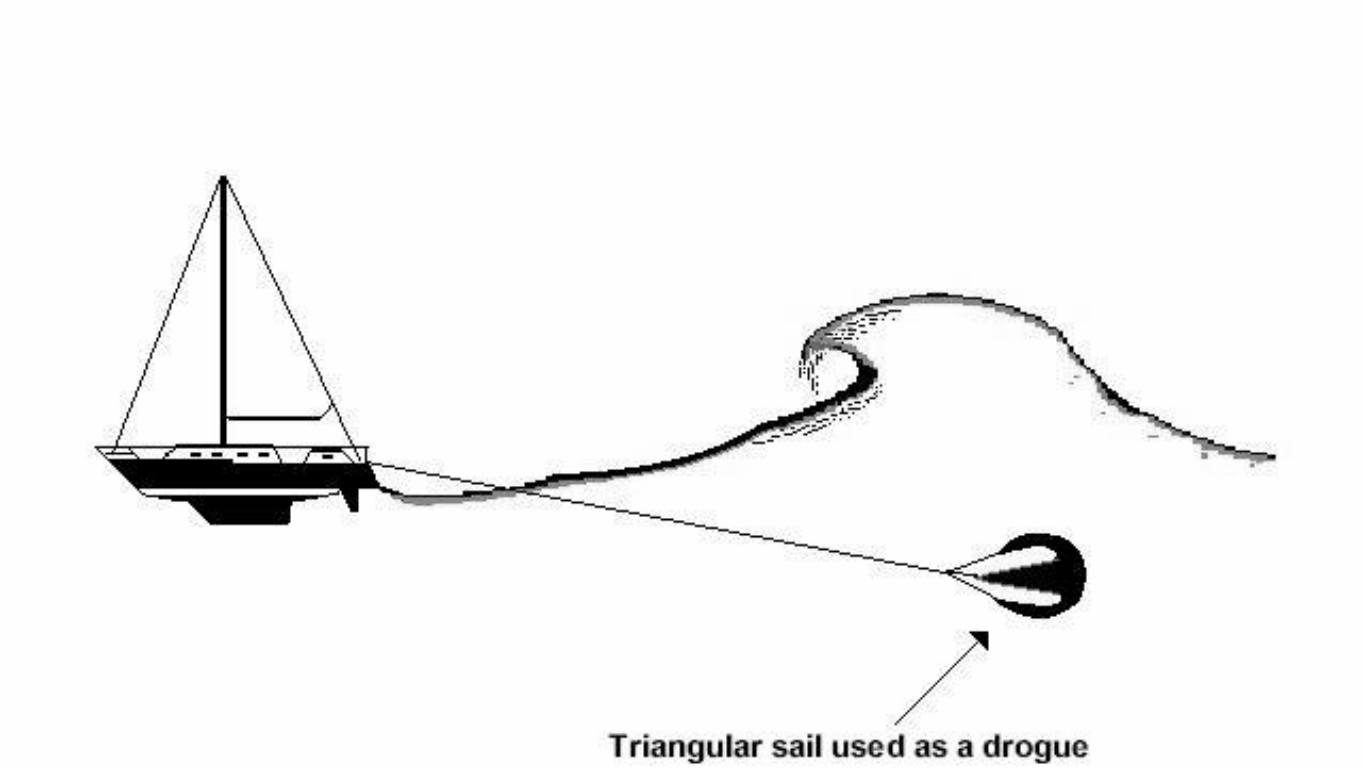
D/M-4

Monohull, Irwin 37

37' x 6 Tons, Low Aspect Fin Keel

Jury-Rigged Sail

Force 7-8 Conditions



File D/M-4, obtained from Charles E. Kanter, Key Largo, FL. - Vessel name *Lorilynn*, hailing port Philadelphia, monohull, center-cockpit sloop designed by Ted Irwin, LOA 37' x LWL 34' x Beam 14' x Draft 4' x 6 Tons - Low aspect fin keel - Drogue: 150% Genoa sail (three corners tied together like a diaper) on 200' x 5/8" nylon three strand rode, with no swivel - Deployed in a low system in deep water midway between Great Anagua and Ackland Islands (Bahamas) with winds of 30-40 knots and seas of 8-12 ft. - Vessel's stern yawed 10° - Drift was said to be very little.

A former delivery skipper, Charles E. Kanter has well over 100,000 blue water miles under his belt. He has served as sailing coach to the United States Naval Academy in Annapolis, conducted extensive tests on ground anchors, written articles about sea anchors, ground anchors and hurricane mooring systems. On the occasion of this file Kanter and crew were sailing their newly refurbished Irwin 37, *Lorilynn*, from St. Thomas to the Bahamas when they ran into full gale conditions. To the north lay the treacherous shoals of Acklins Island, and to the west the equally treacherous lee shore of the Great Bahama Bank.

Kanter rigged a "drogue" out of his largest genoa. He tied the three corners of the sail loosely together with dock lines; he then connected it to 200 ft. of anchor rode and carefully deployed the whole thing over the stern. He was able to get the sail to fill and assume a shape similar to a triangular parachute. The boat then lay comfortably stern-to the seas for a period of about 12 hours, more or less anchored to the surface of the ocean. The wind and the rain were so strong that it was impossible to go on deck. The EPIRB, life raft and the calamity pack were made ready just in case. The crew prepared itself for the worst.

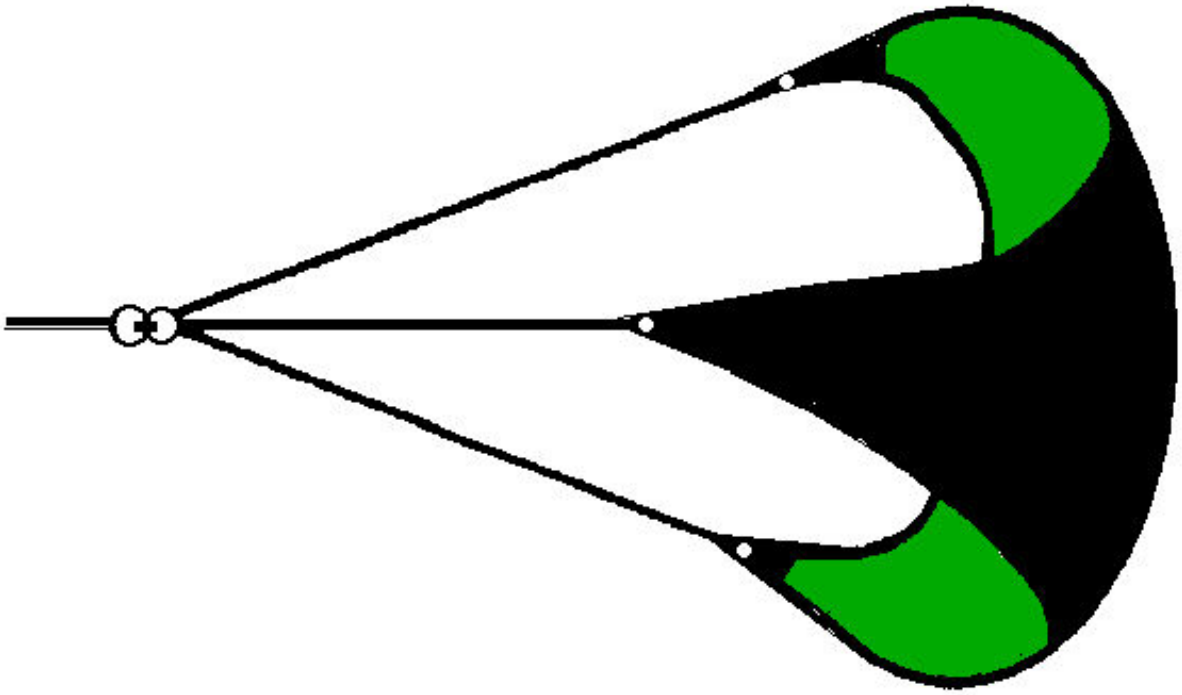
Every fifteen minutes one of them would try to poke a head out of the hatch as a lookout, but it was a futile exercise, the air being so thick with spume and spray. In related articles appearing in the February 1985 issue of *Cruising World* and September/October 1987 issue of *Multihulls Magazine*, Charles Kanter wrote that he spent the entire night on the cabin sole, agonizing and reflecting on the tactic as it related to the particular boat and situation. As it turned out the center cockpit Irwin rode out the storm quite nicely, without excessive yawing or broaching. Her stern stayed more or less snubbed into the seas, and in twelve hours she had drifted only about three miles westward - the wind being from the east. By dawn the storm had abated and they got under way again, after hauling the "genny anchor" back in. It is interesting to note that Kanter mentions observing large cresting waves breaking over the location of the makeshift drogue:

> *We found that the sea anchor being close to the surface caused the waves to break before they reached the boat, just like being behind a shoal. It was awe-inspiring. Giant waves would rush up behind us, looking like they were going to overwhelm us and they would, literally, explode when they hit the sea anchor artificial shoal. We never took green water on the deck in the twelve hours we lay there. It looked a little like the famous Hawaii surf, with us standing just far enough up the beach to get a little foam. (Multihulls Magazine,* September/October 1987, by permission).

In parts of the Mediterranean where ancient Phoenicians knew of the existence of underwater currents they would lower their sails into the depths and get a tow when becalmed. Sails have great potential for use as makeshift sea anchors and drogues. Think about it. If a sail is strong enough to drive a heavy boat through the sea at several knots, why can't it be used as a sea anchor or drogue to reduce drift? In section 8 of *Oceanography And Seamanship*, William G. Van Dorn discusses the use of parachutes as sea anchors and adds that a makeshift parachute can be rigged out of any heavy spinnaker, "using three sheets as shroud lines and any spare nylon for a rode." He goes on to say that the forces will be about the same as if it were flying in a strong wind.

Sailors should also read the article *Sails As Sea Anchors* by Daniel C. Shewmon, appearing in the

July/August 1986 issue of *Multihulls Magazine* (back issues available from *Multihulls Magazine, 421 Hancock St., Quincy MA 02171*). This article explains and illustrates how to convert sails into emergency sea anchors. Shewmon emphasizes that purpose-made sea anchors should be standard equipment on all offshore boats, but that if the unit is lost or damaged it can temporarily be replaced by a sail. "Mains, genoas, and spinnakers are ideal shapes for conversions to sea anchors.... The key to their success as sea anchors is equal flow of water from all three sides." (July/August issue of *Multihulls Magazine*, by permission).



Large, equilateral sails, such as genoas, can be converted into sea anchors - or drogues - by tying the three corners together like a diaper, or by using three short lengths of rope as shown above. A swivel termination is a good idea. On some vessels this "genny anchor" can then be used off the bow, along with a mizzen or riding sail. On others, it may be used off the stern as a makeshift medium-pull drogue.

D/M-5 Monohull, Tayana

Monohull, Tayana

37' x 11 Tons, Full Keel & Cutaway Forefoot

Warps, Submerged Dinghy, Etc.

Force 11-12 Conditions

File D/M-5, obtained from Patton S. King, Houston, TX. - Vessel name *Hudie*, hailing port Houston, monohull, Tayana, designed by Robert Perry, LOA 37' x LWL 31' x Beam 11' 6" x Draft 5' 8" x 11 Tons - Full keel & cutaway forefoot - Drogue: Four warps, 250' each, with various items attached, including buckets, tarp, sail bags and submerged 8-ft. fiberglass dinghy - Deployed in hurricane *Juan* (October '85) in 100 fathoms of water about 130 miles SE of Galveston, with winds of 90 knots and seas of 30 ft. - Vessel yawed 40° and was eventually rolled full circle by a rogue wave, necessitating abandonment.

Hudie, a seakindly, canoe-stern Tayana 37 designed by Robert Perry, was on her way to Key West from Galveston in October 1985. To the east, a tropical depression had formed, which soon matured into a tropical storm, and was later upgraded to a full-fledged hurricane, named *Juan* by the National Hurricane Center in Miami. In the language of meteorologists, the term *re-curvature* refers to the shift in direction of the path of a hurricane, from a westerly to an easterly component of movement. Trying to predict when and where a hurricane is going to re-curve is the sort of thing that gives the men and women of the National Hurricane Center migraine headaches. *Juan* wasn't about to make things any easier. It was "all over the place," stalling and moving about erratically - playing a game of hide and seek with the forecasters.

Juan was only category 1 in stature, weak in so far as hurricanes go. In terms of damage, however, it would soon prove itself to be one of the worst storms in history. On October 28th, for instance, it forced 80 oil workers on 2 offshore rigs to take to life boats. On the 29th it sank an oil barge with 3 crewmen on board. On the 30th it was lashing the Louisiana coast for a second day, causing an estimated fifty deaths and one billion dollars damage. Governor Edwin Edwards said that *Juan* had done more damage to the state than any storm in history, and President Reagan had to declare the state of Louisiana a disaster area on November 2nd.

Meanwhile, back on Friday October 25th, *Hudie* was down to her last reef points, with the storm jib pulling like a bulldozer. The seas continued to build rapidly and on Saturday night she found herself engulfed within *Juan*'s spiraling arms. Wind: Force 11-12. *Hudie* was running before 30-ft. seas now, averaging 6 knots on bare poles. With options narrowing the owner, Patton S. King, deployed a 9-ft. diameter BUORD on the fly, believing that it would stop the boat and pull the bow around, or at least partially around. No swivel was used. The rode consisted of 200 feet of 5/8" diameter nylon three strand, leading out of the port bow chock. The shock of the opening parachute was noted, along with extremely high tension in the rode. The boat's speed decreased from 6 knots to 3 knots. But *Hudie* did not round up into the wind. She didn't even come beam to the seas, but instead assumed a heading still downwind, with the seas on her quarter and with the rode leading off the bow, bent under the keel and trailing out astern.

We should digress briefly and ask the question as to why the 9-ft. diameter BUORD failed to exert some sort of a pull on the bow - make the boat stop, turn around and begin facing into the wind and seas. There are several possible answers.

In the first place, with nearly six feet of draft, a full keel and the forefoot cutaway, the Tayana 37's CE (center of wind effort) is well forward of her CLR (center of lateral resistance). A yacht like this won't even lie a-hull in hurricane force winds. Rather, she will tend to point downwind. For a sea anchor to countermand this tendency and actually pull the bow all the way around it would have to be larger - in the order of 15-18 feet in diameter.

In the second place, there is the matter of the *torque* associated with three strand rope under extreme dynamic loading. The chute was set on the fly, resulting in a significant shock when it opened. No swivel was used (not that it would have been able to rotate, initially) and extremely high tension was noted in the line. What happens to three strand rope when it is subjected to this sort of extreme loading? *It torques.* In trying to unlay, it will stiffens and rotate like an engine shaft, twisting the parachute shroud lines together into a thick lay and reducing the diameter at the mouth of the parachute. The sea anchor was too small to begin with, and with its mouth choked shut it could not possibly have pulled the bow of *Hudie* around into the seas.

At any rate, twenty minutes later the rode parted from chafe under the keel, and the boat resumed its 6-knot run down streaked mountains of water. Four warps, 250 ft. each, were then trailed over the stern, with various items attached, including buckets, 2 tarps, sail bags, an igloo ice box (full of ice and pop) and a submerged, 8 foot fiberglass dinghy. The combined drag was enough to slow *Hudie* down to 3 knots again. In fact, from 10 p.m. on Saturday, until 6 a.m. Sunday, the makeshift drogues improved the behavior of the boat to such an extent that in subsequent telephone conversations with Victor Shane, Patton S. King said that he could not have been happier with the way things were going.

At approximately 6 a.m. Sunday, however, it is thought that a rogue wave picked up *Hudie*, carried her sideways, broke and rolled her through 360° in about twelve seconds. Instantly cans, bottles, tables, utensils, floor boards and people were rolling around in total shambles inside - with broken glass everywhere. There was much evidence of roof damage, with extensive damage to the rigging, mast and spreaders. All the crew had sustained injuries, fortunately nothing major. They could not raise the Coast Guard, but a call to "any vessel" was soon answered by a couple of tugs and a commercial fishing boat. In the meantime they cut away all warps, started the engine, brought the bow around and began jogging into it.

By 3.30 p.m. Sunday afternoon the situation had become altogether untenable - all pumps clogged or broken, engine rapidly overheating and the boat being hammered by 25-ft. seas. When the F/V *Gulf King* appeared and agreed to take the crew aboard the decision was made to abandon ship. Soon all were safely aboard the *Gulf King*. Their last view of *Hudie* was seeing her get knocked down in the distance.

D/M-6A Monohull, Ericson

Monohull, Ericson

25' x 3 Tons, Swing Keel

9-Ft. BUORD, 30" Galerider & Series Drogue

Force 4-5 Conditions

File D/M-6A, obtained from Gary Danielson, St. Clair Shores, MI. - Vessel name *Moon Boots*, hailing port Detroit, monohull, designed by Bruce King, LOA 24' 8" x LWL 20' 10" x Beam 8' x Draft 4' (27" keel up) x 3 Tons - TESTS OF: 9-Ft. Diameter BUORD, 30" Galerider, Jordan Series Drogue - Deployed for evaluation purposes during passage of frontal trough in shallow water (9 fathoms) on Lake Huron with winds of 25 knots and seas of 6-8 ft.

Prior to sailing his Ericson 25 across the Atlantic Gary Danielson tried out three different drag-device concepts: A 9-ft. diameter BUORD parachute off the bow, a 30-inch *Galerider* drogue off the stern, and a Jordan *series drogue* off the stern (88 x 5-inch diameter cones spliced into 300 ft. of braided 1/2" nylon towline at 20" intervals, with a 15 lb. mushroom anchor at the very end to keep the array well-submerged).

To make his investigation as reliable as possible Danielson did all of the testing on a single day, in constant conditions. The crew for this evaluation was along solely to take measurements and record data. The tests were conducted in November 1988 on Lake Huron. On the day of the tests the sustained wind speed varied between 20 and 25 knots with gusts of 30 knots. The waves varied between 6 and 8 feet.

One of Danielson's preconditions was that the swing keel be up and out of harm's way on this particular boat. With the keel raised he found that the 9-ft. BUORD parachute would not pull the bow of *Moon Boots* into the seas in a satisfactory manner. It yawed up to 50° off to each side. This is not too different from the experience of Harley Sachs in file S/M-11, where the bow of *Gamesmanship* yawed 30-45° off to each side when the keel was retracted, but only 10° when it was lowered. Transcript:

> ***Sea Anchor:*** *A 9 foot sea anchor was deployed over the bow attached to 300 feet of 3/8" braided nylon rode. The centerboard and rudder were both raised and all sails were lowered for this test. The sea anchor was very easy to deploy and there was no shock to it when it grabbed hold of the*

boat. It did an extremely good job of keeping the boat in place as sternward drift through the water ranged from .25-.75 knots. The problem was that the boat was yawing through an arc which totaled almost 100 degrees (putting the bow of the boat almost 50 degrees off the wave). It was yawing very slowly from side to side so that there were lengthy periods (60 seconds) where the bow of the boat was as much as 50 degrees from the wave direction.

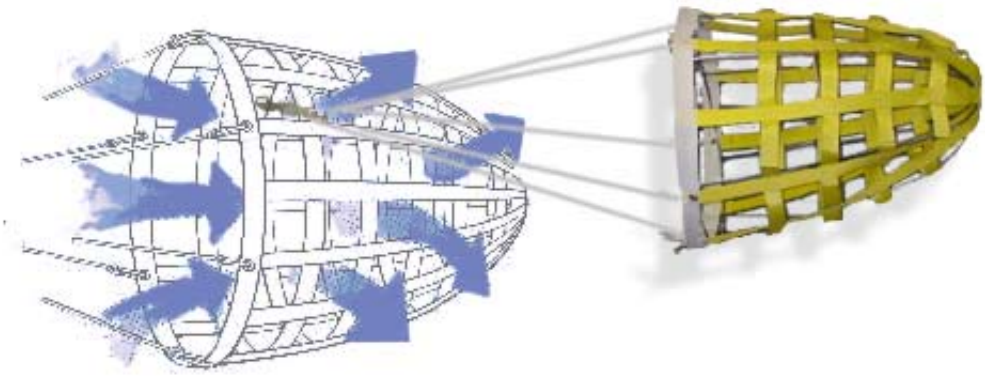
Since the boat spent so much of its time not being bow-on to the waves it rolled quite heavily (in excess of 20 degrees) and relatively quickly. Had the conditions been more severe, this could have proved to have been dangerous. The rode was then shortened to 150 feet of scope to see what effect that would have on the yawing of the boat. Repeated measurements showed no substantial variation in yaw even with the shortened scope. The sea anchor was very difficult to retrieve as Moon Boots *has no anchor windlass on the foredeck and as no trip line had been attached to the sea anchor.*

A BUORD is a porous small parachute issued by the Bureau of Ordnance

Galerider: *The next item tested was the Galerider drogue. This was set from the stern utilizing a 30 foot 1/2" braided tether which was connected to each of the stern quarters of the boat and then attached to a 150 foot 3/8" braided nylon rode. Initially the Galerider was utilized with no sail up, the centerboard and rudder both retracted. The Galerider drogue had a steady and constant pull and did not jerk when it was deployed... it held the boat to a total yaw of 10° (5° per side). The boat rolled (vertically) no more than 10-12° to a side. As well, it rolled much more slowly than it did with the sea anchor out. The Galerider was running below the surface, but only by about 5 feet. Therefore, in heavier conditions it may be somewhat more susceptible to surface wave action. It did not pull the stern down much at all and gave the boat, overall, a very nice ride.*

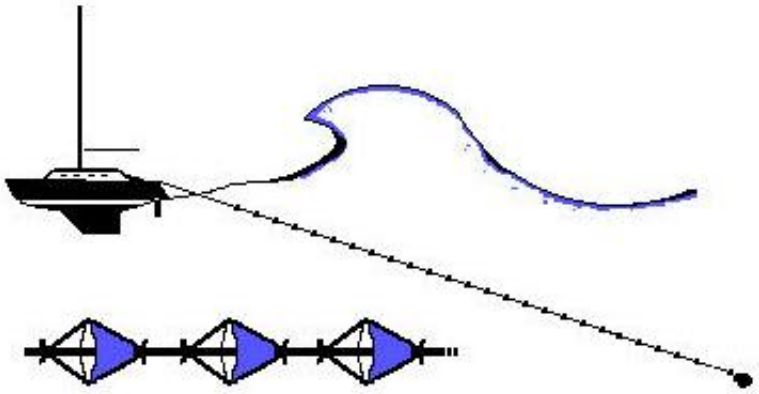
Next, the rudder was lowered and allowed to swing free and the centerboard was lowered while the Galerider was still out. It was noted that the boat then yawed through a total of about 70° (35° per side). The boat still rolled very little and did so slowly. Next, a small jib sail was raised to see

how the boat sailed with the Galerider out. The boat could be sailed through a total arc of 90° (45° per side). The boat speed ranged from 2.5 to 4 knots. There was no tendency whatsoever for the boat to surf and, of course, at these speeds it was very responsive to the helm. The Galerider was particularly easy to retrieve as the rode with which it had been deployed was wrapped around a cockpit winch and winched back aboard.



Galerider drogue produced by Hathaway, Reiser and Raymond

Series Drogue: *The Jordan style series drogue was then deployed over the stern using the bridle to each of the quarters of the boat and attached to the 300 ft. rode (with cones)... the centerboard was up, the rudder was up and all sails were lowered for this test. This drogue was easy to deploy and caused no shock loading when it began to take effect. The Jordan style drogue appeared to sink very deeply into the water and, in fact, created a substantial downward as well as rearward pull on the boat. Consequently a number of waves washed in over the transom of the boat while the Jordan drogue was deployed. The Jordan drogue slowed the boat so that the average speed was between 0 and .25 knots.... The boat yawed a total of 10° (5° per side). The boat rolled very little, only 10-12° per side, and did so slowly. The series drogue was easier to retrieve than the sea anchor (without any trip line) but more difficult than the Galerider. It was easier than the sea anchor because every few feet of rode that were retrieved resulted in one less cone being in the water to create drag and therefore the drag continued to be reduced as the rode was brought in. The difficulty with retrieving the Jordan style drogue is that it cannot be retrieved utilizing winches because the cones get tangled up when a winch is used so that retrieval can only be done by hand....*



The Jordan Series Drogue consists of dozens of tiny cones spliced into the long rode

CONCLUSIONS: *In the moderate conditions of the test the Galerider was definitely the best product of those which were tested. Its advantages are its small storage space, its ease of deployment and retrieval.... It has the additional benefit of having enough drag that the boat can be actively sailed, but will not surf, should you find the wind blowing in a favorable direction. It would be useful if repairs were needed since it stops the boat from rolling. The Galerider is also good in that it does not seem to pull the cockpit down (which would make it vulnerable to breaking waves). The concerns that I have are that it may not ride deep enough to avoid wave action in heavy weather (resulting in a possible loss of drag) and it is possible that it may not offer enough drag in the ultimate storm to pull the stern into a serious breaking wave....*

The Jordan style drogue would be helpful to keep the boat from rolling while some repairs were made and is the best at keeping the boat in a stationary position if drift were undesirable. It also was the best at keeping the stern directly into the waves and at exerting a constant pull. Finally, I am confident that its design of multiple cones coupled with its deep riding nature would ensure that no matter what the wave situation it would never be caught in wave disturbance and lose any appreciable amount of drag. The disadvantage was that it rode too deep and exerted too much downward force on the stern of the boat. However, I will be putting a smaller weight on the end in an effort to reduce the downward pull.

Please note Gary's update after serveral mid-Atlantic gales

D/M-6B Monohull, Ericson

Monohull, Ericson

25' x 3 Tons, Swing Keel

Jordan Series Drogue

Force 8 Conditions

File D/M-6B, obtained from Gary Danielson, St. Clair Shores, MI. - Vessel name *Moon Boots*, hailing port Detroit, monohull, designed by Bruce King, LOA 24' 8" x LWL 20' 10" x Beam 8' x Draft 4' (27" keel up) x 3 Tons. Drogue: Galerider deployed in Force 8, mid-Atlantic - vessel required constant steering. Jordan series drogue (88 x 5" cones on 300' x 1/2" nylon braid rode) - Deployed in a gale in deep water about 500 miles east of the Bahamas with winds of 35-45 knots and seas of 9-14 ft. - Vessel's stern yawed 10° - Drift was about 10 miles during 36 hours of deployment.

This file updates the previous one. Gary Danielson's Lake Huron evaluations took place in 1988. In 1991 he sailed *Moon Boots* across the Atlantic and back. He had occasion to use the *Galerider* and the *series drogue* in a number of Force 8 gales. In the first mid-Atlantic gale he used the *Galerider* and found that it greatly enhanced steering control in 15-ft. seas, but left to itself (while he was resting down below) it would allow the stern of the boat to yaw too much - 40° off to each side at times. In the second Force 8 gale (600 miles from the British Isles and 15-ft. seas again) he used the series drogue and it kept the stern of the boat snubbed into the seas and, in taking total control of the situation, allowed him to remain down below and get much needed rest. Danielson sailed *Moon Boots* back across the Atlantic singlehanded in March 1991, re-tracing Columbus' route from the Canaries to San Salvador in the Bahamas. En route he ran into another Force 8 gale. Transcript:

> *The only heavy weather of the trip occurred about 500 miles east of San Salvador, Bahamas. As my course was due West at that point, it meant the wind was right on the nose. At 25-30 knots* Moon Boots *can't sail upwind effectively any longer. Once the wind got to the low 30's I knew I'd have to put out a drogue. I decided to use the Jordan style series drogue rather than the Galerider because I didn't want to lose any of the ground I'd already gained and the Jordan is a much better "anchor" than the Galerider. In fact, that was pretty much how I decided which one to use on the prior trip also. In any event it did an outstanding job of keeping the stern into the*

waves and of limiting drift to almost nothing (10 miles in 36 hours, less any westerly drift from possible currents). I had changed the 15 lb. mushroom at the end to a 5 lb. weight and that helped the Jordan to ride a bit more horizontal (but still below the surface). The only problem was that the boat had been broken into in the Canaries and the inside lock for the main hatch had been damaged (the hatch fully closed, just couldn't be secured shut). As you probably know, the Jordan drogue exhibits a tremendous pull at all times. The transom of Moon Boots *had been beefed up specially because of this, as had the hatch and the hatch boards. And a good thing too, because every so often a wave would completely go over* Moon Boots *(I could see solid water as I looked out the side ports).*

The problem was that at times these waves would slide the main hatch 2-3' forward. Note that the hatch top itself was custom made of wood, weighted almost 75 lbs., and slid very hard on its track as it did not sit on rollers or cars of any type (just slid on metal tracks). It always took an effort with both hands to slide it open or shut. But these waves would slam it open and at the same time 30-50 gallons of water would pour in, (this happened 9 times in 36 hours). Therefore anyone using this style drogue had better have prepared the stern of his boat properly.

It has occurred to me that since the Jordan style drogue has a constant and continuous pull, it could make a superior sea anchor (off the bow) if sized properly for a given boat. It wouldn't work on Moon Boots *as a sea anchor, but any boat that behaves OK with a sea anchor would probably be even safer with a Jordan style. I now believe, more than ever, that my solo Atlantic passages on* Moon Boots *could not have been accomplished safely without the drogues.*

D/M-7 Monohull, Nor'Sea 27

Monohull, Nor'Sea 27

31' x 5 Tons, Full Keel & Cutaway Forefoot

30" Dia. Galerider Drogue

Force 10-11 Conditions

File D/M-7, obtained from George R. Purifoy, Pittsburgh, PA. - Vessel name *Synthesis*, hailing port Pittsburgh, monohull, Nor'Sea 27 (center cockpit version) designed by Lyle Hess, LOA 31' x LWL 27' x Beam 8' x Draft 3' 9" x 5 Tons - Full keel & cutaway forefoot - Drogue: 30" Galerider on 150' x 5/8" nylon three strand rode, with 1/2" stainless steel swivel - Deployed in a storm in deep water about 500 miles east of Block Island, New York, with winds of 50-60 knots and seas of 20-25 ft. - Vessel's stern yawed 20° with the owner steering manually - Downwind speed was reduced to about 3 knots in 15 hours of deployment.

George R. Purifoy, Jr., is a Pittsburgh engineer who completed a solo Atlantic crossing and return on board *Synthesis*, a Nor'Sea 27 - solid little world cruiser designed by Lyle Hess. The Nor'Sea 27 boasts of about 150 Atlantic and Pacific crossings, and 4 circumnavigations. *Synthesis* left City Island, New York, bound for the Azores and ran into an Atlantic storm on 12 June 88, approximately 500 miles east of Block Island. In an article appearing in the 32nd issue of *Ocean Navigator*, Purifoy recounted his trials and tribulations as he struggled to keep the sea in face of a mounting storm. Methodically, he went through the incremental steps of sail reduction - down to storm jib and double-reefed main. By the time it was blowing 40 knots it was dark and even the double-reefed main had to come down. Down it came, an inch at a time, "thrashing like a thing alive," the decks awash and illuminated by flashes of lightning.

As the storm built, Purifoy put *Synthesis* on a downwind course and began steering her in earnest. From then on it was a battle to keep the yacht from getting a little sideways and tripping on her keel. The mental states experienced by Purifoy in that perilous night might easily be experienced by any sailor running into a storm. Excerpts from the article follow (reproduced by permission of *Ocean Navigator*):

> *Boy, talk about scared! I am just on the ragged edge of control. One of these times I'm going to make a mistake and that will be all she wrote. To compound things, the steepness of the waves and our speed down them is causing the bow to bury in the base of the wave ahead....*
> *Little* Synthesis *is taking green water over the bow up to the mast. Now, along with the distinct probability of a broach, is the very real danger of pitchpoling. Time for the last line of defense:*

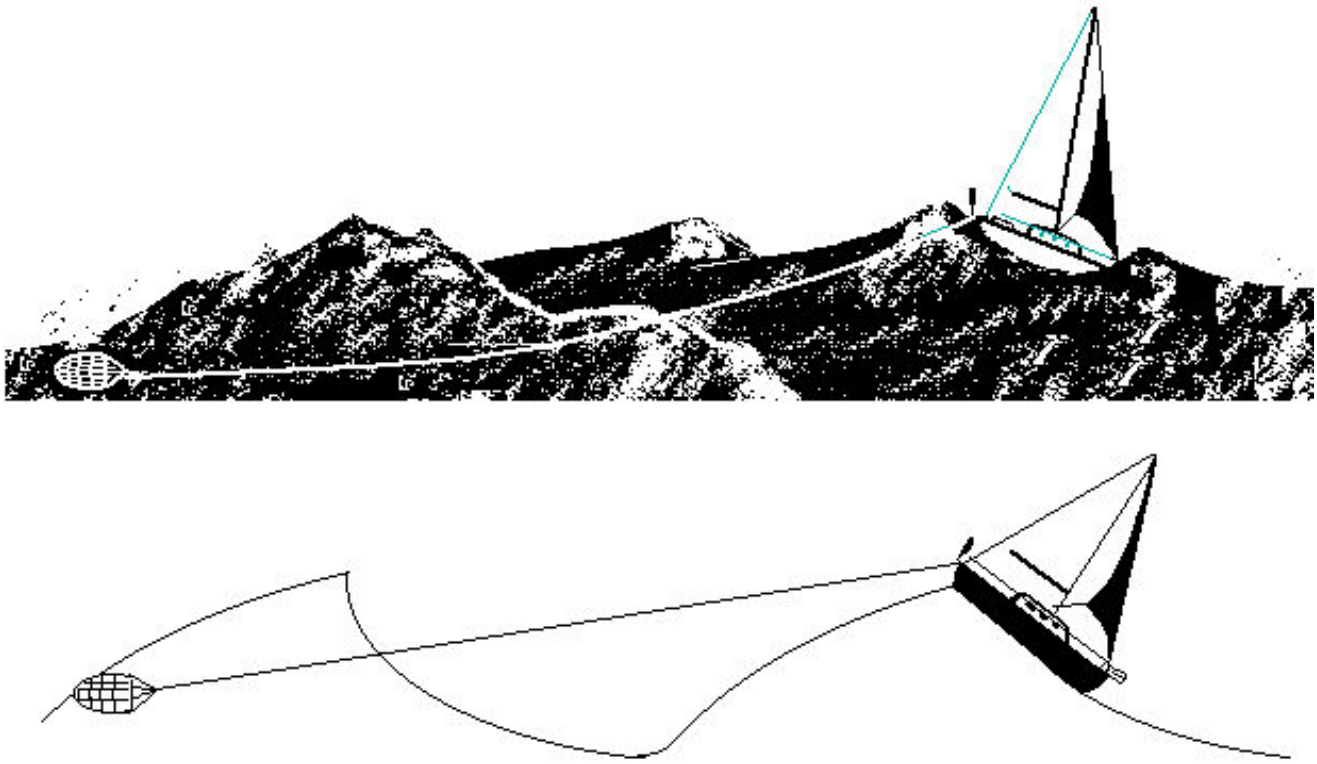
> *the storm drogue. If I can't slow the boat down we're going to buy the farm for sure!*

When Purifoy finally deployed the *Galerider*, there was a dramatic transition from chaos to control. The drogue took hold, slowed the boat's speed down to a safe and sane 2-3 knots, and helped to reduce the tendency to bury the bow. The article continues:

> *What a wonderful feeling. No longer are we rushing crazily toward a cold swim. The boat has slowed down to about two knots or so, even on the steep downhill faces of the waves. Those monster waves are still rushing at us from astern, but* Synthesis *just lifts her stern and all the foam and tumbling water just moves by. Beautiful! I still have to steer, but not with the strain and concentration of before. All of a sudden the storm seems manageable, duck soup even.*

In subsequent telephone conversations with Victor Shane, Purifoy added the following: A bridle was used, with arms of 14' each, made of 3/4" nylon three strand, the tether itself being 150' x 5/8" nylon three strand; the deployment took place in the Gulf Stream; the storm jib was flying for the duration of the time in which the drogue was deployed; the boat had to be steered manually without interruption, although happily the steering was much easier with the drogue in tow; without continuous manual input at the helm *Synthesis* might have broached and/or capsized; notwithstanding she might not have survived the storm intact without the assistance of the *Galerider*. In answer to your Shane's question about the *positioning* of the drogue Purifoy had this to say:

> *The 150' rode seemed about right for the wave system - the drogue was always one wave back of* Synthesis*, and on the back side as* Synthesis *was on the front side. I guess the wave length must have been more like 90-100'.*



Positioning the drogue... "on the back of the next wave."

D/M-8 Monohull, Morgan 382

Monohull, Morgan 382

38' x 9 Tons, Low Aspect Fin Keel

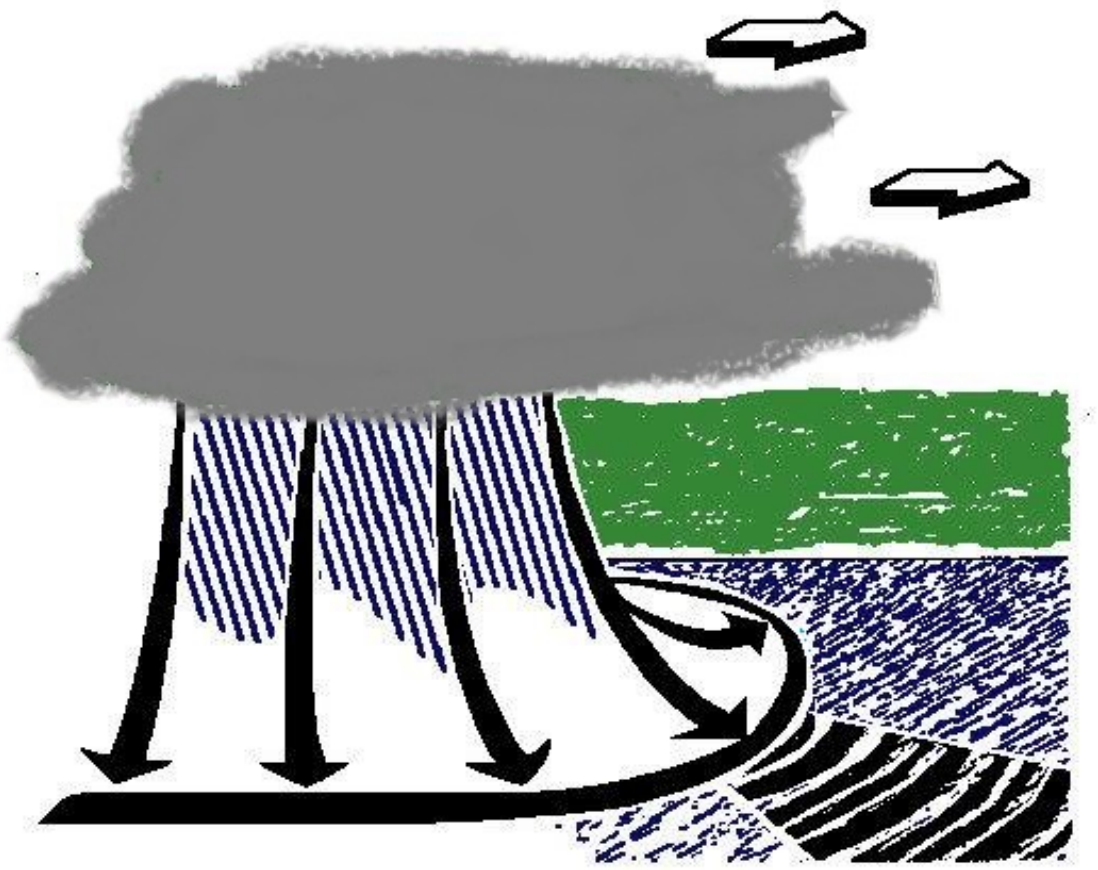
Five 14" Plastic Cones In Series

Force 11 Conditions

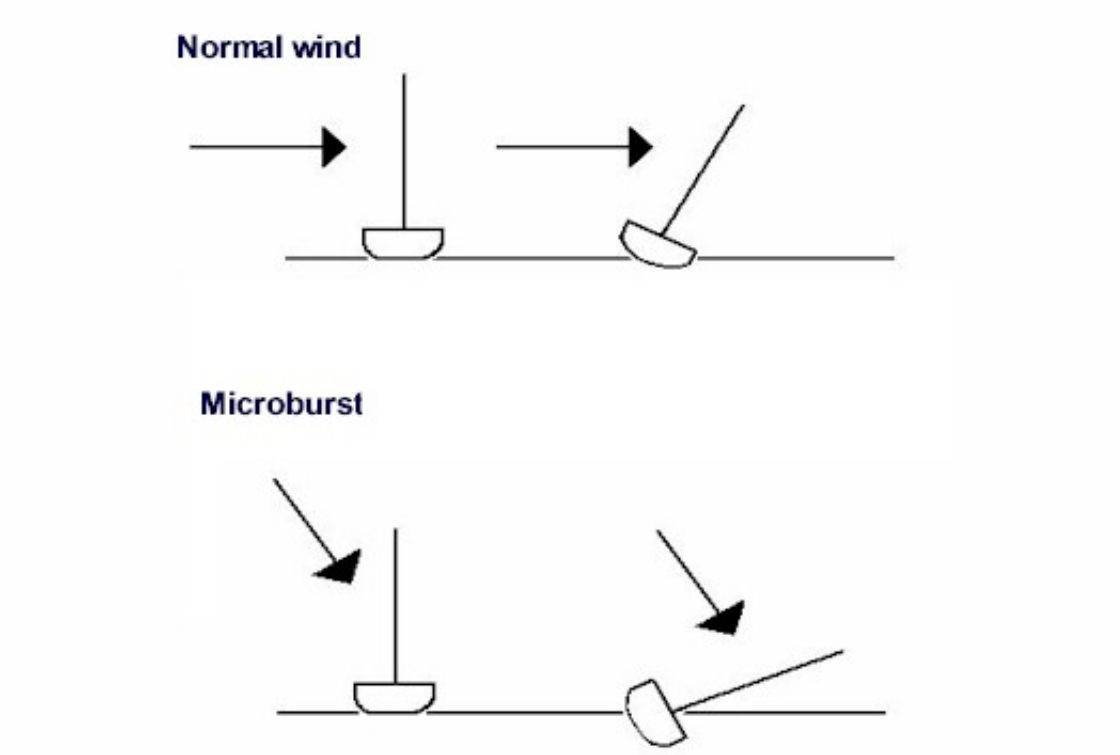
File D/M-8, obtained from Jim Gilster, St. Clair Shores, MI. - Vessel name *Windsprint*, hailing port St. Clair Shores, monohull, Morgan 382 designed by Ted Brewer & Jack Corey, LOA 38' 4" x LWL 30' 6" x Beam 12' x Draft 5' x 9 Tons - Low aspect fin keel - Drogue: 5 each 14" diameter plastic cones (Davis Instruments) on 300' x 5/8" nylon three strand rode plus 20' of chain - Deployed in a storm in deep water about 200 miles north of Bermuda with winds of 60-70 knots and seas of 20 ft. - Microbursts - Vessel's stern yawed 10° - Speed was reduced to about 2 knots during 33 hours of deployment.

On 3 June 1984 the British sailing barque *Marques* capsized and sank with loss of 19 lives, 80 miles northeast of Bermuda while participating in the Tall Ships Race. On 14 May 1985 the replica sailing vessel *Pride Of Baltimore* capsized and sank 240 miles north of Puerto Rico. On 31 August 1986 the *Calida*, a 135' replica of the *Cutty Sark*, capsized and sank in similar circumstances 90 miles southeast of Cape Fear, North Carolina.

The culprit in each case: *Microburst.* Microbursts, or "white squalls," as they are sometimes called, are associated with massive thunderstorm cells embedded within existing storm systems. A microburst involves a sudden, cataclysmic release of bottled-up energy in the form of one or more *downbursts.* These downbursts - sometimes sporting wind gusts of 100 knots - consist of cold, dense air which plummets down to the surface of the sea, thereafter spreading out on all sides, the outer edge being called a *gust front* or *shear line*.



This precipitous downward movement of air, also known as *wind shear*, is now believed to have been the cause of a number of previously inexplicable air tragedies, among them the tragic crash of Delta flight 191 in Dallas in 1986. The crash of Delta 191 prompted the National Oceanic and Atmospheric Administration to sponsor the development of NEXRAD - "next generation" pulse-doppler radar capable of detecting wind shear as well as incipient tornadoes and twisters. (Today NEXRAD is in wide use throughout the world). The added leverage gained by the wind, because of its downward vector, has no doubt been the undoing of many a sailing vessel. Try sailing under the wash of a hovering helicopter with a sailing dinghy and see what happens. The downward blast from those rotors will instantly knock your dinghy down. The same phenomenon occurs in nature, only on a much, much grander scale - *microbursts*. It is Victor Shane's opinion that the Queen's Birthday Storm of June 1994 was reinforced and exacerbated by a great many microbursts (see File D/M-12).



Normal wind blowing horizontally will heel a canvassed yacht before spilling out of the sails. Microburst coming down at an angle will instantly roll the yacht onto her beam ends.

Sailing vessels situated directly beneath the microburst will find themselves in grave peril, especially those with lofty rigs. The added leverage gained by the wind will easily knock down, capsize, or drive the bow down under, as was the case with the *Marques*. The downward force of the wind struck against her lofty rig from the port quarter, burying the bow; the sails, then on the starboard side, served as the lever to spin the *Marques* around and quickly roll her onto her beam ends. She filled with water and sank in a matter of minutes.

It is interesting to note that the builders of the old Baltimore Clippers seemed to have had foreknowledge of microbursts, and made allowance for this vice of nature in the way that they designed the rigging. In an article called *The Baltimore Clipper*, appearing in volume 14 of *Sea History*, Melbourne Smith writes, "Everything aloft was made as light as possible to reduce windage and save weight. The gear could be struck at will by the large number of men carried aboard. Some of it was purposely fashioned light as a built-in safety factor so that it could be `removed by the Lord' if the crew failed to do so in time." (Courtesy *Sea History*, a publication of the National Maritime Historical Society.)

Getting back to file D/M-8, *Windsprint*, a Morgan 382, was being sailed to England in June 1984 when she was caught in the same storm system that sank the *Marques*. The owner of the boat, Jim Gilster, was quick to take down all sails and set a new course downwind, a few degrees off the rhumb line to Bermuda. *Windsprint* was soon averaging 7 knots on bare poles with the helm manned. The skipper then deployed a drogue consisting of five 14-inch diameter plastic cones, shaped like Mexican hats,

manufactured by Davis Instruments. (Davis is still manufacturing the "Mexican hats", but for use as "rocker stoppers" only). The five cones, spaced 18" apart at the end of a 300' nylon rode, did a good job of keeping the stern of the yacht pointed into the seas for some 33 hours. In fact, once the helm was properly adjusted and locked no further steering was required. The crew was able to retire down below and rest in relative comfort, seventy knot winds and twenty foot seas raging outside. Transcript:

> *We were in the storm pattern that sank the* Marques *on June 3, and we were told of its sinking by one of the tall ships continuing on to Halifax. When we arrived in St. George's Harbor in Bermuda we witnessed services being held aboard the one tall ship that dropped out of the race to assist in the search and rescue effort.*
>
> *The five plastic cones were spaced 18" apart; I rigged them up with 5/16" braided nylon, doubled, with a thimble at the bend, and figure eight knots at the holes in the cones. I attached all this to 20' of chain and 300' of 5/8" nylon line, led to the port stern cleat and port sheet winch. I felt confident it would all hold up. It did, in 70 knot winds and 20' seas. We slowed down to 1.5 to 2 knots from 7 knots on bare poles. I adjusted the wheel to allow us to quarter the waves, and we were "comfortable".... We were occasionally pooped, but with a bridge deck and tight hatch, little water entered the cabin. Although each of the five cones was cracked when we hauled them back in, we did not notice any diminished resistance while "at anchor." I am in the process of affixing two cones together to make five sets of two each, somehow each set of two cones sealed/glued together for strength.*
>
> *Interestingly, these cones were originally marketed as "sea anchors" in the early 60's when I purchased a set for this purpose. I think Davis should beef them up a bit and again denote them "sea anchors." I would, and will, use them again in the same manner. I was very pleased with the way they slowed the boat down, although, of course, I had no lee shore to contend with.*

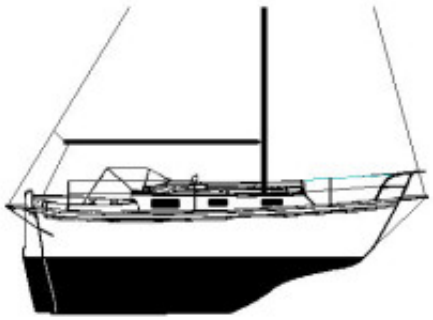
D/M-9 Monohull, Gulf Island

Monohull, Gulf Island

30' x 4 Tons, Full Keel & Cutaway Forefoot

36" Dia. Galerider Drogue

Force 8 Conditions



File D/M-9, obtained from Warren Hawkins, North Pole, Alaska - Vessel name *Ancient Mariner*, monohull, Gulf Island, LOA 30' x LWL 27' x Beam 8' x Draft 5' 4" x 4 Tons - Full keel & cutaway forefoot - Drogue: 36" Diameter Galerider on 200' x 5/8" nylon three strand rode, with bridle arms of 20' x 5/8" Dacron braid and 1/2" stainless steel swivel - Deployed in a gale in deep water about 1200 miles NE of Hawaii with winds of 35-40 knots and seas of 18 ft. - Vessel's stern yawed 20° - Speed was reduced to about 3 knots during 20 hours of deployment.

The trade winds blow steadily over vast stretches of ocean and can generate surprisingly large seas and swells. When Victor Shane was sailing to Hawaii, for instance, stiff trades had produced swells that averaged about 10 feet. Typically these seas are very lumpy and uncomfortable as well. Add a few squalls and a low system and it's time to heave-to or get out the drogue. *Ancient Mariner*, a Gulf Island 30, was being delivered to Hawaii from Alaska when she ran into this sort of situation. Transcript of the feedback provided by delivery skipper Warren Hawkins:

> *During the early morning hours of July 30, 1990, the* [trade] *wind steadily increased, while holding approximately the same direction (70-90°). By dawn the main was down completely. We were running on about 1/3 of the roller-reefed jib. Our speed was manageable, the swells being about 12' high. Our course to steer was only about 20-30 degrees from straight downwind. By 0900 hrs. we were under bare poles, the wind still increasing and the swells running 15-18'. Steering was becoming a problem to keep from broaching or from running straight down a wave and possibly pitchpoling.*
>
> *Just before noon, while maneuvering on one of the larger swells whose upper 4' broke on us, the tiller snapped off. At this point deployment of the drogue was an absolute necessity. I made up a bridle out of about 60' of 5/8" braided Dacron, in the middle of which I tied a loop using a figure eight knot. The loose ends ran inside the stern cleats and around the two genoa sheet winches. The 200' rode was attached to the bridle approx. 20-25' aft of the boat with a bowline. The other end was attached to the Galerider swivel with a bowline. The rode itself was braided nylon and*

could have been longer.

The very instant that the Galerider took hold it was as if you had pushed a button and calmed the gale. We made a quick jury-rig repair on the tiller (which lasted all the way to Honolulu) and the motion of the vessel was such that we could take normal steering watches on the tiller and the off watch could get some sleep. One pleasant surprise from using the Dacron bridle was that due to its very low stretch it did not chafe where it went over the two corners of the transom (no sawing effect).

By 0800 the next morning the swells were back down to 10-12', the wind was subsiding and we hauled in the Galerider. The Gulf Island 30 was not designed as an ocean crossing vessel. We would have been hard put to weather the gale without some form of speed reduction even if the tiller had not broken.

D/M-10 Monohull, Charter Vessel

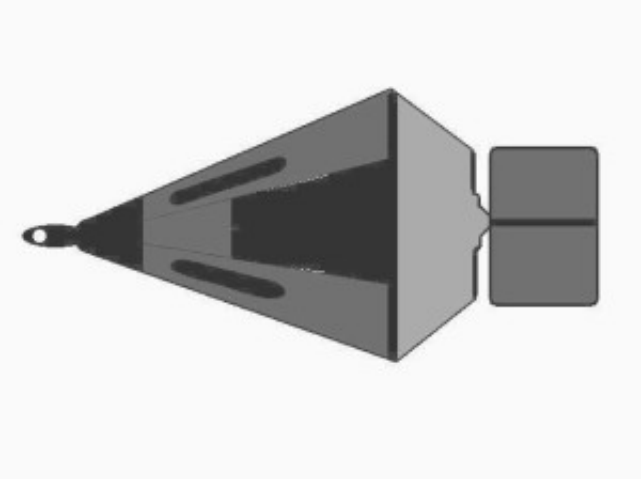
D/M-10

Monohull, Charter Vessel

35' x 15 Tons, Long Keel

36" x 12" Cylindrical Device

Force 12 Conditions



Seabrake Mk I

File D/M-10, obtained from John Abernethy, Woollahra, Australia - Vessel name *Papeo*, hailing port Port Fairy, monohull, charter vessel, LOA 35' x Beam 10' x Draft 6' x 15 Tons - Long keel - Drogue: 36" x 12" Diameter stainless steel calf bucket on 100' x 1" nylon three strand rode - Deployed in a "Southerly Buster" storm in shallow water (15 fathoms) near Lady Julia Percy Island (Bass Strait) with winds of 100 m.p.h. and seas of 50 ft. - This event led to the genesis and development of the Australian *Seabrake* drogues.

Seabrake was born in the Australia's notorious Bass Strait, as treacherous a body of water as one could wish for. The Bass Strait is a 170 mile wide gauntlet that divides the Australian mainland from Tasmania. It has claimed thousands of lives. The roaring forties and mature Southern Ocean waves roll in unabated all the way from Africa, and run headlong into this gauntlet. As they try to squeeze into the narrow Bass Strait they jump over the shallow Continental Shelf and undergo a metamorphosis that can only be described as a sailor's nightmare. Sudden storms can come up without warning, producing life-threatening

conditions within hours.

The Roaring Forties aim straight for the Bass Strait

Running before such steep and unstable seas is a little like barreling down muddy hills on a dirt bike without brakes. Imagine flying over bumps, skidding and careening sideways, somehow trying to keep the bike from falling out from under you, dirt and mud flying all over the place. If you can imagine all this, you will understand the logic and thinking behind the invention of the Australian *Seabrake*.

As a yacht is running down the face of such seas there will be times when the rudder will be ineffective. Because of orbital rotation and the movement of water on waves that are breaking, helm control will decrease on the crests, where it is needed most (see Figs. 7-10 and Fig. 49). As the boat is picked up and accelerated by a crest, the flow of water past the rudder is suddenly diminished and the helm goes limp. Small craft rudders are all but useless on the crests of breaking seas. If the boat is "captured" by such a crest and cannot disengage from it, the wave-induced yawing moment will be greater than the restoring moment available from the rudder and the result may be a broach, a capsize or even a 360° roll. This is

where the directional restraint of a drogue (situated elsewhere on the wave train) is needed to help keep the vessel aligned, as well as to provide the drag needed to disengage the boat from the fast moving crest.

The incident that sparked the creation of *Seabrake* took place in 1979 - the year of the Fastnet tragedy. Abernethy's boat, *Papeo*, was on a charter, looking for great white sharks. She was anchored in the lee of Lady Julia Percy Island, some twenty miles from the Australian mainland, when a "Southerly Buster" came up. The wind quickly built up to hurricane force and in no time *Papeo* had lost all three of her ground anchors. With her engine started she began to make a desperate run for safe harbor on the mainland. However no sooner out of the lee of Lady Julia Percy Island than she was pummeled by mountains of fast moving white water. A cone-shaped sea anchor, several feet in diameter, was deployed off the stern as an emergency measure, but it slowed the boat down too much. She was squarely hammered by a breaking wave. This wave wiped her entire deck clean, breaking a number of items as well as ripping off the focs'le hatch and taking it out to sea. A miracle of sorts then occurred when three dolphins that had been seen in the vicinity of the boat swam to the floating hatch and pushed it back close enough so that Captain Abernethy could gaff it and bring it back on deck. With the hatch hastily reinstalled, Abernethy took the knife and cut away the rode to the sea anchor. *Papeo* was then picked up by another huge wave and sent hurtling down into the abyss-like trough. Instinctively, Abernethy reached for the only remaining item that could function as a drogue - a stainless steel cylindrical calf bucket. These calf buckets are commonly found on Australian farms and often used as bait buckets on Australian fishing boats. Abernethy attached some line, grabbed an axe and sliced open a few holes in the bottom of the bucket and threw it over the transom. This calf bucket, since dubbed "the most famous milk bucket in Australian maritime history," then took hold of the situation and produced the desired effect, both in terms of limiting *Papeo*'s speed, and also in terms of keeping her attitude safely aligned with the seaway.

The ride was exhilarating, to say the least. Abernethy described it to Victor Shane as "a lazy elevator." The boat would be picked up, half rolled and carried along, but never thrown or overwhelmed or broached by the mountains of confused water. By sheer luck the restraint of the makeshift drogue was just enough to keep *Papeo* on an even keel throughout the ordeal. She was able to keep plenty of water beneath at all times and never even came close to falling off a wave, or burying her bow into the bottom of a trough. It was a defining moment. It left an indelible mark on Abernethy's mind and several years later he came up with the first prototype of the *Seabrake* drogue. Subsequent models underwent extensive tank tests in the Australian Maritime College, and *Seabrake* came to be. Abernethy's firm has since produced a wide variety of drogues for sailboats, powered vessels and even large ships and submarines. When Abernethy was in the United States Shane had the privilege of interviewing him in Los Angeles. A synopsis of that interview follows (by permission):

> *The development of Seabrake was preceded by ten years of commercial operation in Australia's Bass Strait. As a commercial fisherman and charter boat owner based in the most dangerous stretch of Bass Strait, I was routinely operating in heavy seas and often towing large game fish in them. I was frequently involved in Search and Rescue operations as well, towing various types of distressed vessels to safety. Typically, conditions involved combined seas in excess of 20 feet and sustained winds of 30 knots or more. On many outings I have encountered 50 ft. seas and 50 knots winds. The incident that occasioned the birth of Seabrake involved 80 ft. combined seas and winds peaking at 100 m.p.h. There were other factors that contributed to the development of Seabrake. Contact with many who have lost vessels in the Bass Strait in the past 40 years, for one thing. My own experience showing that "speed kills," and that conventional cone-shaped drag devices don't*

assist and in fact can be dangerous, for another. Moreover I have found that towing items such as large game fish, bundles of rope, etc. on a short warp can create too much drag and cause a "stall" at the wrong moment - the bottom of a trough. And towing them on a long warp does not always produce the desired effect either. Drag and restraint can vary from too much to too little, depending on the direction of pull and how much rope remains in the water.

From the above I endeavored to devise a drogue that could maintain a consistent ratio between speed and drag. Never is the statement "speed kills" more relevant than when applied to vessels running before strong following seas. Finding a happy medium is the key to success. Seabrake is designed to kick in at around 7-8 knots and then continue to increase its effectiveness as the load increases beyond this speed. The ultimate goal is to maintain helm and choice of direction while keeping the ship's speed below 6 knots. In survival conditions the trick is to prevent taking on board any water and keeping the vessel as buoyant as possible, which means avoiding breaking crests or becoming bogged down in troughs. This is only achievable if the vessel has headway and helm. In my experience, even in the worst conditions it is far easier to obtain "safe water" running with a sea than jogging into it [with the engine]. *And this is where Seabrake comes in.*

The development of Seabrake evolved from a need to travel in harmony with the sea, with room to maneuver, much the same as rolling along at speed in heavy traffic - as opposed to being out of control and all over the road. Seabrake, in simple terms, is a remote control two-stage speed regulator, activated by a compression spring that opens and closes the drogue's baffle gates. With the baffles closed the flow of water around Seabrake is laminar, exerting just enough drag to improve steering control below hull speed or safe maximum speed. Any sudden acceleration or surfing brought on by a wave crest will cause Seabrake's nose cone to extend, which triggers the compression spring and opens the baffles inward. With the baffles open the flow of water around Seabrake becomes turbulent, instantly increasing its drag by about 70%. Conversely, a sudden deceleration in boat speed (in a wave trough) will release the spring, which will close the baffles, instantly reducing drag and preventing a "stall."

By running before the seas under restraint of a two-stage system of speed suppression and compensation, a vessel may be steered through the worst conditions in relative safety. Reading the immediate wave astern and maneuvering to expose the least amount of stern - quartering the seas rather than taking them on square - is all that needs to be done in order to avoid both the PUSH and the FALL as a dangerous wave passes under the boat. The Seabrake principle has now been in effect for some 15 years and has been tested and evaluated both academically and in the field. It has saved many lives and vessels under horrific conditions, doing so without any technical knowledge or formal training on the part of the users - the "set it and forget it" principle truly applies here.

As a final comment I need only repeat my earlier statement, "speed kills." While running before heavy seas it is important to try to keep the speed range below 6-7 knots, but above 3 knots. Slowing down below 3 knots will result in loss of steerage and allow a vessel to wallow, which is equally unsafe. I base the above on personal experience, but note that individual applications may be subject to a great many variations. Following these guidelines, however, will assist in measuring the general situation.

NOTE: A rival Australian company, *Broachbrake International Pty., Ltd.*, was manufacturing a similar plastic drogue called the *Sea Squid* for a while. John Abernethy brought suit against the company for infringement of certain legal rights. Broachbrake was subsequently issued a court order to cease and desist and has since stopped making the device. Abernethy told Shane that *Sea Squid* was an altogether inferior imitation of his product. There is an illustration of the now outlawed *Sea Squid* in file D/M-12 of this publication.

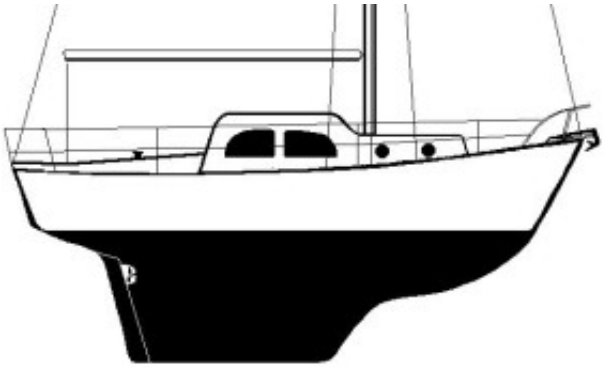
D/M-11 Monohull, Islander

Monohull, Islander

29' x 4 Tons, Full Keel & Cutaway Forefoot

36" Dia. Galerider Drogue

Force 8 Conditions



File D/M-7, obtained from William A. Forest, San Luis Obispo, CA. - Vessel name *Seraphim*, hailing port Morro Bay, CA, monohull, Islander Wayfarer, LOA 29' x LWL 24' x Beam 9.5' x Draft 4' x 4 Tons - Full keel & cutaway forefoot - Drogue: 36" Diameter Galerider on 200' x 1/2" nylon braid rode, with 1/2" stainless steel swivel - Deployed in a gale in deep water about 500 miles west of San Francisco, with winds of 35-45 knots and seas of 15-20 ft. - Vessel's stern yawed 20° - Speed averaged out to about 4 knots during 40 hours of deployment.

William A. Forest sailed *Seraphim* to Hawaii and back singlehanded in July 1989. On the way back he ran into a gale about 500 miles west of San Francisco. The wind was blowing out of the northwest, so he used a *Galerider* to slow *Seraphim* down and stabilize her attitude while continuing on in the right direction. Transcript:

> *I made the trip just to see if I could, and having done it I don't have to prove to myself that I can any more. The trip was made in 1989, when I was 66. The problem wasn't the boat, equipment or weather, but the chance that, as a single hander, I might get injured or break something. I did take a fall on the return trip, and cracked two lower ribs. I had not followed my own rule of wearing sneakers when on deck, and my bare feet went out from under me. Lucky it wasn't worse.*
>
> *Until the time I deployed the Galerider on the way back, I had forgotten I had it on board. When the seas built up, the Monitor* [wind vane] *was unable to keep course as I sailed down into the troughs. The boat was surfing at that time, and the natural tendency was to try and round up, making it a dangerous broaching situation. This involved several hours of hand steering. Very tiring, at best. I took down the reefed main, hoisted the storm jib, and deployed the Galerider at 0200 hrs. on July 20th. I let out the Galerider rode to 150' initially, but later adjusted it between 125-200' to get best response, control and ride. The rode came in through the port after chock, taking half a turn on a corner cleat, then to my jib winch and onto another cleat. This way the strain was distributed between the first cleat and the winch, and I could take in or let out as the situation changed. As soon as the Galerider was deployed and the rode adjusted I had instant*

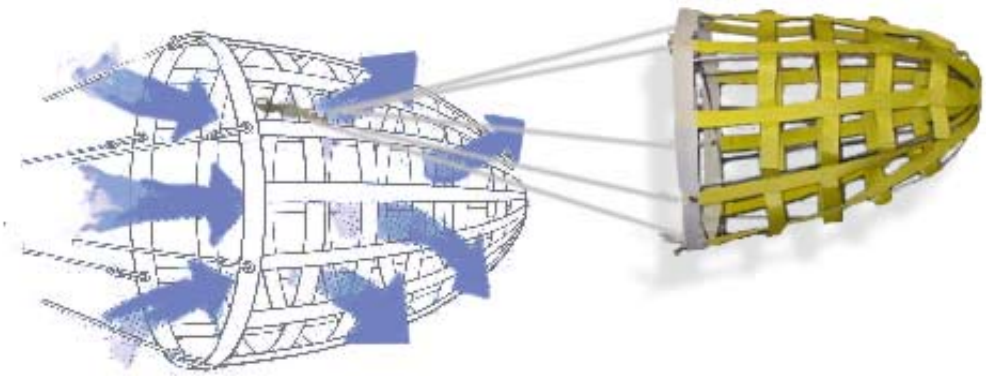
control. It was amazing. A note here that chafing gear must be used at the chock or the rode will easily wear through and the drogue be lost. It should also be noted that I had a 90 sq. ft. storm jib up. In order for the drogue to work properly it is necessary to have forward motion.

I adjusted the rode so that the Galerider was on the same side of the wave as the boat. In my case it was two waves back [on the same part of the wave as the boat]. *I found that the strain was less on the line, and there were no jerks or rapid slowing as the boat moved forward. After deployment it was never necessary to hand-steer again. Once the Monitor wind vane was engaged I was able to unlash the tiller and my course became more exact. Sometime during early daylight hours a rogue wave from the port side carried away the wind vane sail and the dodger, filling the cockpit.*

The Galerider worked well. There was plenty of searoom and the wind was blowing in the direction I wanted to go. However, in a situation of a dangerously close lee shore, and the loss of a rudder or sails, there is no doubt in my mind that a sea anchor would have been required. There is no law about not having both on board. In the unlikely event that I should go cruising again I would have both.

In subsequent telephone conversations Victor Shane asked William Forest why he didn't position the drogue on the *back side* of its wave when the yacht was surfing down the face of its wave (see Fig. 52). His answer was that he tried that, but given the particular situation - 35-knot winds - the yacht had a tendency to stall and wallow in the troughs. He added that in 50-knot winds he likely would have positioned the drogue on the "meatier" part of the wave.

In answer to the question as to whether he would prefer to take the seas squarely on the transom or on the quarter, Forest indicated that he would prefer to take them on the quarter with the drogue in tow, although it would depend on the particular circumstance. He stressed that every gale is different, every boat is different, and decisions such as where to position the drogue, or whether to use a bridle or not, or whether it is better to run directly downwind or to take the seas on the quarter are fluid decisions that need to be tailored to existing circumstances and conditions



Galerider drogue produced by Hathaway, Reiser and Raymond

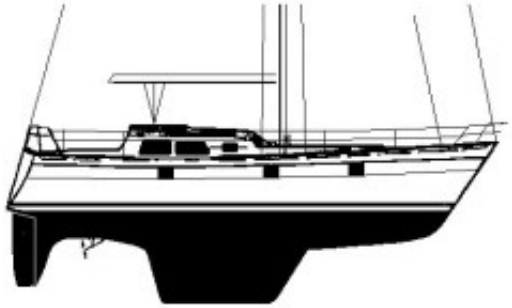
D/M-12 Monohull, Norseman 447

Monohull, Norseman 447

45' x 14 Tons, Low Aspect Fin Keel

Sea Squid Drogue

Force 12+ Conditions



File D/M-12, obtained from Paula & Dana Dinius, Long Beach, CA. - Vessel name *Destiny*, hailing port Long Beach, monohull, Norseman 447 designed by Robert Perry, LOA 45' x LWL 37.6' x Beam 13' x Draft 6.5' x 14 Tons - Low aspect fin keel - Drogue: Australian *Sea Squid* on 200' x 1/2" nylon braid rode + 12' of 3/8" chain, with bridle arms of 20' each - Deployed in the Queen's Birthday Storm in deep water near 25° 55.7' S, 175° 28.4' E (about 400 miles SSW of Fiji) with winds of 80-100 knots and seas of 60 ft. and greater - Vessel's stern yawed 45° and more with the owner steering - Speed averaged about 6 knots during 15 hours of deployment - *Destiny* was damaged after somersaulting off a huge stacking wave and had to be abandoned.

In June 1994 a regatta of pleasure yachts left New Zealand, headed for Tonga. En route they were devastated by an unseasonable cyclone.

The event coincided with the celebration of Queen Elizabeth's birthday, and has been referred to as the Queen's Birthday Storm ever since. About half a dozen boats were abandoned. Two dozen sailors had to be rescued. The yacht *Quartermaster* sank with loss of three lives.

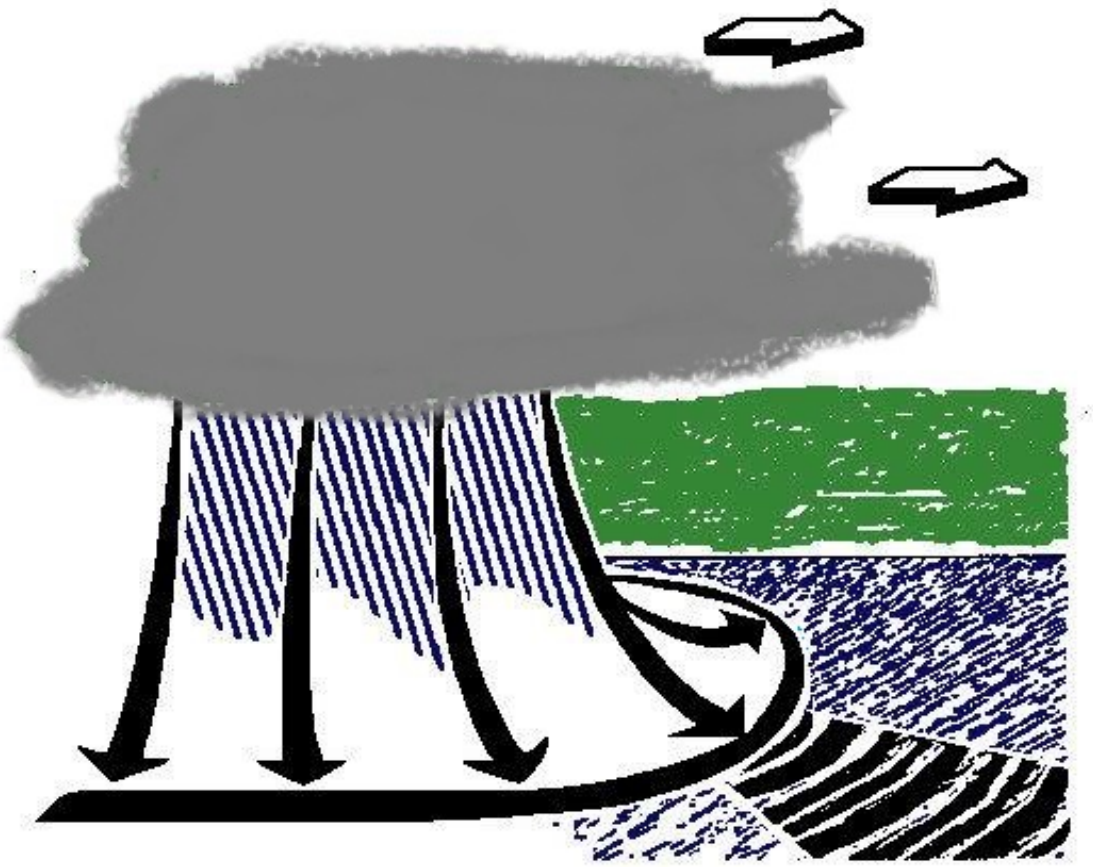
Destiny, the subject of this file, did a spectacular dive off the top of an eighty foot wave. Dana Dinius told Victor Shane that it was like going over the falls on a surfboard - the yacht fell straight down. He distinctly remembers being weightless while hanging on to the wheel. *Destiny* went end over end when she finally hit bottom, doing a cartwheel and snap roll that bent her mast all the way around the hull. Dana's leg was badly broken at the hip, incapacitating him. Paula somehow managed to drag him inside, where the two spent a night to remember, rescue aircraft circling overhead.

The life and death rescue drama that transpired the next day is described in great detail in other texts and videos, among them Tony Farrington's book *Rescue In The Pacific* (International Marine Publications), and Ninox Films's epic video, *Pacific Rescue* (Ninox Films, Ltd., PO Box 9839, Wellington, NZ).

At this point we would like to digress and say something else about the Queen's Birthday Storm: *the*

cyclonic conditions were exacerbated by microburst-generated ESWs. The term ESW - *extreme storm wave* - was coined by Jerome W. Nickerson when he was head of NOAA's *National Weather Service Marine Observation Program.* "The ESW appears to be about 2.5 times the significant wave," wrote Nickerson in the NOAA publication, *Mariner's Weather Log* (Vol 29, No. 1 - see also Vol 37, No. 4, the *Great Wave* issue). ESWs arrive as colossal walls of water with a deep trench in front. When aligned with the seaway they may be technically classified as *episodic* (wave events that stand apart from all others during the analysis interval). When misaligned, they may be classified as *freaks, mavericks* or *rogues*, because they intrude into the dominant seaway at angles of up to 50°, causing "stacking" and "wave doubling" where they intersect with the regular significant waves. Sometimes ESWs come in pairs, the largest following on the heels of the first. On rare occasions they may even come in sets of three, a fearsome phenomenon dubbed *the three sisters* by ancient mariners.

GUST FRONT OR SHEAR LINE



Microburst producing a 'gust front' or 'shear line'

Cold, dense air from the upper part of thunderstorm cell plummets downward. When it reaches the surface it spreads out on all sides, but most strongly in the direction of the movement of the storm. The outer edge is called a *gust front* or *shear line*. Bold arcs in lower right corner indicate dangerous area in which the gust front is sufficiently synchronized with the prevailing waves to reinforce/amplify a few significant ones into Extreme Storm Waves (ESWs). There were dozens of massive thunderstorm cells embedded within the Queen's Birthday Storm.

Putting all things together, several components can be applied to the Queen's Birthday Storm, setting the stage for the genesis of ESWs: Inordinately steep pressure gradients, resulting from the confrontation of differing air masses; a rapidly developing, warm-core cyclonic system, rotating clockwise in the southern hemisphere; wind field rapidly increasing to above Force 10 (50 knots sustained), producing significant waves of about 20 feet. The picture so far is fairly representative of the average storm. However, we now have to look for an additional reinforcing agent or catalyst by means of which significant waves can be built up to the 80-ft. monster that threw *Destiny* end over end in the Queen's Birthday Storm.

According to Jerome W. Nickerson, one such catalyst or reinforcing agent can be found in extreme downbursts. Such downbursts are associated with the rapid venting of energy bottled up in discrete thunderstorm cells embedded within the larger storm system. Thunderheads have been known to reach heights of 65,000 feet. The cold, dense downdraft from such a concentrated energy cell will sometimes produce wind gusts of 100-knots and higher - as with tornadoes. When such a downburst reaches the surface of the sea it could statistically synchronize with, organize, reinforce and amplify the existing significant waves into ESWs.

We already have a 979 mb cyclone in the Queen's Birthday Storm. Add sudden, catalytic release of energy bottled up in massive thunderstorm cells, pulsing down against the surface of the sea and thereafter spreading out on all sides (but most strongly in the direction in which the storm is moving) in the form of a *gust front* or *squall line*.

Speculation locates the genesis of an ESW at a place where the speed and direction of the moving gust front coincides with the speed and direction of the highest existing waves (lower right corner, bold arcs in Fig. 55). The developing ESW - the dominant wave in the train - will now collect more energy from the wind than the other waves. Moving faster, it will also merge with and collect energy from the smaller waves it is overtaking, in effect "stacking" and "snowballing" into the stature of a genuine *extreme storm wave*.

Was this the case in the Queen's Birthday Storm? Well, it could have been a contributing factor because we have many first hand accounts of violent thunderstorm activity. In fact there was so much electrical activity that many claimed to have seen strange lights - some even thought they had seen flying saucers. Commander Larry Robbins of the HMNZS *Monowai* (one of the rescue ships) reported seeing such lights, as did other personnel aboard the ship. "Suddenly the decks lit up... the sky just lit up and we could see for miles," said Lieutenant Andrew Saunderson. Jim Helden, captain of the cargo ship *Tui Cakau III* - whose Fijian crew took Paula and Dana off *Destiny* - saw the electric show, as did Paula and Dana Dinius themselves. Said Paula in the interview that she and Dana did for Ninox Films, "The lightning was approaching... I believe we went right through the center because of this lightning show... it was just amazing... you could just see it coming directly, and then it was on us, and it was just all over us... you could feel it as it cracked... it would just go through your body."

One can also infer microbursts from the baffling testimony of Dana Dinius himself. Dana was bewildered by the chaotic nature and direction of the wind as he struggled with *Destiny*'s helm: "We had 85 knots of wind, and it really wasn't a wind... it was a mist, it was really intriguing... there was a real presence there, an evil that we felt... the wind would come in from the right or the left and swirl up in front of us in a big mist, and then it would exit... and it might exit forward, it might exit over my shoulder... it wasn't a consistent type of a wind, and with the lightning cracking all around us, it was... we can only describe it as a real evil." (Courtesy Ninox Films).

Only a severe microburst - or macroburst - could have exhibited such chaotic characteristics (meteorologists call downbursts with outflow diameters of no greater than 2.2 nm *micro*bursts, and those with outflow diameters greater than 2.2 nm *macro*bursts). Depending on her position beneath the downburst, *Destiny* might have been blasted with 80-100 knot gusts from any number of directions. Transcript:

> *On June 4, 1994, five days out of Auckland, New Zealand, approximately 400 nm SSW of Fiji, my wife Paula and I were hit by an out of season 979mb cyclone. It was to come without warning and deliver constant 80-85 knot winds (gusts over 100 knots) and 15 meter breaking seas. At the storm's conclusion 21 people were rescued, 7 cruising boats abandoned and, sadly, three lives lost. Our boat and home for seven years, a Norseman 447 named* Destiny*, was a 45 foot fiberglass performance cruiser designed by Robert Perry. Unfortunately, she was not to survive the storm, pitch-poling off a 100 foot stacking wave resulting in severe damage to both the boat and her crew.*
>
> *The cyclone dropped on us without warning. Our land-based weather service had forecasted for us 35-40 knots of wind during the evening, coming from a 1005mb LOW located to the north around Fiji. Since our weather fax printouts from both New Zealand and Australia confirmed that report, we had no reason to suspect anything else. At 1800 hours, after our evening check-in and with 3 meter breaking seas behind us, we elected to go to bare poles and deploy our drogue. At the time we felt it to be a bit of an overkill, but thought it would provide us with a relatively quiet night. Our drogue was an Australian SEA SQUID, an orange plastic cone designed to channel water into its sides and out the rear, creating a braking effect. Not expecting any real weather, we deployed it off the port side on 200 feet of 1/2 inch yacht braid, and 12 feet of 3/8" chain to hold it down under the surface. The line was run through the aft port chock and up to the primary winch in the cockpit. A bridle of sorts was jury rigged by tying a shorter piece of 1/2 inch line to the rode and running it back to the primary winch on the starboard side. By adjusting the length of the both leads we could get the drogue to trail directly behind the boat, or to either side.*

SEA SQUID (no longer available).

During the night the seas increased to giant mountains towering well above the mast. It had the look of traveling through snow-capped mountains during a lightning storm. The P-3 Orion crew that held station over us during the rescue, said their ground search radar was giving them 80 to 100 foot variances, indicating trough to peak heights. We found our drogue set-up to be optimal in conditions that far exceeded what we expected that night. Destiny *was held to 3-4 knots in the troughs and 7-8 knots running down the giant wave faces. There seemed to be little or no yawing, and steering control, while being a little sluggish from the trailing drogue, was responsive enough to handle the storm. The ride in general, although very wet, was relatively smooth.*

Although the speed was well under control we still felt it necessary to hand steer the boat. The blast of wind hitting the transom as we raised up out of the trough (generally 35 knots in the trough and 80+ on the crest) was strong enough to drive the stern of the boat hard to port or starboard. Reaction had to be quick and complete enough to bring the stern back around before the breaking seas engulfed it. Failure to complete this maneuver left us exposed at an angle to the breaking seas, which would in turn push the boat further around, greatly increasing the danger of a broach/roll. There were times we were hit so hard that Destiny*, even with the helm hard over,*

barely corrected stern to the seas before the next wave crest. It is our feeling that the autopilot (an Auto Helm 6000-Mark II) would not, at the peak of the storm, have been able to correct fast enough to complete the maneuver.

We feel our chances of surviving the storm were greatly increased by choosing an active role at the helm. This decision took into account exhaustion and exposure. Warm, tropical weather diminishes exposure problems, and as for exhaustion, we've learned in extreme conditions the pure adrenaline pump will keep you going many more hours than you think is humanly possible now. Had we been in a colder climate we may have decided differently. We also realize that an active technique is not for everyone. For those who do not wish an active part, a much larger drogue that would hold the boat at a snail pace, "perhaps" would give the resistance needed to stay stern-to with the aid of an autopilot. We are sure, however, the boat would take a terrible beating given the size and power of the seas we experienced. As it was, we lost most of our cockpit canvas and saw extensive damage to the supporting stainless steel long before the pitch-pole.

What was learned:

1) 200' of rode is not enough. Twice during the night our drogue broke loose and pulled out of the wave behind us. Destiny *shot from 7 knots to 14 knots in the bat of an eyelid. Had there been any way to extend the rode at that point we would have, but by then the weather was critical. The cockpit was constantly awash. Hanging on and steering was all we could manage. We learned that given a shorthanded crew, the rig you go into extreme weather with is most likely what you will be* forced *to stay with for the duration. Hindsight tells us that even if we didn't think we would use it, we should have rigged more line. Our suggestion is to have the stern anchor rode rigged so you can attach the drogue at a moment's notice.*

2) We found that directly downwind was the most stable and survivable course. In our case, at 7 knots, burying the bow was not a concern. Our biggest concern was being caught sideways and rolled. We attempted to cheat to the SSW whenever possible to work out of the dangerous SE quadrant of the storm, but found it almost impossible to make much ground without putting the boat at risk of a broach.

3) The most critical point of the storm, with respect to survival, came when the winds had subsided a little, during the eye of the storm. The wind was never the real problem. As it fell from the 80's to the 50's the seas, which up to this time had their crests blown flat, began to break more top to bottom. The wave faces became steep enough to force corrections port or starboard to keep from broaching in the troughs, even traveling at 7 knots. Three times during the morning hours, Destiny*'s keel broke loose and we slid down the wave face like dropping in an elevator. It was at this point we felt control had been lost and we issued our PAN PAN call. As the wind began to clock south and increase again, there developed a secondary wave direction which created a "stacking effect." Ultimately, we feel that's what killed* Destiny. *Two or three breaking waves stacking on top of one another produced a bottomless situation. Under those conditions we don't think any drogue could have held the boat from that fall. There comes a time in extreme conditions when your survival boils down to the luck of the draw. We feel this was one of those times.*

4) We have been asked if our chances would have been better with a sea anchor. Not having tried one we will never know. We do know that after the boat pitch-poled and had been dismasted, we were lying a-hull for many hours. During that period we suffered countless 120° knock-downs, but were never rolled again. Perhaps the broken mast, which was wrapped around the boat, gave it additional stability? Who knows. The boat did take the pounding and seemed to hold up pretty well. But it should be noted here that conditions were such that things could have gone pretty much any way at that point. Had the boat broken up, a hatch tear off or a window break (we had the storm shutters on), we would not be here today. To attempt to man a life raft in those conditions would have been a sentence of death.

Being inside, without control, was the first time we felt helpless to protect ourselves. Because the boat withstood the pounding [while lying a-hull] *one could make a case for the para-anchor. However, given the size of the seas we were in, we would worry about how the anchor is attached to the hull. The issue of chafe goes without saying, but even more worrisome is the question of attachment points. What stresses are at work when you are hit by a breaking wave taller than a telephone pole moving along like a freight train? And this continues for 12 to 16 hours? We question the ability of many cruising boats to hold up under those conditions. Still, all things being equal, with adequate warning of* extreme *conditions, we feel we would chose to go with a large para-anchor, 500 feet of heavy line, attached with a wire bridle distributing the load to points throughout the hull. In our opinion, there is a good case for both a drogue and a para-anchor aboard a seaworthy cruising yacht. In the final analysis it's up to each of us to decide on the solution we can* live *with. When that moment comes, it's nice to have options at hand.*

In subsequent telephone conversations Victor Shane pressed Dana Dinius about the perennial question as to whether one should run directly downwind or try quartering the seas. After thinking about it Dana replied that on *Destiny*, in *that* storm, it *had* to be directly downwind. However he added that in other situations he might decide to quarter the seas, especially if the bow was beginning to bury itself in the base of the next wave now and then.

On another matter, Dana confirmed that he and Paula felt most vulnerable when the wind dropped in the eye of the storm. He said, "as the wind dropped, the waves became hollow." This is something that Shane had heard before, something that one should be prepared for. Compare with John Glennie's statement in File S/T-7: "Without the wind regulating the seas, I was afraid that two or three waves might ring hands and turn into rogues."

D/M-13 Monohull, Mason

D/M-13

Monohull, Mason

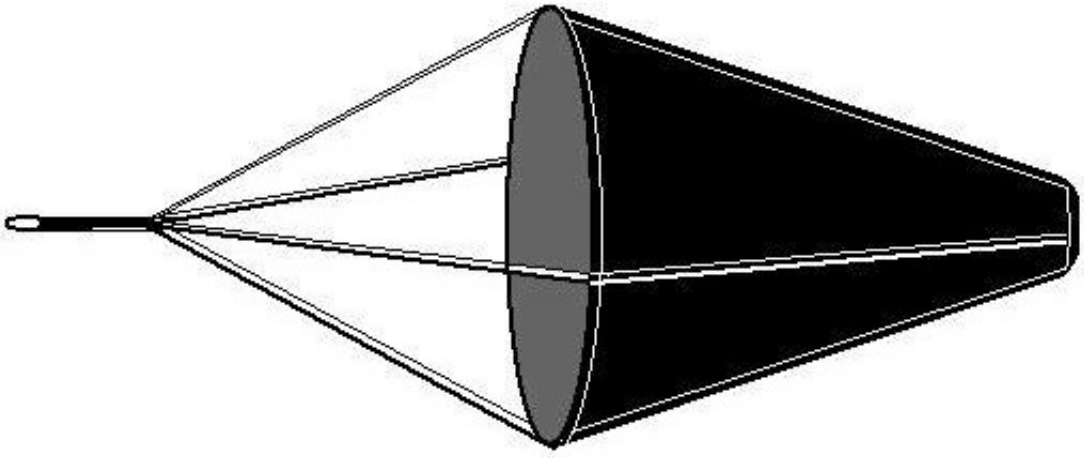
46' x 12.5 Tons, Full Keel

30" Dia. Conical Drogue

Force 11+ Conditions

File D/M-13, obtained from Evo Zembal, Nanaimo, BC. - Vessel name *Sine Timore*, hailing port Nanaimo, monohull, Mason 39, designed by Al Mason, LOA 46' x LWL 39' x Beam 12' x Draft 6.5' x 12.5 Tons - Full keel - Drogue: 30" Diameter Jim Buoy cone (Cal June, Inc.) on 600' x 1/2" nylon braid rode, with 1/2" galvanized swivel - Deployed in a storm in deep water about 1200 miles northeast of Hawaii with winds of 60-70 knots and seas of 25-30 ft. - Vessel's stern yawed 45° and more with the owner steering - Speed was reduced to about 4 knots during 16 hours of deployment.

Sine Timore ran into a Force 10-11 storm on the way back from Hawaii. She was doing 8 knots on bare poles when the 30-inch conical drogue was deployed.



Jim-Buoy 30" cone "Not For Storm Use"

When this yacht was in Santa Barbara Victor Shane was invited on board and it didn't take very long to

realize that she and her crew had been through a terrifying storm. Shane was then amazed to find that the drogue that had reputedly saved this boat was a 30-inch diameter *Jim-Buoy* cone, the sort that grandpa uses when he is trolling for fish in his 15-ft. aluminum skiff!

Cal June (North Hollywood, California) does not manufacture these particular cones for use in heavy weather. They are classified as "trolling sea anchors" and the words "Not For Storm Use" are printed on their containers. Notwithstanding, this one *did* see combat duty as a storm drogue on 12-ton *Sine Timore*!

When Shane examined the cone he saw that most of the seams had indeed ruptured. The device was in fact on the brink of catastrophic failure, leading him to suspect that the crew of this yacht had somehow dodged a bullet. Perhaps the cone lasted so long because Evo Zembal used 600' of 1/2" nylon rode. Transcript:

> *Barometer steadily dropped from 1029 to 999 in ten hours. We deployed the drogue when the wind speed had built to 55 knots sustained. A few minutes later the boat had slowed down and the ride was actually very comfortable compared to what was going on outside the boat. We stopped sliding down on the wave faces. This was the first time in my life that I had ever used a drogue. I didn't know that I had to use a swivel. Another thing I didn't use was a bridle from each side of the transom, this way the swing was sometimes up to 30°. I really believe that the drogue saved my life and the boat.*

D/M-14 Monohull, Twister

D/M-14

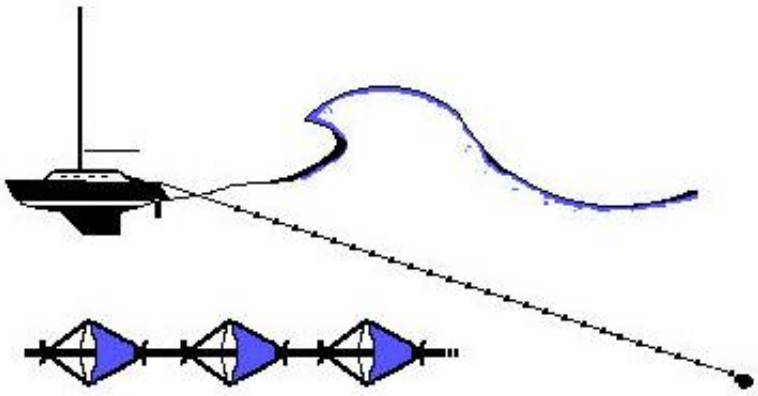
Monohull, Twister

28' x 5 Tons, Full Keel

Series Drogue - 90 x 5" Dia. Cones

Force 10 Conditions

File D/M-14, obtained from Professor Noël Dilly, London, England - Vessel name *Bits*, hailing port Medway, Kent, monohull, Twister sloop designed by Holman and Pye, LOA 28' x LWL 25' x Beam 8' x Draft 5' x 5 Tons - Full keel - Drogue: Jordan series, 90 x 5" diameter cones on 320' x 3/4" Multiplat nylon braid rode, with bridle arms of 20' each and 35 lbs. of chain spliced into the end of the array - Deployed in a storm in deep water about 25 miles west of Cape Carvoeiro, Portugal, with winds of 50 knots and seas of 15 ft. - Vessel's stern yawed 10° - Drift was about 50 miles during 50 hours of deployment.



The Jordan Series Drogue consists of dozens of tiny cones spliced into the long rode

Noël Dilly has been sailing for 40 years and is *Yachting Monthly*'s correspondent for Medway and North Kent, having written numerous articles, including *Making And Using A Series Drogue* (May 1994 issue of *Yachting Monthly*). A professor at St. George's Hospital Medical School (University of London), Dilly is one of the planet's experts on drag devices. An associate of the late Geoff Pack (*Yachting Monthly*), and

also Peter Bruce (editor of *Heavy Weather Sailing*), the professor has been wrestling with the subject of heavy weather tactics for decades. Apart from making several series drogues, he has numerous other drag devices in his possession, including a 9-ft. BUORD sent by Victor Shane, a Para-Tech sea anchor and *Delta Drogue*, an Australian *Seabrake*, etc.

On the occasion of this file Dilly and clan were sailing *Bits* to the Mediterranean when they ran into a storm near tiny Berlenga Islands (about 60 miles up the coast from Lisbon). Transcript:

> Bits*, a Twister, long keel, 28 ft. LOA, 8 ft. beam, Holman and Pye design. Weight when hanging from a crane, 5 tons. We built her over 3 years in the hospital car park, hence the students nicknamed me "Noah." Main influence on our fitting out was my experiences in a Contessa 32 in Fastnet '79. We use our series drogue whenever going to windward is a bore, that is, usually winds in excess of 30 kts. It is just not worth the bashing. Summer gales do not last above 30 kts much more than 15 hours and we do not seem to lose much more than 10-20 miles downwind of our starting position on the drogue.*
>
> *The longest we have hung to the drogue is 50 hours off Portugal, on a passage to Gibraltar from Portsmouth. It was January, wind NW Force 7-11 for 3 days, sustained Force 9 for 18 hours. Our wind gauge does not go above 50 kts, but BBC said we had a Force 11. Position, off the Berlenga Islands, near Cape Carvoeiro. We saw the Berlenga Islands from wave crests when we deployed the drogue, and could still see them 3 days later when we recovered it. I suppose we had moved about 10-15 miles, but I was not in the mood for measurement. However we were fit enough to ignore the temptation to sneak into Lisbon for R & R and carry on towards Gibraltar.*
>
> ***Deployment:** There are two ways of storing the drogue. We used to wind it onto a spool, weighted end first, with the bridle last. The idea was to attach the bridle, and feed out the drogue from the spool. But spools are awkward to store. Now what we do is store the drogue in a sports bag (zipper whole length of bag). We flake it in so that the bridle is at the top. This arrangement gives a great option of storage sites. We mark the two bridles with a piece of thick tape so that we know the correct lengths of the lines without having to adjust the deployed drogue, and, if necessary, we can deploy at night. Before we deploy the drogue, we remove the vane from the self steering and release the paddle. For deploying the drogue, we drop the trysail, but continue at about 15° from dead downwind under storm jib. Once the drogue is deployed we secure the tiller amidships with 1/4" bungee.*
>
> ***Riding sail:** Our storm jib is much smaller than the average storm jib and we rig it on a removable inner forestay (another invention I have fiddled with). This jib is 5ft x 4ft x 3½ft. The forestay extends from the cross tree* [mast spreader] *to the samson post. The jib flies about 4 feet off the deck. It is tiny, I would hate to think of the conditions in which I would be forced to take it down. I think it stabilizes the boat directly downwind. I picked up the idea when fleeing before the Fastnet winds. I like this idea of using a riding sail with the series drogue, but I would also treat Don Jordan's comments with great respect. I suppose that he is worried that the wind and waves may be coming from different directions* [Jordan designed the series drogue for use without riding sails]. *Once the drogue is deployed, we harden up both jib sheets so that the sail is amidships, and leave it.*

Motion of the yacht: *I think the series drogue ride is a stable affair. Once deployed, description of the new motion of the boat as "bungee jumping" is a good one. Be prepared to hang on, or better still retire to your berth* [Jordan recommends that everyone be strapped in by aircraft-types seat belts inside the boat]. *In the troughs, she feels loose. As you rise up the wave and the wind hits with full force she hardens up. Surprisingly this is the best time to do things below deck. Usually that's all there is to it, but if you get accelerated by a crest, you can feel it and hang on for the quite dramatic deceleration. Once the crest has passed these things stop, and you are back to the up and down thing. It is all very slow and undramatic, until there is the violent motion associated with the odd crest strike.*

Cones surfacing: *A very rare event. I have seen them revealed when a particularly steep wave was approaching. I suppose there were about 10 cones visible, but I was trying to fix a second safety harness clip at the time, and found that pretty urgent. In Force 7,8,9 I have never seen the cones surface. In wind strengths above that it is so difficult to look to windward, the spray hurts too much. Indeed our storm gear includes a pair of industrial safety goggles so that we can try to inspect the drogue/sea interface during the storm.*

Chafe: *Chafe is the great enemy of all drag devices. To counter chafe at the weight end we enclose the chain-to-rope splice in a spiral whipping so it cannot move* [Dilly uses a length of chain instead of the usual 35 lb. weight]. *At the bridle end we enclose the lines in thick-walled polyethylene tube where they pass over the transom.*

Hatches & life raft: *We have massively strong washboards. We seal the cockpit hatch joints with 2" duct tape, also the cockpit locker lids (we have discovered how leaky allegedly waterproof locker lids can be). Finally we move the life raft into its gale storage position, which is on the cockpit sole. It is secured in place by two straps that are jointed by a long pin, such that if you pull the pin the straps are released. This storage has two advantages. First it reduces the weight of water in the cockpit when you get pooped. And second, it is a much more secure place for the life raft than exposed on deck where a breaking storm sea might easily take it, just when it might be needed.*

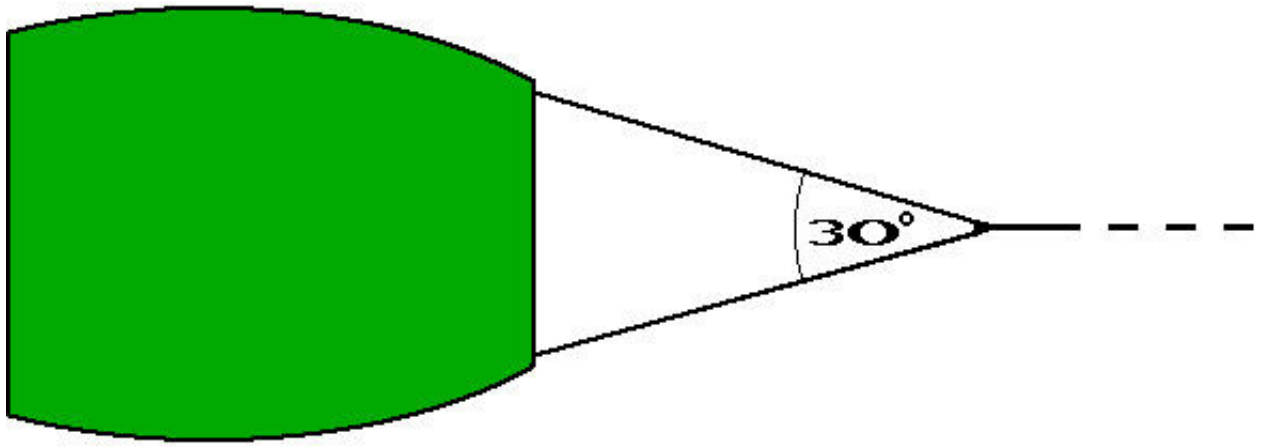
Cockpit drain holes: *Four 2-inch diameter cockpit drain holes are not adequate as it takes several minutes for the cockpit to drain. Next time I would try 4-inch diameter drains, but the hazard is then of sheets and lines being washed down them.*

Recovery: *We have a bridle long enough to use the genoa winch to wind in the drogue. I takes ages, but we have plenty of time. My daughter Sarah has suggested that next time we take a line to the bow, outside everything, release the drogue, and lie bow to it, then use a combination of the anchor winch and motoring to recover it, just like recovering an anchor.*

In subsequent communications Victor Shane also asked Professor Dilly why he and other safety experts recommend that the angle subtended by the bridle arms be about 30° or less.

The principle applies to any storm bridling system, including those utilized by multihulls using sea anchors off the bow. As the bridle arms are shortened the angle increases and the *toggle force* on each attachment point can grow precipitously - farmers still use the principle to dislodge tree stumps. The professor's answer was brief and to the point:

> *Why 30°? There are good mechanical equations that show that as the angle between the two lines increases the load on them increases severely. 30° Is well within the safe angle. It is just about the same as the Hawaiian chappies idea of twice the transom width for the length of the bridle arms.*



Most experts agree that the bridle arms should subtend an angle of about 30°. As the angle increases the toggle force can multiply severely.

D/M-15 Monohull, Contest 40

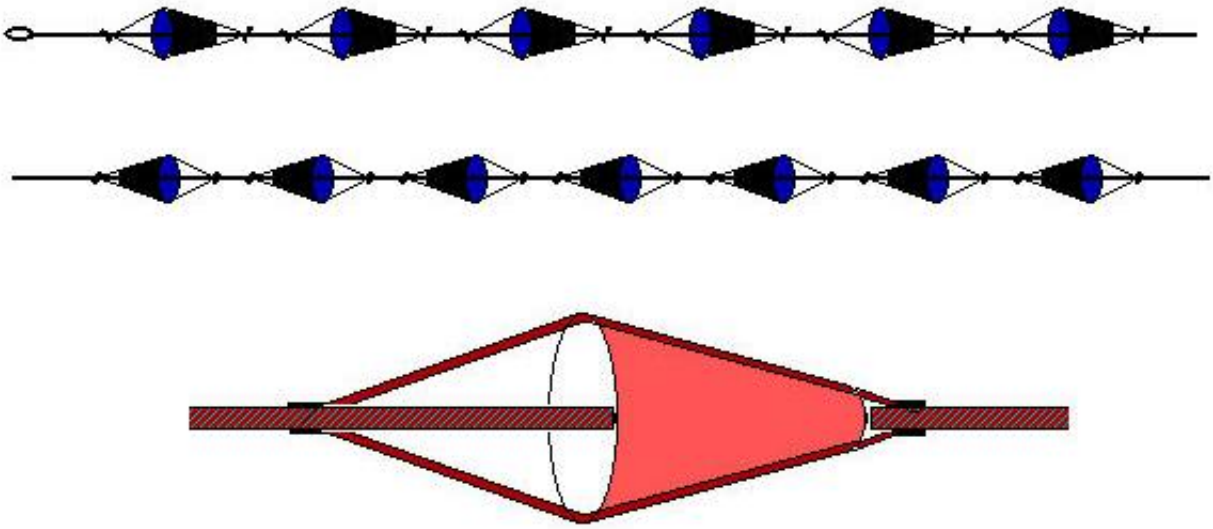
D/M-15

Monohull, Contest 40

40' x 8 Tons, Fin Keel

Series Drogue - 120 x 5" Dia. Cones

Force 9-10 Conditions



A Jordan Series Drogue consists of dozens of small cones spliced into a long rode

File D/M-15, obtained from Robert J. Burns, Townsville, Australia - Vessel name *Peter Sanne*, hailing port Detroit, MI, monohull, Contest 40, center cockpit ketch designed by Conyplex, LOA 39' 9" x LWL 29' x Beam 12'6" x Draft 6' x 8 Tons - Fin keel - Drogue: Jordan series, 120 x 5" diameter cones on 300' x 3/4" nylon double braid rode, with bridle arms of 15' each and 35 lb. anchor at the end of the array - Deployed in a whole gale in the Gulf Stream with winds of 45-55 knots and seas of 20 ft. - Vessel's stern yawed 20° - Drift was about 12-15 nm during 6 hours of deployment, with a 3-4 knot current running.

Robert Burns made up his series drogue with the help of Professor Noël Dilly (previous file). En route to Newport from Bermuda he ran into a whole gale in the Gulf Stream and deployed it. Six hours later he

lost the series drogue due to chafe. He then deployed a 2-ft. diameter conical parachute type drogue. This is an important file which provides an immediate comparison between the two different drogue concepts. The following are excerpts from Burns's article entitled *Streaming A Drogue*, appearing in the December 1993 edition of *Yachting Monthly* (reproduced by permission):

I've run before rising gales, but never with such menacing seas. There were three distinct inter-active wave patterns that combined to form massive pyramids which collapsed periodically in an immense surge of white water. As long as I could avoid the breaking portion of the waves there was little danger of sustaining damage from the mass of breaking seas colliding with the yacht.... We were truly surfing now, down wave faces that would break behind us, catching us as we increased speed, then engulfing the yacht in white water. Steering required intense concentration to keep the stern pointing in the direction of the breaking sea and present the minimum surface area, reducing risk of broaching. I was conscious of the forces of the rudder. The last thing we needed was to lose steerage.... If the storm was going to build for another four hours, it was time to try another tactic before it got too dark to see what we were doing.... The series drogue consisted of a 300ft length of 3/4" double braid nylon that had 120 5-inch diameter cones spliced onto the line through their axes. The drogue had an anchor attached to the outboard end for a weight and was attached to the stern with a bridle. The gusts were furious now. The seas were 25-30 feet with faces at 45 degrees and 50 degrees and breaking frequently. The shrieking of the wind in the rigging and the whip-like crackling of the ensign was making me most anxious. It was time to stop. We were above hull speed most of the time now, and it was hard to control the vessel. I sent Curley astern to kick the anchor over the side that would commence the deployment of the drogue.

The drogue had been rigged at the stern with anchor attached. As soon as the weight was released the drogue line paid itself out of its storage box. The tow line streaked out with dramatic speed and force. After less than a minute the drogue was deployed and the cones began to exert their resistive force on the bridle. The slowing effect was phenomenal. Deploying the drogue was like bungee jumping off a 30ft wave with a 40ft. yacht. The feeling of being elastically attached to the sea itself is hard to imagine. After a minute or so we had slowed from 8 knots to 1.5 knots. The stern was pointed aggressively into the wind and sea. It was as if we had entered a calm harbor of refuge. The yacht held her position near the top of the waves' crests. When a wave approached and threatened to break on board, the drogue would pull us up and over the top of the breaking waves. There was no possibility of a breaking wave hitting us broadside, as we were always above the majority of the white water.

We furled the remaining portion of the jib, tied off the helm, checked to make sure everything on deck was secured, and then went below. Inside the main cabin the noise of the gale was much less. With the reduction in the yacht's motion, our situation seemed not too bad. We were all exhausted and took the opportunity to try to get some sleep. The time was 2130. I got up several times to check the situation. Despite the roar of breaking seas as we were pulled over the tops of breaking waves, I slept surprisingly well....

At about 0230 the sound of waves falling on deck seemed to increase and the motion of the yacht changed. Gone was the elastic "bungee effect." I was about to climb out of my bunk and put on harness to inspect the rig, when the boat heeled sharply to port under the force of a wave striking the starboard quarter. The sound of flowing water was everywhere. In the next instant the companionway doors shattered, and an angry stream of water rushed into the saloon.... I reached for the nearest overhead light... it came on to reveal the main saloon with 2-3ft of seawater sloshing above the cabin sole. Debris

of the splintered hatch floated with charts, books, wet blankets and sleeping bags. The cockpit was full to the top of the coamings with frothing sea water. The night was dark, but I could still make out the towering peaks of white water around and above *us. I glanced at the wind instruments; we were lying with the wind just aft of the beam, we had no headway. "So," I thought, "this is what it is like to lie a-hull." The priorities were to clear the boat of water, and try to repair the shattered companionway in case we were boarded by another sea. And to check what had happened to the drogue. The crew were in favor of launching the life raft. I recalled previous conversations about abandoning a damaged yacht. In the 1979 Fastnet Race it had been a major contributor to loss of life. We were still very much afloat. The thought of taking to a life raft was not at all appealing to me.... My priority was to reset the drogue.*

I found the bridle dangling over the transom, severed on both sides. The 3/4" nylon bridle had been abraded by the self-steering mounting brackets. There was damage to the stern pulpit and deck fittings, evidence of the forces and motion exerted on the hull by the drogue before it parted the bridle. It was imperative to get the stern facing the seas again. I pulled several lengths of anchor rode and mooring lines out of the aft lazarette, tied them together, and streamed them over the transom. This had little effect as the line was mostly polypropylene and skipped along the surface. Every moment we continued to lie a-hull we were at risk of being struck by another breaking monster. I recalled that I also had a small hand-made parachute-type sea anchor stowed below. My wife had constructed it some years ago for our coastal cruising around Tasmania and it had never been used.

The parachute sea anchor was a 2ft diameter cone made of synthetic canvas with ¼" polypropylene lines braided together to form the shrouds. It looked frail in comparison to what it had to stand up against. I tied the parachute to the longest length of line and let it slip over the side. Nothing happened at first. When all 300ft of line was out and the chute was subject to some forward motion the line came taut. There was no bridle now, so the tow line was only attached to the starboard stern cleat. The yacht yawed to port, aligning the stern almost into the wind and sea. Our forward velocity was about 2 knots. Big waves would cause us to surge forward and down the waves faces, as the chute didn't have sufficient surface area to slow us down against the push of big seas. We were much better off now. If the chute held we would be safe.

Gone was the feeling of "bungee jumping" [associated with the series drogue]. *The forces exerted by the chute were sharper* [jerkier] *and nowhere near as powerful. However, the strategy of lying stern-to was still the most comfortable and safe. The little chute did well. We had no serious broadside wave strikes, even though there were still a lot of breaking seas around us. The chute was not able to pull us up and over the breaking waves, so the occasional wave dumped on the stern. As the yacht had a center cockpit, there was less danger of it being filled.... Dawn came slowly. The fury was fading from the wind and it seemed like the little chute would see us through the gale.... We cranked out a tiny bit of jib from the furling gear. The yacht pointed directly downwind, similar to riding with the series drogue. I wondered why I had not thought of using a bit of jib earlier.... By noon 6 June we had crossed the Gulf Stream axis into the cold water of the US continental shelf.*

Robert Burns constructed another series drogue for his next boat, the 50-ft. aluminum Holman & Pye ketch, *Eclipse*, which he and his wife Kathryn sailed to Australia. Burns has since set up *Mid-Ocean Marine Sciences Pty. Ltd. (MOMS)* in Townsville, Queensland. MOMS is currently marketing the series drogue in Australia.

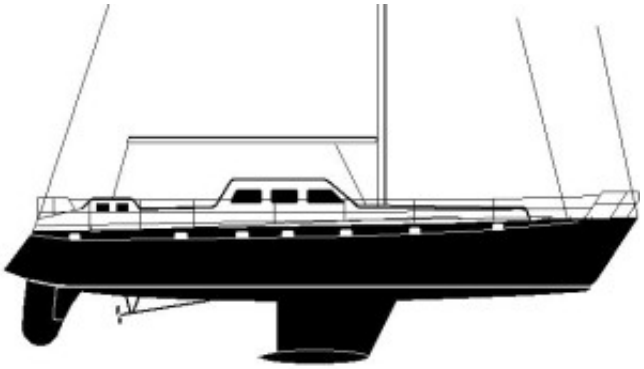
D/M-16 Monohull, Cutter

Monohull, Cutter

65' x 18 Tons, Fin Keel

Series Drogue - 144 x 5" Dia. Cones

Force 9-10 Conditions



File D/M-16, obtained from John A. Traylor, Alta, Wyoming - Vessel name *Beyond*, hailing port Portland, Oregon, monohull cutter, designed by John Traylor, LOA 65' x LWL 56' x Beam 12' 8" x Draft 8' x 18 Tons - Fin keel - Drogue: Jordan series, 144 x 5" Diameter cones on 330' x 1"- 3/4"-5/8" nylon braid rode, with 24' of 3/8" chain at the end of the array - Deployed in a whole gale in deep water about 90 miles west of Point Conception, California, with winds of 40-60 knots and seas of 18-24 ft. - Vessel's stern yawed 10° - Drift was about 68 nm in 33 hours of deployment.

Before setting off on a major ocean passage John A. Traylor equipped *Beyond* with a number of drag devices, including a Para-Tech sea anchor and a Jordan series drogue. The series drogue was used in a gale off Point Conception. Transcript:

> *The drogue took me personally about 24 man hours to construct, from a kit sold by Dave Pelissier (Ace Sailmakers). Once I had tied a few cones on the rode, construction was easy, but of course boring! The tow-rope specified for our 18-ton cutter is: first third 1" nylon braid, second third 3/4" nylon, and the last third 5/8" nylon. Total number of cones: 144. We did fabricate a bridle, each leg being about 25 feet long, leading to large port and starboard bronze cleats on the stern. The end weight was four fathoms of 3/8" chain.*
>
> *It took me about thirty minutes to bring the gear up from below and lash the bag into deployment position, and rig the bridle. The most difficult task was to remove the Aries vane (one of Nick Franklin's last models, which can be quickly dismounted). This was a bit dangerous - I had to go down into our stern "sugar scoop" and unhinge the vane, all the while watching for the next wave which might sweep the scoop. Once the Aries was secured, deployment was very easy. Just drop the chain off the stern and stand clear.*
>
> *There was no noticeable shock* [when the drogue took hold], *but I could clearly see the heavy nylon rode stretching and squeezing the water out as it absorbed the load. We had been running under bare poles. Over a period of perhaps 40 seconds our speed dropped from 8 knots to about 1 3/4" (one and three-quarters) knots. The rudder was lashed amidships with a nylon bungee. There were no signs of rudder stresses. Chafe was not a problem throughout the duration of the 44 hour*

gale, but would have been if we had not removed the Aries vane gear.

Our vessel is 65 feet long and has a center cockpit. We had no water shipped in the cockpit, so I cannot comment on the performance of the cockpit drains, companionway, etc. The rather large "sugar scoop" stern was frequently swept by the cresting seas, and the noise was occasionally quite loud. On several occasions large waves broke astern and completely filled the "scoop." But the series drogue kept the hull very well aligned into the seas, with at most 10 degrees of occasional yaw. Once the long narrow hull was held stern to the seas, the wild ride was much smoother. Either my wife or myself stood watch in the deckhouse, where we could look astern and watch the seascape.

The gale abated rather quickly in the early hours of 27 October. The seas were quite lumpy and with no wind to steady the ship, the strain on the rigging was a concern. We decided to attempt to retrieve the drogue immediately, rather than wait for the light of dawn. With a rolling hitch on the bridle, and line led to our largest coaming winches, we found we could retrieve the drogue, albeit slowly, without damaging the cones. We were about 15 minutes into this process (and had retrieved about ¼ of the total) when my wife noticed a tanker to the northwest, already well over the horizon and with leading lights lined up directly on us. After two attempts to raise him on VHF with no response, we could now see the foam under his bow from the bright moon overhead. I had my wife standby with a knife, ready to cut away the drogue if necessary. But much to our relief we were able to "rouse the watch" on the ship by playing our 600,000 candlepower spotlight on our mast and finally, I must admit, on the bridge of the ship, perhaps a mile away! We soon heard a voice (Greek?) in unmistakably angry tones on the VHF. After a short explanation, he bore away and wished us "Bon Voyage!"

All in all, we were most pleased with the performance of the drogue. My main concern with our particular installation is the necessity to remove the Aries vane gear. This exposes the crew to some definite risk of injury. If the gear is left in place, it will eventually be destroyed and the series drogue will probably be lost as well. One would hope to foresee the onset of serious weather and make preparations in advance, but as our experience with the rapid (and poorly forecast) onset of this gale shows, this is not always possible.

D/M-17 Monohull, Cutter

D/M-17

Monohull, Cutter

41' x 8 Tons, Modified Fin Keel

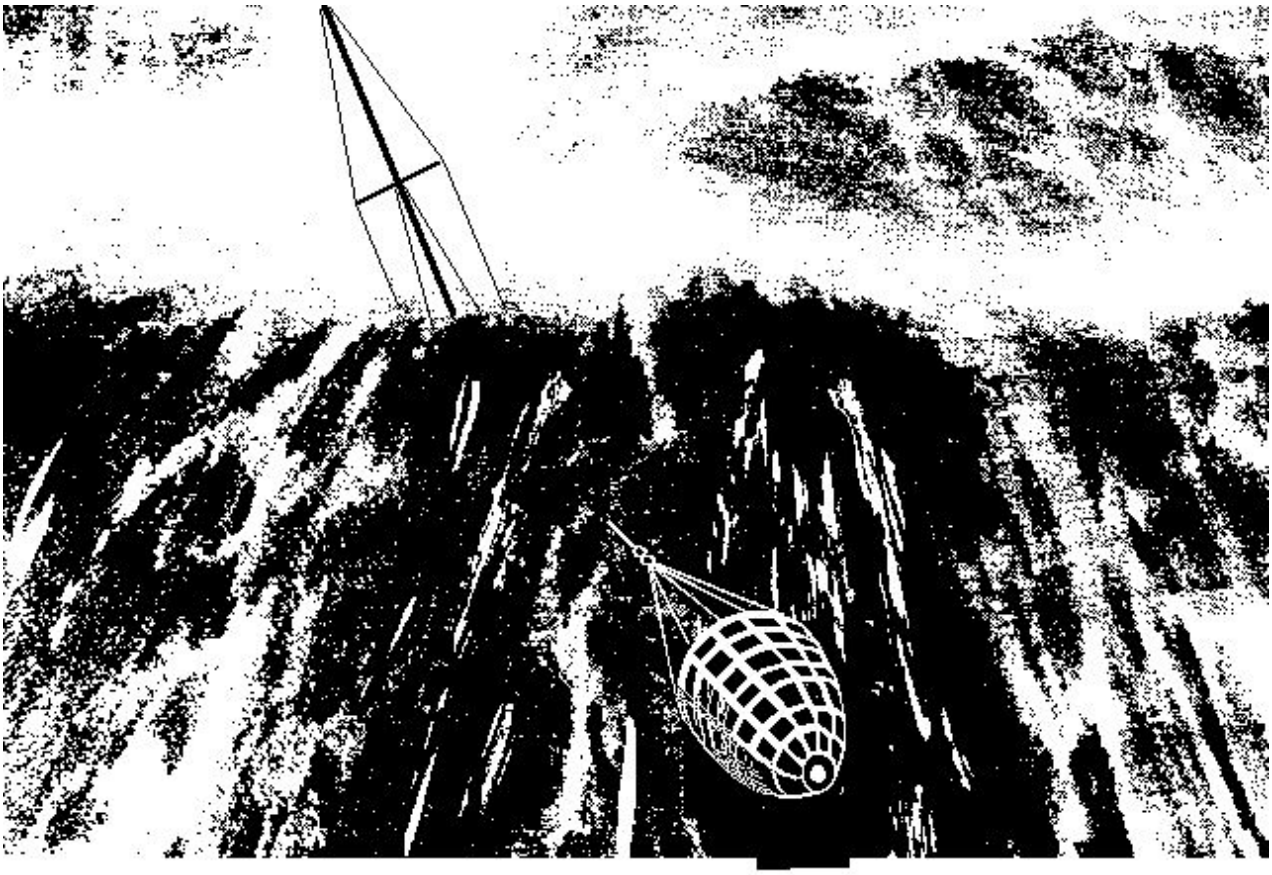
36" Dia. Galerider Drogue

Force 11 Conditions

File D/M-17, obtained from Michael & Doreen Ferguson, Auckland, NZ - Vessel name *St. Leger*, hailing port Vancouver, monohull, G.R.P. cutter, LOA 41' x 8 Tons - Modified fin keel - Drogue: 36" Diameter *Galerider* on 250' x 3/4" polypropylene three strand rode, with 5/8" stainless steel swivel - Deployed in the Queen's Birthday Storm in deep water about 400 miles south of Fiji with winds of 60 knots and seas of 40 ft. and greater - Speed was reduced to about 3.5 to 4 knots during 60 hours of deployment.

St. Leger was in the same June 1994 "Queen's Birthday Storm" that claimed three lives and numerous yachts. Her Canadian owners, Michael and Doreen Ferguson, sent the following report to Skip Raymond of Hathaway, Reiser and Raymond, who then forwarded it to Victor Shane for inclusion in the database. Transcript:

> *We launched* St. Leger *in 1 May 1982. She is a 41 ft. G.R.P. cutter with modified fin keel and fully unbalanced rudder, using a "Sayes Rig" self-steering vane. We moved aboard* St. Leger *the day before the launching and have lived aboard since 1982. We retired in 1991, Mike was a Sargent with the Royal Canadian Mounted Police - the NCO I/C of Marine Services with commercial maritime qualifications. After a hair raising experience in severe weather in Queen Charlotte Strait in 1989, we purchased a Galerider drogue directly from Hathaway, Reiser and Raymond after seeing an advertisement in a yachting magazine.*
>
> *In May of 1991 we left our home port of Vancouver, Canada, and headed for Alaska. Thus began our life as full time cruisers. In April 1993 we crossed the Pacific from Mexico, arriving in New Zealand in November of that year.*
>
> *In June 1994 we departed Tauranga, New Zealand, bound for Fiji, with only Michael and I aboard. At 1600 hrs on our second day out and approximately 75 miles from the North Cape of New Zealand, we first heard of a low pressure system situated over Vanuatu, predicted to track southeast into our intended path. The weather forecast in our area predicted southeast winds 35-40 knots, not particularly severe, so we decided to continue on our course under reduced sail. Later, under bare poles and in deteriorating conditions, we ran before it in very steep, short seas, and the wind sustained at 50 knots, with higher gusts.*



At about midnight on day 2 of the storm we decided to deploy the Galerider as our boat speed was now 11-12 knots in precipitous seas. We deployed the Galerider using a single line off the starboard quarter, approximately 250 feet of 3/4 inch three strand polypropylene line. We selected polyprop three strand because of its floating ability. Our plan was to slow St. Leger *down, whilst still maintaining steerage using the "Sayes Rig" vane, due to shorthanded crew. Immediately upon deployment our boat speed was reduced to 3.5 to 4 knots and we felt much more comfortable.*

The wind vane continued to steer beautifully, but as St. Leger *slowed down in the troughs of the huge seas the tow line and Galerider tried to catch up to us, leaving a loose coil of 12 to 15 feet of tow line floating in close proximity to the vane's trim-tab steering paddle. Fearing that the slack line might tangle in the trim-tab and surely tear it off, Mike began bringing in the slack each time we were in a trough, using a primary cockpit winch, until the Galerider was approximately 80-90 feet behind the boat. The drogue was in the same wave as* St. Leger*, but on the other side of the crest* [on the back side]*. We observed the Galerider for hours! A small "half-moon" section of the drogue was visible at times, and we noted the three strand polypropylene tow line did not unwind, nor did the Galerider oscillate or rotate. And best of all, this enabled the wind vane to steer the whole time.*

We towed the Galerider without incident for 60 hours, with winds at 60+ knots (our "Swoffer" wind gauge was pegged at its limit). At approximately 0800 hrs on day 5 the wind had dropped to 18-20 knots. The low pressure system was east of the Kermadec Islands and moving away from us.

The seas were still high, but we readily retrieved the Galerider, which was in almost new condition with no damage or excessive wear after a tough workout!

We should also mention that the New Zealand Air Force Orion aircraft searching the area [for other vessels in distress] *made a low pass over us and we advised them by radio that we were OK and not in need of their assistance. Our sails were set and we spent the next week hard on the wind in light northerly winds with very lumpy, confused seas. We arrived safely in Suva, Fiji, where we exchanged tales of the "Queen's Birthday Storm" that claimed three lives and seven cruising yachts. Everyone involved was interested in what "worked" and what didn't.*

D/M-18 Monohull, Cal T-2

Monohull, Cal T-2

27' x 3 Tons, Fin Keel

36" Dia. x 72" Conical Drogue

Force 9-10 Conditions

File D/M-18, obtained from Wes Thom, Brownsville, TX - Vessel name *Paper Dragon*, hailing port Annapolis, monohull, Cal T-2 designed by Bill Lapworth, LOA 27' x LWL 24' x Beam 10' x Draft 5' x 3 Tons - Fin keel - Drogue: 36" x 72" heavy duty, Coast Guard approved cone made by Cal June, on 125' x 1/2" nylon three strand tether and bridle arms of 10' each, with 1/2" galvanized swivel - Deployed in a whole gale in deep water about 125 miles west of Bermuda with winds of 45-50 knots and seas of 20-25 ft. - Vessel's stern yawed 20-30° - Speed was reduced to about 2 knots during 48 hours of deployment.

Wes Thom has delivered yachts on the east coast and across the Atlantic. En route to Bermuda on his own boat, a 27-ft. Cal T-2 designed by Bill Lapworth, he had occasion to use one of the heavier 36-inch diameter Coast Guard approved cones manufactured by Cal June of Los Angeles. This is quite a large cone, about six feet long, not to be confused with the smaller "fish trolling" ones made by Cal June. It was deployed on 125' of rode and Wes Thom and his wife saw it being repeatedly tumbled by the crests. Thom did not consider the tumbling a drawback at the time because the cone would always recover and re-exert its pull at the needed time. Transcript:

> *We had been sailing from Cape May to Bermuda. Two days out, on a Wednesday, we talked to a Russian tanker by radio and were warned by an individual, who seemed to be out of breath, to head back for the mainland immediately. Basically he told us that a bad storm was on the way and a small boat like ours had no business being out there. He said they were increasing their own speed to full speed to avoid the storm. We thanked them, but told them we could not get to land that fast. They said "God bless you, we will pray for you."*
>
> *At 7000 hrs Friday we had a full main and 150 jib up. As the wind increased we rolled in the 150 and hanked on a working jib. At 1100 hrs first reef in main. At 1200 hrs 2nd reef. At 1400 hrs storm jib. At 1500 hours no main. At 1600 hrs bare poles. At this point we were still going in the general direction of Bermuda about 1.5 knots, and a little concerned about the reefs around Bermuda if the storm blew us all the way there. We were 100-125 miles west of Bermuda, our course NE, the wind out of the south. As our speed increased to about 6 knots, occasionally*

surfing at 10-11 knots, we put out two warps. No knots, no weights, just 150' of 5/8" line [nylon three strand] *off the port winch, and 300' of 1/2"* [nylon three strand] *off the starboard winch. With the warps out our speed came back down to 1.5 to 2 knots, still heading NE. We thought if we needed to we could always use the port winch to pull the warps in and add weights etc. In reality we could never have done that. The strain on each warp, even after the worst part of the storm, was amazing. The 5/8" warp was pulled so tight it would make noises like a cello string, and the 1/2" warp had an even higher pitch, like a guitar string. After putting out the warps we later rigged a 125' piece of 1/2" line, the end securely bridled through corner stanchion bases, with a 2-size larger CAL JUNE conical drogue* [36" x 72" Coast Guard Approved "Storm Sea Anchor"]. *When our speed got back up to 6 knots* [with warps in tow] *we deployed the cone, which brought our speed back down to 1.5 knots* [the two warps coming off port and starboard winches and widely spaced to right and left, the Cal June cone and its tether in the center].

Most of the waves seemed to be breaking before they got to the boat, but a few would drop 10" of water in the cockpit. At night we also steered by listening for the oddball waves crossing the others. They sounded a bit like a train when they hit, rocking us sideways if we had not turned down wave for them. The main waves were out of the SW. The odd ones from the S or SSE.

In the daylight we could see that the waves were not less than the height of our spreaders (about 25') and about 150-175' from crest to crest. We were in deep water east of the Gulf Stream, WNW of Bermuda, still headed NE. We could look behind and watch the drogue start up a wave as we came over a crest. We could see it tumble on its own crest as we slid down the back side of ours. About the time we were in the trough it would grab again, and up and over the next crest we would go. We could clearly see the yellow cone tumbling repeatedly. It would get rolled, get tossed around, go end over end and everything in between. But it wasn't getting turned inside out, and it seemed to be doing its job when needed.

Most of the time we could let the autopilot steer. We could get 2-3 hours of very good sleep, even with the freight trains coming every once in a while. Once, when I was inside and looking through a port hole I saw the bow get buried by green water, which then turned white, and rolled off, and I could see the bow again. Sunday morning (48 hours later) it starting moderating. By 1600 hrs we had hauled in our CAL JUNE. It had to be winched in, a few feet at a time, when it was tumbling on the crest behind us. The sea was still sloppy when we set sail and the last warp [which was still left out] *served to ease our motion.*

We believed we had been blown 50-75 miles WNW of Bermuda and set a course for south. Monday morning we got our first celestial sight, and a few hours later a running fix, but something was very wrong. Our intercepts were very long and our sights had never been this far off before. Theory says you don't have to know an exact DR. Just guess. So I picked 500 miles NE. The intercept said no, not there. I tried 500 miles NW - no not there. I tried 500 miles SE - not there either. But they all said "here," so I moved my DR there, and sure enough, I knew where we were. From the last known DR position we had been blown 125-150 miles. We had overshot Bermuda! By Monday about noon I knew we had sailed south past the East Coast of Bermuda and now had to double back to the NW to get to our destination. Monday night we were in St. Georges Harbor, tied up, in good condition, undamaged, safe. Our only loss was the 150' x 5/8" three strand warp. It had unlayed and hockled in the middle, in random 10' sections, and had to be

scrapped. Not much to pay for a safe trip.

D/M-19 Monohull, Sparkman & Stephens

D/M-19

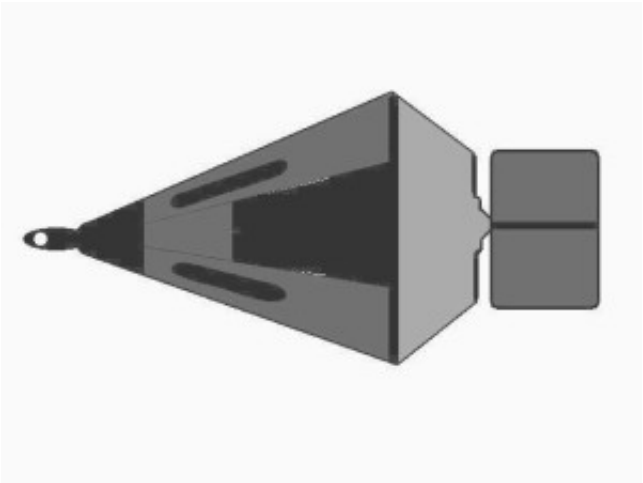
Monohull, Sparkman & Stephens

39' x 8 Tons, Fin Keel

Seabrake MK I

Force 10+ Conditions

File D/M-19, obtained from W.R. Allen, Milson's Point, NSW, Australia - Vessel name *Adele*, hailing port Sydney, monohull, Superstar sloop designed by Sparkman & Stephens, LOA 39' x LWL 35' x Beam 12' x Draft 6' x 8 Tons - Fin keel - Drogue: *Seabrake MK I* on 200' x 5/8" nylon braid rode - Deployed in cyclone *Bola* in deep water about 50 miles NW of the North Cape of New Zealand with winds of 60 knots and seas of 40 ft. - Vessel could be steered through a wide arc in the proximity of land - Speed was reduced to about 3-5 knots during 36 hours of deployment.



Seabrake Mk I

The Seabrake used in this file was the same model used by Peter Blake in D/T-1, the more expensive *MK I*, with the spring-loaded gate mechanisms. The mechanism is adjustable and can be set to open the gates at a certain speed, instantly increasing drag by about 70%. Refer to inventor John Abernethy's explanation of the workings of the spring-loaded mechanism in File D/M-10. The earlier versions (likely this one) had ballasted nacelles to help keep them submerged, while later versions relied on a length of chain in the rode. Transcript:

Since purchasing the Seabrake I have made four Tasman crossings - Sydney to Auckland and

return. The first two crossings were reasonably monotonous. The third included my involvement as a competitor in the Trans Tasman Transfield Challenge Race [Feb/March 1988]. *In this race competitors were savaged by cyclone Bola in the vicinity of Three Kings Island and the North Cape of New Zealand. We ran into Bola on the approaches to the northern tip of New Zealand. There was no race warning and the first advisory we had was a weather forecast from a shore-based NZ radio station! Needless to say this warning was passed rapidly through the fleet! We passed through Bola whilst it was centered in the area of Three Kings Islands, Cape Reinga and North Cape. Retrospectively the weather maps indicated that Bola had three centers concentrated in the area at the time.*

We had to make an important decision regarding our course across the top of NZ, a particularly treacherous piece of water in bad weather. Even in settled weather the NZ pilot advises that small vessels should approach no closer than fives miles to land. In rough weather fishing boats and even large vessels have been lost, in some cases without trace. This is largely due to strong currents flowing up and down the West and East coasts, and shallow waters (120-130 meters). In bad weather the safer course is to keep northward of the Three Kings and proceed via the Three Kings Trough in deep water (more than 1000 meters). This is the course we adopted.

At 2200 hrs on the 7th March at 33° 36' S, 169° 17' E, we were under bare poles and had set the Seabrake. Shortly thereafter we suffered a 90 degree knockdown, but apart from a few bruises there was no damage. However through this incident we were made very much aware of the confused nature of the seas and that we were catching the odd rogue cross sea. On the 8th, 9th and 10th March we proceeded in a SE direction following the Three Kings Trough, towing the Seabrake. During this period of heavy breaking seas with winds in excess of 60 knots the Seabrake was in continuous use, doing a marvelous job steadying our progress and giving us a strong feeling of security regardless of the conditions. At no stage did Adele *show any tendency to broach and it was always possible to maintain a measure of control, despite the extreme*

conditions.

With the wind generally NW we streamed the Seabrake from the starboard primary winch, which meant the brake was mainly on the quarter, though when the occasion demanded with a particularly big sea we would run straight before. I am not aware of any period when the brake was not on the back of the next wave. On the crest of a wave we would occasionally pull the brake clear [out of a wave face] *but it always dug in to hold us for the next one. We made no adjustments to the spring-loaded mechanism which was set to operate* [kick in and generate 70% more drag] *at 5 knots, and generally we were able to maintain that speed.*

We had no problems with chafe and we did not use chain or any other means to weigh the brake down. Wind speed was variable between 40 and 60 knots and for shorter periods 60 plus. Difficult to estimate the height of waves. With a fifty odd foot mast we would on occasions be buried in the trough. On the 8th we had periods of heavy rain followed by gusty winds up to 50 kts. On the 9th with storm jib set the log says "from midnight to daybreak ran before heavy breaking seas - Seabrake probably saved us from being rolled in the early hours of the morning. During the day and evening conditions too rough to get sailing so jilled along at 2-5 kts under Seabrake in a SE direction away from North Cape." On 10th March conditions had moderated and we were able to proceed under full sail.

On the return journey, Auckland to Sydney, we experienced peak conditions. A high extended right across the Tasman with a broad front covering most of the North Island of New Zealand with a narrow front bordering the New South Wales coast [of Australia]. *We left New Zealand in extremely light conditions having to motor up the East Coast until we cleared the Three Kings. Thereafter we moved in an easterly air flow right across the Tasman.*

As we approached Australia the wind steadily increased. This was further exacerbated by low pressure areas developing north and south of the high. During the last five days we experienced winds in excess of 40 knots for most of the time, including a squall which lasted about an hour which was an absolute white out of wind-driven seas, which we estimated in excess of 100 knots.

Throughout the period of five days we towed the Seabrake off the weather quarter. Initially we sailed under trysail and boomed out storm jib. As conditions increased in severity we progressively lowered the trysail then the storm jib. Later the cockpit spray hood and life buoys, to reduce windage. As you can imagine, with an easterly air stream extending right across the Tasman the seas built up and were breaking dangerously, particularly at times when the winds reached about 50 knots. Adele *handled the conditions extremely well with the Seabrake out. It was quite remarkable how in the midst of a breaking wave it would hold the boat momentarily and allow the wave to sweep forward and away from under us.*

As you will have gathered from this I have the highest regard for the Seabrake. Even under the worst conditions the brake always gives a measure of control and at the same time enables you to make progress. Not the least virtue is a sense of security and a great boost to your confidence at time when your morale could be at low ebb. The downside is that they are comparatively heavy and they take up room in the cockpit, though this can be overcome to some extent by mounting them on special brackets [on the stern pulpit]. *Still, for safety at sea, anything is worthwhile.*

I have also had some experience with parachute anchors which are also great, particularly with prolonged periods of heavy weather when you want to get some sleep and rest up for a period. You can really sit back and enjoy a good storm! The main problem is with chafe and this needs constant attention.

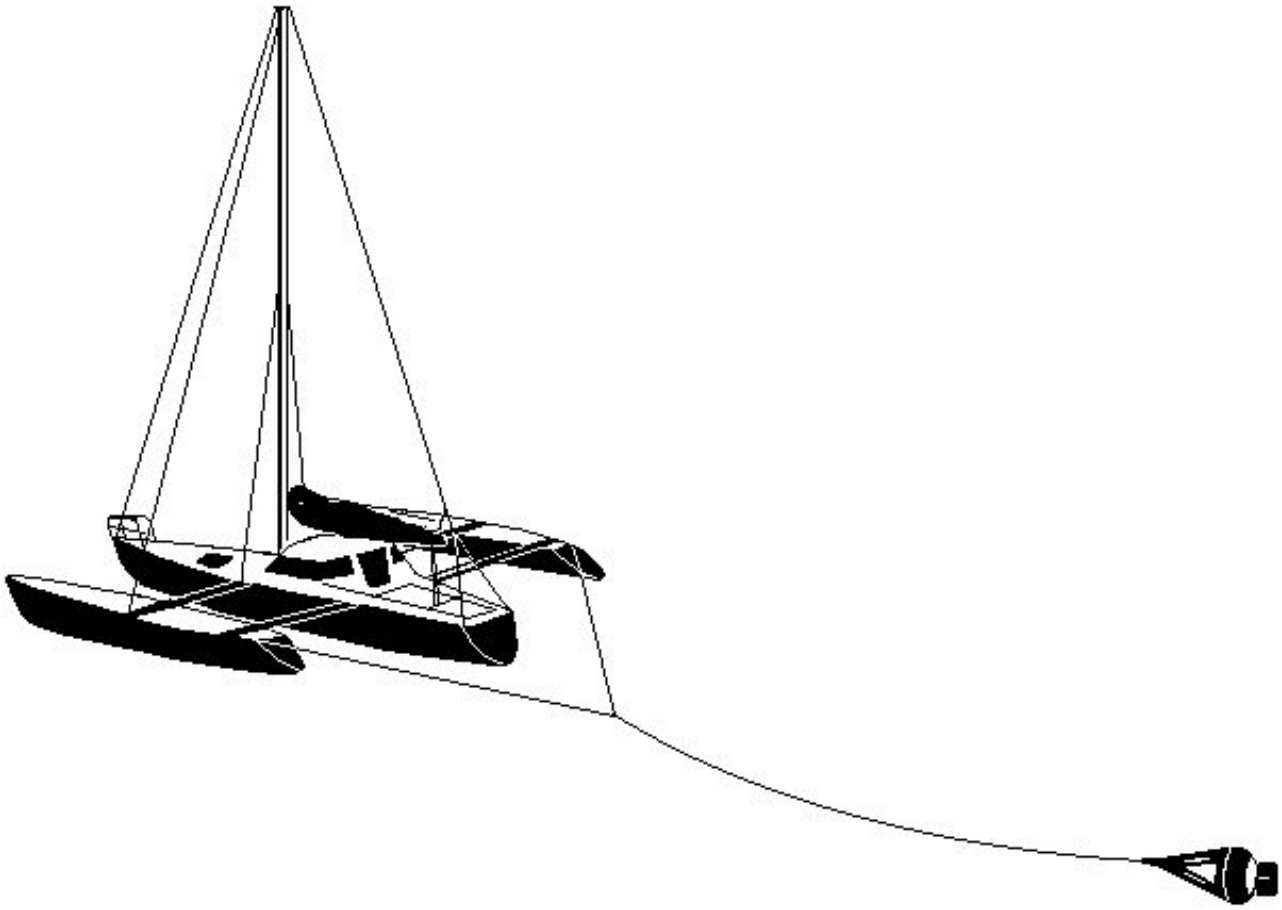
Drogues on Trimarans

D/T

D/T

Files Relating to Drogues

Used by Trimaran Sailboats off the Stern



"We used the Seabrake again between Fremantle and Adelaide, across the bottom of Australia. We used it with a vengeance there and it definitely saved the boat and the crew in a full force winter storm coming in from the Southern Ocean."

Peter Blake

D/T-1 Trimaran, Steinlager

Trimaran, Steinlager

60' x 52' x 5.5 Tons

Seabrake MK I

Force 11+ Conditions

File D/T-1, obtained from Sir Peter Blake, Auckland, NZ - Vessel name *Steinlager*, hailing port Auckland, Maxi racing trimaran designed by David Allan Williams, LOA 60' x Beam 52' x Draft 5' x 5.5 Tons - Drogue: *Seabrake Mk I* on 300' x 3/4" nylon braid rode and 30' of ½" chain - No bridle - Deployed numerous times in the *Bicentennial Round Australia Two-Handed Race* with winds of 55-70 knots and large, confused seas - Vessel's stern yawed 10°.

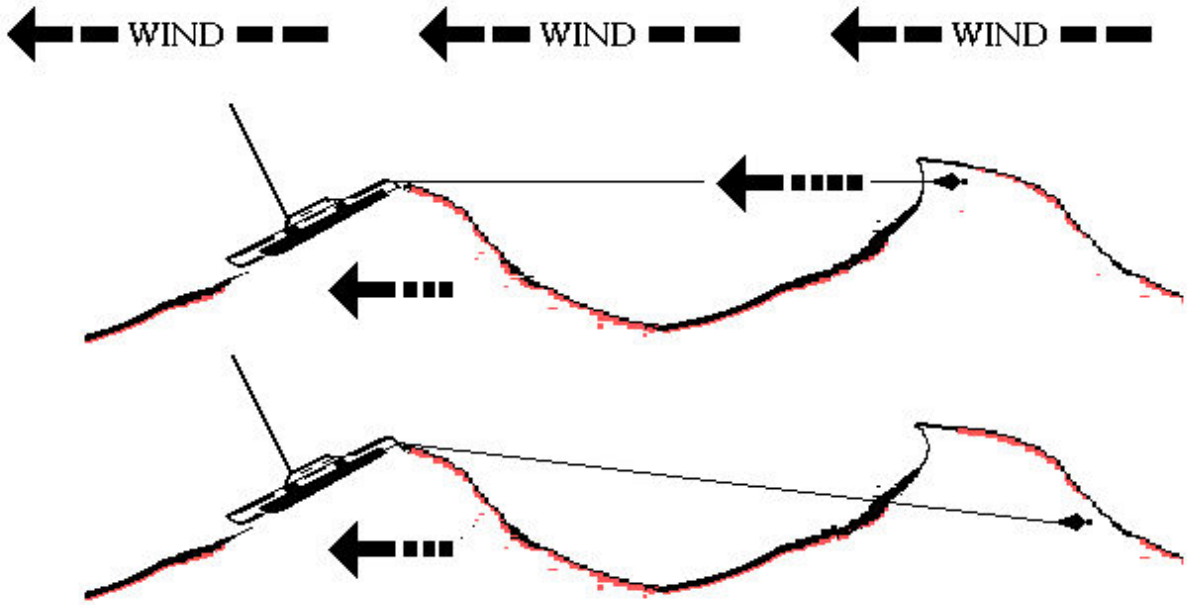
Sir Peter Blake is one of the most experienced sailors on the planet earth (500,000 blue water miles). His heavy weather experiences span the entire gamut of gales and storms on board every conceivable type of small craft both monohulled and multihulled. Victor Shane had the privilege of interviewing Peter on the telephone just after his team won the America's Cup on the New Zealand yacht *Black Magic* in May 1995, in San Diego. The interview revolved around a number of subjects. Here is a transcript (by permission):

> ***The 1988 Round Australia Race:*** *The Bicentennial Round Australia Two-Handed race started on the 8th of August 1988 from Sydney to Sydney* [anti clockwise]*, with a number of stops in between. You go up inside the Barrier Reef to start, go round through Torres Strait to Darwin, down the Indian Ocean to Fremantle, and then come along the Great Bight of Australia to Adelaide, down to Hobart, back up the east coast of Tasmania, back through the Bass Strait towards Melbourne, and then through the Bass Strait again up to Sydney.*
>
> *The Seabrake* [MK I] *was used in the first storm, which occurred within the first twelve hours of the race. We had winds of 55-60 knots from dead behind against very big seas because of a south going current. The wind was southerly and the set was going south so it built very big seas. We used the Seabrake again between Fremantle and Adelaide, across the bottom of Australia. We used it with a vengeance there and it definitely saved the boat and the crew in a full force winter storm coming in from the Southern Ocean. We used it again between Adelaide and Hobart, along the bottom of Tasmania, again with a severe weather front coming through, and then later on we used it again between Melbourne and Sydney, just coming up round the corner from the Bass Strait turning north. On this occasion we were beating into it with reduced sail when my partner Mike Quilter suddenly yelled at me as I was down below getting ten minutes of sleep. He said, "come up quick," and in about two minutes the wind went from 25 knots northerly to about 50 knots southerly. And so the Seabrake went over the transom straight away, no sails set, and the sea still coming from the north, but the southerly wind was driving us hard into those sea, so if we*

hadn't slowed the boat down I think it would have broken up.

The worst case scenarios were on two different occasions. One was on the day we started the race [8 August]*, and if I hadn't had the Seabrake I wouldn't be talking to you now, probably. And the other occasion was the day and a half before the finish, when I think if we hadn't had the Seabrake there was no way we could have slowed the boat and the lightweight racing trimaran would probably have self-destructed, again because the wind changed and we were being driven headlong into northerly seas by a 50-knot wind from the south. These were very big breaking seas, real breaking waves collapsing down their full fronts.*

Using the Seabrake without a bridle the trimaran steered very well [without autopilot]*. We pulled the centerboard up and the boat basically blew down wind with the Seabrake off the back. It was really great, no keel to trip over, no roll, no yaw, nothing, just straight downwind, fantastic. Multihulls are very good like that, much better than monohulls. No need for bridle, just a single tow line coming to a great big winch.*



In extreme conditions an improperly positioned drogue may come flying out of a steep wave face when boat is surfing down another steep wave face. Positioning the drogue on the back of the next wave will help prevent this. The use of chain next to the drogue will help as well.

The drogue pulling out: *On a few occasions we found that when we started to surf very hard the Seabrake broke free of the seaface behind. Depending on if we had it at the right distance behind the boat or not, it sometimes broke free and nearly caught the boat up. I mean it came whistling through the air like a rocket and we severely damaged the first one and replaced it with another, which we then tied all our anchor chain to, between the rope and the drogue - probably about 30' of ½" chain - then it was just fine and didn't pull out any more. We broke the original Seabrake up because it wasn't designed for such a large boat (we had a 400 sq. ft. wingmast on* Steinlager*) and that particular Seabrake was designed for boats up to 45 feet I suppose, and a bit heavier. But it did a marvelous job nevertheless. Once we added the chain it didn't pull out any more and it worked well.*

ENZA: *Far more recently we did a run around the world with a boat called* Enza, New Zealand. *We broke the record for non-stop around the world on this 92' x 43' catamaran. We went around in 74 days and 22 hours, and really I think there's a lot more to be learned from that, an enormous amount more than the Round Australia Two-Handed Race, mainly because it's fresher in my mind. At one time we were in sustained seas that we estimated over 60 feet, totally breaking down their fronts. And on the second occasion, when we had all warps out, not only did we have 40-50 ft. seas coming from behind, but also seas of 50-60 ft. coming at right angles from the port beam and it was a nightmare. We just about lost the boat on two occasions at that point going down the mine, until we got the drogue out the back and then suddenly we could relax. That really was a matter of survival. It was an "if we don't get the drogue out we're not going to be alive" scenario. There was no maybe to it that time.*

We spent quite a bit of time in the last 24 hours from the finish in full Atlantic storm conditions on Enza *and we used what we had on board, which was all of our anchor chain and every single bit of rope we had, strung in a bight off the back and that worked fantastically. That was just as good. Two bridles, made up from 300 meters of rope on each side, and then right at the end we had all of the anchor chain, which was I suppose about 30 meters parceled up, and around that we had wrapped the anchor warp and seized it all up so that it made like a big bundle, but a heavy bundle, and that worked extremely well. It wasn't as easy to deploy as the Seabrake, however, took a bit of getting out and a bit of getting it back. The Seabrake we used to throw over with no hesitation, and it no doubt saved us on a number of occasions just because it was so easy to use.*

Sea anchor or drogue? *I've got my own view, and not just the facts. I've been hove-to in cyclones, I've run before, I've used trysails, I've dragged things, I've been beam on, you name it, on every sort of vessel. To me the biggest thing is that you must be prepared. I think that a lot of people get into problems because sometimes these weather patterns creep up on you and then suddenly it really is very nasty and you haven't quite realized it, and then to get out the necessary drag device, whatever it may be, is almost too late. By then people are seasick if it's a cruising boat, or they're not too used to it, or not necessarily experienced. So to have something easy to put over, such as a Seabrake, or whatever drag device you are using, I think that is very important. I have never layed to a sea anchor in earnest, but I can see that it might be reasonable. I tried lying to a sea anchor with my own trimaran once. We used a jet aircraft drogue parachute, but the trimaran had a big wingmast, and we could never anchor her conventionally by the bow anyway, having to anchor her by the stern instead. And we finally blew that parachute out, there was so much load on it. So I don't think there is any fixed answer to a set of conditions, though I think that if you've*

got searoom I, personally, would always go with a drag off the back. But if you haven't got searoom you haven't got an option. On a number of occasions in the Round Australia Race, on Steinlager, *we would be on a lee shore with nasty weather coming in and we would actually keep an eye on the geography of the shoreline, even though it was a hundred miles to leeward, knowing that if conditions were to really turn bad we weren't going to be able to go to windward - no boat goes to windward in a storm - and we were going to have to run downwind, and the best thing probably would have been to find a place that didn't have steep cliffs and run the boat up on beach as far as possible. Run it up on a sandy beach and just get off the thing.*

Quartering the seas? *I don't necessarily go along with the idea of quartering the seas* [with drogue in tow]. *I think that it depends on what you are on, and if you're on a multihull it's definitely much better to be running squarely downwind, because if you're running with the wind on the quarter you're likely to dig a bow and loose it much more easily. Better to run absolutely downwind* [in a multihull]. *It's dangerous to take the seas on the quarter, and much, much better to take them square on the transom; that's in a multihull - a trimaran or a catamaran. A monohull, I think, is a different scenario, and I might agree with the quartering idea.*

Lying A-Hull: *I've hove-to in some really extreme conditions. I'm happy to sit there, but would be absolutely against lying a-hull anywhere. I don't think lying a-hull is a mode of survival that one should contemplate if conditions are really severe. In moderate conditions, if you're not too worried about the sea state, maybe it's OK. But lying a-hull in a storm is a recipe for being rolled, or having the deck or the cabin top stove in and heavy water come inside. I think that the other approaches are better. Even though lying a-hull is natural and sort of easy, I definitely don't think it's a tactic that people should use, unless they haven't got another option.*

D/T-2 Trimaran, Newick

Trimaran, Newick

31' x 26' x 1.5 Tons

5-Ft. Dia. Shewmon

Force 9-10 Conditions

File D/T-2, obtained from Thomas Follett, Orange City, FL. - Vessel name *Galliard*, Val ocean racing trimaran designed by Richard Newick, LOA 31' x Beam 26' x Draft 5' (2' 5" board up) x 1.5 Tons - Drogue: 5-Ft. diameter Shewmon (sea anchor) on 200' x 5/8" nylon braid tether, with bridle arms of 80' each and 1/2" galvanized swivel - Deployed in a whole gale in deep water about 300 miles east of Cape Cod, with winds of 45-50 knots and seas of 12-15 ft. - Vessel's stern yawed 10-20° during 48 hours of deployment.

This is one of several files Victor Shane was able to obtain from Thomas Follett. Follett delivered hundreds of boats all over the world. In February 1985 Follett and crew were delivering *Galliard*, a Newick Val 31 ocean racing trimaran, to Villa Mora, Portugal, from Vineyard Haven, Massachusetts when they ran into a heavy gale some 300 miles east of Cape Cod. Follett deployed a 5-ft. diameter *Shewmon* sea anchor off the stern - in drogue fashion. The boat was hove to the *Shewmon* for 48 hours, during which time the sea anchor must have withstood over 40,000 wave cycles. Transcript:

> *A crew of two and heavy load of stores. Boat was essentially a daysailor and not suitable for the North Atlantic in October, and we ended up returning to Norfolk. About 300 miles ESE of Cape Cod a NE breeze came up and increased to Force 8 or 9 with rough seas. Streamed a 5' drogue with a bridle to the stern ends of both amas* [floats]. *Bit of nuisance with the stern of the aka* [main hull] *jutting out and all cluttered up with antennas and with a spade rudder hanging down. Managed to get part of the bridle under the rudder at one time and this took some time to sort out. Unlike Rogue Wave* [see file D/T-3] *there was not enough windage on* Galliard. *Finally had to set a storm jib in order to reduce the tendency to surge forward and then snap back, as though tethered to a rubber band. Caused the drogue to collapse after a time and we had to reel it in for a sorting out. In general, however, we lay quite comfortably about 20° off the wind and very few seas broke aboard in spite of the heavy load of stores and crew. No damage to the drogue, except for the swivel, which got crosswise somehow.*

Before 1981, Tom Follett was using warps and other makeshift drag devices during his deliveries. Typically the setup consisted of two lengths of rode, with a bit of sail or chain in the bight. The arrangement proved itself quite satisfactory when Follett was delivering lightweight multihulls. Here is a transcript of a report involving one such occasion:

Vessel name, Bonifaccio*, 41-ft. trimaran designed by Dick Newick and built by Damien McLaughlin for a French owner to sail in the Double-Handed Trans Atlantic Race from Plymouth, England, to Newport, R.I. in 1980. Used warps (3/4" braided nylon) from both ama sterns with a 10-ft. piece of 1" chain in the bight. Each warp was about 200 ft. Wind about Force 8 from SW (blowing us in the right direction, i.e., towards Plymouth) with heavy rain. Rough sea. One part of the bridle led through a snatch block on the Ama stern and back to a cockpit winch. Very easy to handle the whole mess and the boat rode very easily. Not necessary to steer. Fresh breeze only lasted one night and we were back in gear about noon the next day. Fair amount of drift. About 2 knots, more or less.*

General comments: *The trimaran configuration makes the use of a bridle difficult when streaming a drogue off the stern. If one could get around to setting things up with the wind about Force 4, life would be easier. But unfortunately it's often Force 8 or more before one gets around to it. Then the difficulties are magnified and one often ends up doing it all wrong. The ideal system would be one which is easy to sort out, does not put too much strain on the boat or fittings and holds the boat fairly steady while riding easily. Not exactly compatible factors.*

D/T-3 Trimaran, Newick

D/T-3

Trimaran, Newick

60' x 34' x 8 Tons

5-Ft. Dia. Shewmon

Force 10 Conditions

File D/T-3, obtained from Thomas Follett, Orange City, FL. - Vessel name *Rogue Wave*, Maxi ocean racing trimaran designed by Richard Newick, LOA 60' x Beam 34' x Draft 8' (board down) x 8 Tons - Drogue: 5-Ft. Diameter Shewmon (sea anchor) on 100' x 3/4" nylon braid rode. - No bridle - Deployed in a gale in shallow water (50-60 fathoms) about 80 miles west of Tunisia with winds of 50 knots and unstable seas of 15 ft. - Vessel's stern lay at a 25° angle during 36 hours of deployment with very little drift.

This is the second of two major reports obtained from veteran delivery skipper Tom Follett (see also previous file). The occasion of this file led to the publication of the Shewmon Paper, *Sea Anchor - Rode Tactics* (1986, Shewmon, Inc.)

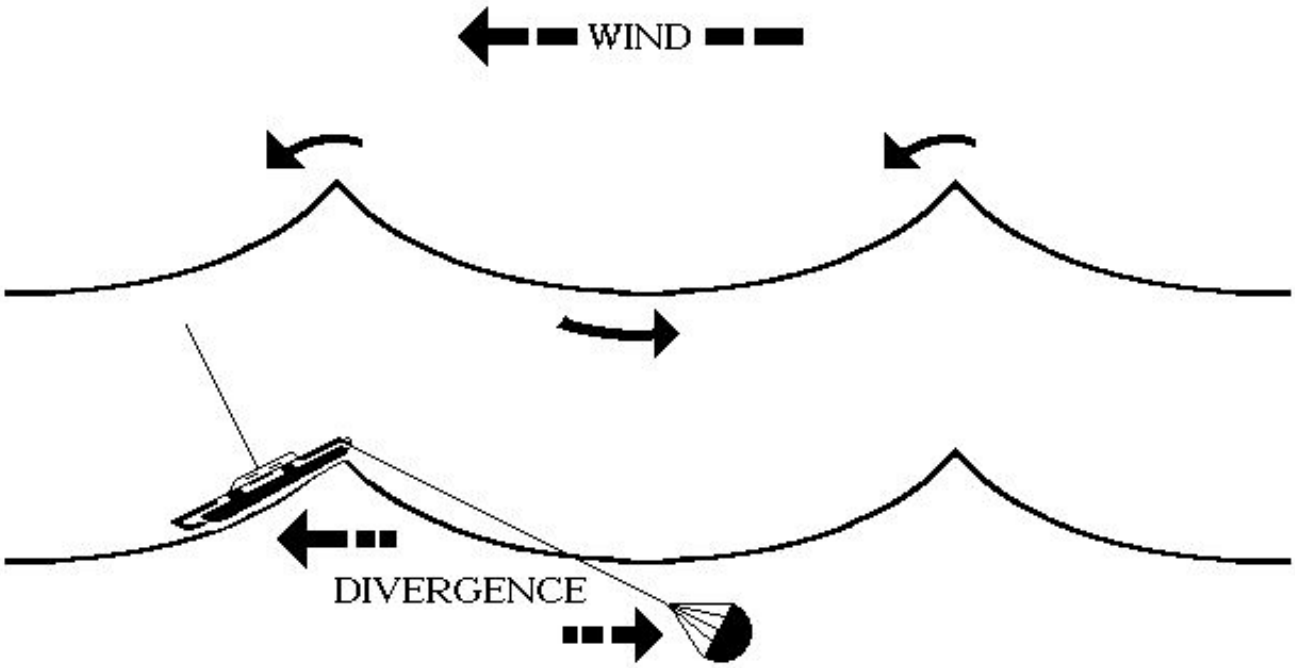
Multihull sailors may recall that *Rogue Wave* once belonged to the late, great Phil Weld, whose previous 60-ft. trimaran *Gulfstreamer* was capsized by a rogue wave in the Atlantic, later to be picked up by the Russian ship *Boreas* and taken to Odessa, where she collected dust for many years. Some time after Phil passed away, *Rogue Wave* was purchased by a wealthy individual of the United Arab Emirates. Tom Follett and crew were delivering the big tri when the incident occurred.

Rogue Wave departed Almerimar, Spain, in February, bound for Sidi-bu-Said, Tunisia. Two days later and some 100 miles north of the African coast - in shallow water - she ran into an *Arifi* (a cousin of the *Scirocco*), packing 45-50 knot winds. The waves were about 15 ft. high and 200 ft. from crest to crest. *Rogue Wave* was doing about 10 knots on bare poles with her 117 sq. ft. wingmast feathered when the 5-ft. diameter Shewmon sea anchor was jettisoned over the stern.

The crew had led about 100 feet of the rode through some deck hardware to three cockpit winches, thinking that they could let out more line afterwards. When the sea anchor took hold it brought the huge trimaran to a jarring halt, yanking some minor hardware out of the deck. The three cockpit winches held, however.

Tremendous tension was noted in the rode, "too great to risk paying out any more line after we got the

thing made fast," quoting Follett. Notwithstanding, the sea anchor held the stern into the seas for 36 hours, until the storm abated. According to Shewmon, "When the sea anchor was retrieved, many of its longitudinal seams were found ruptured despite its tug-tested 10,000 lb. pull rating. The wind force on the boat was well under 1,000 lbs., so what caused the other 9,000 lbs. of pull?" Dan Shewmon then draws from Bowditch table 3303 showing that the circular surface water particulate speed for the reported 15-ft. waves must have been 3 knots.



Orbital rotation can cause extreme high loads in the case of large sea anchors, or small ones used as medium pull drogues.

When the boat was moving downwind on a crest at 3 knots the sea anchor must have been moving upwind at 3 knots in the adjacent trough. This adds up to a divergence of 6 knots, "which explains the missing 9,000 lbs. and the ripped out hardware and ruptured seams." (Quoting from the Shewmon paper, *Sea Anchor - Rode Tactics.*) The trouble appears to have been caused by a rode that was too short. Had the crew tied off 400-500' of rode (instead of only 100') the initial shock and the subsequent system loads would have been a great deal less. (Walter Greene seems to have run into a similar problem in File D/C-1).

Rogue Wave spent a few weeks in Tunis and then departed for Crete. About 100 miles from Sicily she ran into a *Gregale* (a cousin of the *Mistral*). This time Follett used a smaller, 3-ft. diameter Shewmon *drogue*. Transcript:

> *About a hundred miles or so east of Sicily, we streamed our smaller (3-ft. diam.) Shewmon drogue in an easterly wind of Force 7, in order to avoid plugging to windward. Worked much better. Lots of shipping about and we could maneuver with the engine whenever necessary* [drogue in tow]. *Didn't stop us but slowed us down a lot and was very comfortable. Not nearly as much strain (of course the wind was only about Force 7) and we could easily vary the length of the rode.*

EPILOGUE: Tom Follett passed away shortly after Victor Shane obtained invaluable feedback from him. He was a close friend of Richard Newick and delivered many of Dick's fantastic wind machines to exotic places all over the world. During his lifetime he made fifteen Atlantic crossings and numerous other passages, successfully negotiating a variety of heavy weather situations in monohulls and multihulls.

Tom knew the sea. He could discern subtle differences between gales and compensate for them ahead of time. He knew when to heave-to in a H-28 monohull and when to deploy a drogue on a 60-ft. racing trimaran. We are very fortunate that just before passing he left some of his priceless knowledge to us.

D/T-4 Trimaran, Newick

D/T-4

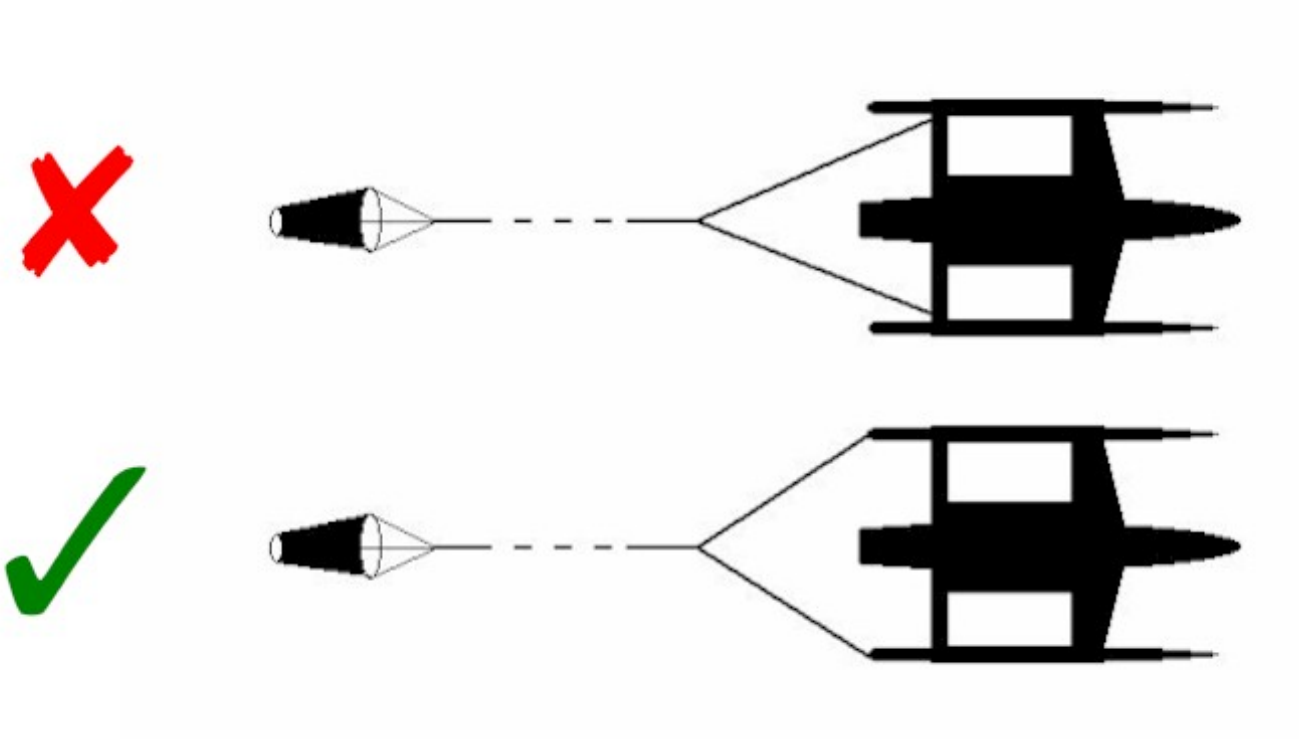
Trimaran, Newick

31' x 26' x 1.5 Tons

4-Ft. Dia. Conical Drogue

Force 9-10 Conditions

File D/T-4, obtained from B.J. Watkins, Arnold, MD. - Vessel name *Heart*, hailing port Richmond VA, Val ocean racing trimaran designed by Richard Newick, LOA 31' x Beam 26' x Draft 5' (2' 5" board up) x 1.5 Tons - Drogue: 4-Ft. Diameter cone (unknown make) on 200' x 1/2" nylon braid tether, with bridle arms of 75' each and 1/2" galvanized swivel - Deployed in a whole gale in deep water about 300 miles NE of Bermuda with winds of 40-50 knots and seas of 20 ft. - Vessel's stern yawed excessively - Damage and risk of capsize lead to the abandonment of the boat.



In order for a medium-pull drogue to take greater control bridle should be attached to the extreme outboard ends of the floats. (Review also Figs. 22, 23 in Section 4 for options relating to the attachment points of low-pull drogues that may require hand steering).

B.J. Watkins was singlehandedly sailing *Heart* from Annapolis to England to participate in the 1988 *C-STAR* (*Carlsberg Singlehanded Trans Atlantic Race*). Her intent was to become the first American woman ever to finish that race. "That is not what happened, unfortunately," writes B.J. in an article entitled *The Agony of a Premature Defeat* (March/April '88 issue of *Multihulls Magazine*).

B.J. departed Annapolis on 9 April 1988. On the third or fourth day out the boat hit something, damaging the rudder. A week later, 380 miles NE of Bermuda, *Heart* ran into a whole gale. B.J. set a 4-ft. diameter, conical drogue - unknown make - off the stern.

While the cone was too small to pull the *bows* into the seas (B.J. had tried that once and the boat just laid beam-to), by all tokens it should have done a good job of pulling the stern into the seas. But it did not. Why not? Likely because of the incorrect attachments points of the bridle. *Heart* was practically identical to *Galliard* (file D/T-2), both trimarans being Newick Val 31s. The difference was that Tom Follett deployed a 5-ft. diameter Shewmon with a bridle leading to the extreme outboard ends of the floats, whereas B.J. deployed a 4-ft. cone with a bridle secured to chain plates located on the cross-arms, inboard and forward.

The cone may have been on the wrong part of the wave train as well. In order to keep the stern aligned into the full blown gale B.J. found that she had actively to *steer* the Val trimaran. The pull of the drogue was not constant. Now and then the yacht would surf down the face of the steeper waves. To steer risked further damage to the rudder. To not steer risked a broach and possible capsize. The barometer kept falling. Components began failing. The seas built up and finally started to break over the small trimaran.

The situation became untenable and B.J. had no alternative but to turn on the EPIRB (Emergency Position Indicating Radio Beacon). She was taken off the crippled trimaran by the Dutch container ship *Charlotte Lykes*.

B.J. Watkins had spend about $50,000 in preparing her boat, which was uninsured once it was 200 miles from the U.S. coast - a bitter loss. A transcript of the DDDB feedback submitted by B.J. Watkins follows. It includes portions of related correspondence with Donald Jordan (by permission):

I have enclosed a copy of the correspondence I had with Donald Jordan. I hope this is helpful. Mr. Jordan and I have reached the conclusion that the reason the sea anchor did not pull the stern to the seas was because of the location of the attachment points. We feel that they were too far forward on the boat and too far inboard....

> [From the Jordan correspondence]*: I cannot tell you exactly what size drogue I had. It was a cone shape, approximately 4 feet in diameter at the widest point. It was original equipment which came with* Heart*, so I do not know the exact measurements. I had attached snatch blocks to half-inch "D" shackles whose pins formed the pins for the turnbuckles on the mast rig. The bridle lines ran through the snatch blocks to the primary winches. I am at a loss to explain why the boat did not ride stern to the wind. My experience with* Heart *prior to rigging with the wing mast was interesting. I had on a previous occasion deployed the sea anchor from the bow of the main hull, no bridle. This was done in Long Island Sound, 50-knot winds, 5-8 foot seas, no bridle.* Heart *laid beam to the seas at that time. We had the board up but the rudder was in place. Dick Newick suggested that possibly if we had raised the rudder we might have then set bow-to. The action of*

the sea anchor at that time prompted me to investigate further. We added the bridle and decided to try stern-to.... I agree that the best arrangement is to attach the bridle to special reinforced fitting provided at the aft ends of the amas.

UPDATE: Two years later B.J. Watkins and her teammate Boots Parker were participants in the 1990 Two Handed Transatlantic Race on the 45-ft. Peter Spronk catamaran *Skyjack*. On their way to England they lost both rudders (the shafts had been fabricated out of aluminum instead of stainless steel). And, while attempting to limp to the Azores on one spare rudder they ran into two Force 8 gales!

However, this time B.J. had an 18-ft. diameter Para-Tech sea anchor on board. In the second gale she deployed it. The orange parachute pulled the bows of *Skyjack* into the teeth of the gale, parking the boat and minimizing damage.

In a subsequent telephone conversation with Victor Shane, B.J. said that the parachute sea anchor performed in a most satisfactory way - it was a morale booster and it allowed them to "call time out" in a difficult situation.

D/T-5 Trimaran, Kelsall

D/T-5

Trimaran, Kelsall

30' x 24' x 1 Ton

18" Dia. Conical Drogue

Force 9-10 Conditions

File D/T-5, obtained from Michael Redvers Golding, Slough, UK. - Vessel name *Gazelle*, hailing port Poole, Dorset, modified Stripling 28 trimaran designed by Derek Kelsall, LOA 30' x Beam 24' x Draft 4' (12" board up) x 1 Ton - Drogue: Custom-made 18" diameter cone on 200' x 5/8" nylon braid tether, with bridle arms of 40' each - Full trip line - Deployed in a whole gale in mid-Atlantic with winds of 40-50 knots and seas of 30 ft. - Vessel's stern yawed 20° with the helm lashed - Drift was estimated to be about 25 nm during 10 hours of deployment.

Transoceanic racing skipper Mike Redvers Golding has been in many offshore gales. In 1989 his slender racing trimaran *Gazelle* came to grief off the Shetland Isles during the Round Britain Race. In an article appearing in the December 1989 issue of *Multihull*, he recounts the harrowing events that led to the loss of his boat (reproduced courtesy of *Multihull)*:

> *We were only 20 miles off the Shetlands, a lee shore, and 30 miles from our turning point, the infamous Muckle Flugga. Once round the headland we could head off south toward Lerwick.... I would normally have lain to the drogue in these conditions but the lee shore was far too close for comfort. We had spent some time beating, which although painful felt very safe until we could no longer climb the mounting seas.... The noise level rose to fever pitch as* Gazelle *was picked up by another nasty sea.... It was a slow sickening roll, not at all what I had imagined, with a crash as*

the port float met the water.... Water rushed below, filling the boat to chest level.... Then came the immortal words, "We've capsized."

Golding and first mate activated the EPIRB and took to a life raft. They were later picked up by a Scottish Search And Rescue helicopter and taken to Lerwick. In the same article Golding writes, "Our proximity to land prevented me from lying to the drogue, although I am sure that this would have prevented the capsize, having ridden out storms with *Gazelle* which were of equal magnitude, although in the open ocean." Victor Shane contacted Michael Redvers Golding about his previous use of the drogue and Golding then sent the following for inclusion in the DDDB. The drogue was an 18-inch diameter cone, custom made by a sailmaker. Mike used it in an Atlantic gale while participating in the 1988 CSTAR. The cone reduced the speed of the lightweight (2,000 lb.) trimaran from more than 12 knots to about 2.5 knots, with steering generally unnecessary. Transcript:

I have experimented with many methods of lying a-hull and lying to drogues, and must confess that I have reached no definitive conclusion. For simplicity I now consider that there are three basic weather conditions which the skipper must prepare for:

1) ***HEAVY.*** *It is my opinion that in the event that the weather is unlikely to deteriorate further it is often the safest course of action to sail on with a well prepared boat, an alert helmsman and a linear reduction in sail area.*

2) ***SEVERE.*** *With a multihull it is often necessary to only take the edge off the most extreme turns of speed. In this situation it is prudent to tow warps or lay to a drogue over the stern, which slows the boat to an acceptable speed, preventing surges and reducing the risk of tripping.*

3) ***SURVIVAL.*** *When conditions reach the ultimate for a given craft it seems logical that a strong sea anchor system with a bridle over the bows is the best of a bad lot. As you know survival conditions are rare, though consideration must be given when setting up the boat in the previous category as to whether or not the situation will deteriorate to survival condition, as re-organizing the boat may be both difficult and dangerous.*

I will state again that it is my confirmed opinion that Gazelle *would not have capsized had we been lying to the drogue. At the time we were too close to a lee shore and the drogue we carried would have only slowed us to around 2.5-3 knots. No doubt there are sea anchors which could have slowed us further, however I doubt that my decision would be much different taking all the factors into account.*

Victor Shane forwarded literature on para-anchors to Golding. Had *Gazelle* been equipped with such a

device she would probably have been able to stand off the lee shore, the currents off the Shetlands permitting. The 43-ft. catamaran *Ariel* did as much in file S/C-6A.

D/T-6 Trimaran, Searunner

Trimaran, Searunner

31'x 18' x 2.2 Tons

Sea Squid Drogue

Force 7-8 Conditions

File D/T-6, obtained from Donald Longfellow, Garden Grove, CA. - Vessel name *Take Five*, hailing port Ventura, CA, Searunner trimaran designed by Jim Brown, LOA 31' x Beam 18' x Draft 6' (3' board up) x 2.2 Tons - Drogue: Australian *Sea Squid* on 130' x 7/16" nylon braid tether with bridle arms of 30' each - Deployed in *Papaguyo* winds in 100 fathoms of water about 30 miles off the coast of Nicaragua, with winds of 30-35 knots and seas of 8-10 ft. - Vessel's stern yawed 20° with autopilot steering - Speed was reduced to about 5 knots during 18 hours of deployment.

Another reminder that the Australian *Sea Squid* is no longer available. Transcript:

> *The Sea Squid was deployed 18 hours after leaving Costa Rica and approximately 30 n.m. off the coast of Nicaragua. The seas had grown during the night as my distance offshore grew, and by morning I was becoming concerned about the way the occasional cross waves would knock the stern 40 degrees sideways to the primary wave track as the boat accelerated down wave faces. Neither the electronic nor the mechanical autopilot was quick enough to correct this and I was in no mood to start hand steering. Still, I didn't feel safe risking the boat getting beam-to on the wave faces, especially when it was traveling at over 6 knots. Top speeds down some wave faces were 8-10 kts (double-reefed main up, sailing almost dead downwind.) I didn't want to go bare poles, but I wanted speeds kept under 6 kts. and the yawing reduced. It seemed like an appropriate time to baptize the Sea Squid (it was already hooked up, ready to go).*
>
> *Over the side it went with no noticeable shock when the line went taut. The effect was immediate and quite apparent, speed down wave faced maxed at 6 kts. (curious though, my ambient speed remained nearly the same as before, 4-5 kts.versus 4-6 kts). Yawing was noticeably reduced. The self steering was now able to handle conditions, allowing me to get much needed rest (singlehanding). Occasionally the Sea Squid would briefly pull free when it was on a wave face. This removed tension on the bridle with unfavorable results. It wasn't a major problem, but I felt it could have been under heavier conditions. Seems to me this could be rectified with the addition of some chain to the drogue's line. There was a Galerider drogue aboard, but I never used it during that trip. It is one size larger than the company recommends for my boat displacement (36" dia. instead of 30"). If I had encountered heavier conditions than the one above, I would have used the*

Galerider instead of the Sea Squid. There is no doubt in my mind that the sea conditions on that day presented only two reasonable options for my boat: para-anchor, or running down the swells. I would no sooner leave on a cruise without my para-anchor and drogues than I would leave without secondary anchors and heavier headsails.

D/T-7 Trimaran, Searunner

Trimaran, Searunner

37' x 22' x 7.5 Tons

Series Drogue - 120 x 5" Dia. Cones

Force 8-9 Conditions

File D/T-7, obtained from Philip & Marilyn Lange, Longwood, FL. - Vessel name *Kuan-Yin*, hailing port St. Augustine, trimaran, designed by Jim Brown, LOA 37' x Beam 22' x Draft 6' 11" (3' 6" board up) x 7.5 Tons - Drogue: Jordan series, 120 x 5" diameter cones on 200 x 3/4" & 5/8" nylon braid tether, with bridle arms of 75' each and 10' of 5/8" chain at the end of the array - Deployed in a gale in deep water about 500 miles east of the Bahamas with winds of 35-45 knots and seas of 20-30 ft. - Vessel's stern yawed 10° - Drift was 18 nm during 46 hours of deployment.

Kuan-Yin was en route to Virgin Gorda, British Virgin Islands, from St. Augustine, Florida, when she ran into a gale. Philip and Marilyn Lange deployed a Jordan concept series drogue consisting of 120 x 5-inch cones. The drogue was homemade, with instructions received from Donald Jordan himself. See also Marilyn Lange's technical article and illustrations on how to fabricate a series drogue with an ordinary sewing machine, appearing in the March/April 1997 issue of *Multihulls Magazine* (back issues available from *MULTIHULLS MAGAZINE, 421 Hancock St., Quincy MA 02171 - Tel: 617-328-8181*). Transcript:

> *This was* Kuan-Yin*'s maiden sea passage - and first long passage for captain & mate. Our gale was never mentioned throughout its duration on HF WWV! We were not prepared in advance. Wife/mate assembled Jordan series drogue components in our center cockpit and threaded bridle through aft snatchblocks (#3 Lewmars) and around transom, while I steered to avoid broaching. (Her Lirakis harness saved her at least once.) We used 10 feet of 5/8" chain as the weight on the end of the drogue. The Jordan series drogue deployed easily, and immediately slowed us down from 8 knots to 1.6 knots under bare poles. Our strongly-built stern lifted easily and smoothly to the oncoming waves. An occasional breaking wave dumped several quarts of seawater in, around the* [stern castle] *window gasket. Although the rushing and pounding noises were terrific below, we were able to rest because the movement of the boat was quite regular and predictable. We set a timer to remind us to freshen the nip* [let out a few inches of line to shift the wear point and minimize chafe] *and wrapped towels around potential chafe points on the bridle as it led to the Anderson 40 winches mounted on either side of our stern companionway.*

The pressure on the drogue line alternated rhythmically between the two arms of the bridle - the tension was surprisingly light and the bridle winches could be adjusted easily. Our Autohelm wheel was bent when our first efforts to secure the rudder with line worked loose. The cheeks of our snatch blocks took a lot of wear. It took both of us to haul in the drogue hand-over-hand. Other than one wear point on the bridle it was in perfect condition!

D/T-8 Trimaran, Piver

Trimaran, Piver

35' x 20' x 3.5 Tons

4-Ft. Dia. Conical Drogue

Force 12 Conditions

File D/T-8, obtained from Warren L. Thomas, Charleston, SC. - Vessel name *Lady Blue Falcon*, hailing port Charleston, Lodestar trimaran designed by Arthur Piver, LOA 35' x Beam 20' x Draft 2' x 3.5 Tons - Drogue: 4-ft. Diameter cone, custom-made from heavy mesh (porous) material on 250' x 5/8" nylon three strand tether, with bridle arms of 60' each and bronze swivel - Deployed in an unnamed hurricane about 300 miles north of Bermuda with sustained winds of 80 knots and breaking seas of 30 ft. and greater - Vessel's stern yawed 30° and more with the owner steering.

To quote the immortal words of K. Adlard Coles in *Heavy Weather Sailing*, "When the wind rises to Force 10 or more and the gray beards ride over the ocean, we arrive at totally different conditions, and for yachts it is battle for survival, as indeed it sometimes may be for big ships." In July 1990, *Lady Blue Falcon*, one of Arthur Piver's original "Lodestar" designs, was off the northern coast of Maine sailing to Charleston, South Carolina, when she became entwined in a cyclonic system with sustained hurricane-force winds - an unnamed, minor hurricane. What followed was five days of sheer terror for the singlehanded sailor on board, Warren Thomas. The boat was driven without mercy round all points of the compass, eventually finding herself back in Halifax, Nova Scotia.

The only drag device on board was a 4-ft. diameter cone, custom made from some sort of tightly knit, porous, nylon mesh material. Thomas deployed it off the stern on 250' of tether and a bridle with 60-ft. arms attached to the outboard sterns of the floats. The bridle would not allow the boat to be steered freely, a major disadvantage in Thomas' opinion. In the chaos that followed, Warren Thomas tried quartering the seas by bringing both bridle arms to one float. This turned out to be a bad idea - made things much worse. To compound matters, the cone would completely pull out of the water at times, allowing the boat to lurch ahead at incredible speeds. The whole experience was traumatic and Thomas' recollection of the details are hazy - "due to complete blank of mind & loss of charts & notes" (to quote Thomas). Transcript:

> *I used the drogue off the stern of my Piver Lodestar in a mild hurricane 300 miles north of Bermuda, approx. 360 miles east of Cape Cod. Got blown 570 miles in 5 days, running completely out of control. Drogue's bridle would NOT let me steer at high speeds of 22 knots on 2-3 minute continuous runs. (Once rode a gale in Albermorle Sound with 45-55 knots for thirteen hours. It*

was a walk in the park compared to this.)

Seas in excess of 25 ft. but running faster than HELL! Wave patterns rather organized but about every hour a series of oddballs would come. I could hand-steer them, except at night when I could not see them coming. All this under bare poles. I was alone, scared and just hanging on. It was the biggest horror of my life. The sea won the war! Cannot erase the fury from my mind. First time that I have ever cried like a baby, I believe just from nerves.... Eating raw Taster's Choice right out of the coffee jar.... Wind blew all around compass. Was hovering around 80, gusts exceeding 100. I knew I was going to die. Just did not know when. Mr. tough-guy did die out there. Now only a cautious, humble sailor remains. Took two years to shed the fear and exchange it for a healthy respect for the sea. Am sure I am alive today because of luck only. If I had had a para-anchor I would still have needed luck, but I would have been rested enough to appreciate it!

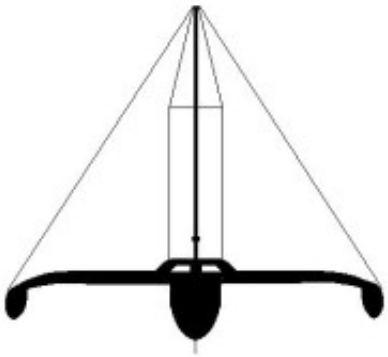
D/T-9 Trimaran, Shuttleworth

Trimaran, Shuttleworth

60' x 40' x 10 Tons

12 Knotted Warps (300' each)

Force 12 Conditions



File D/T-9, derived from an article by Richard B. Wilson, appearing in the October 1991 issue of *SAIL MAGAZINE* - Vessel name *Great American* (ex-*Livery Dole IV*, ex-*Travacrest Seaway*) hailing port Boston, MA, maxi ocean racing trimaran designed by John Shuttleworth, LOA 60' x Beam 40' x Draft 11' (3' board up) x 10 Tons - Drags: 12 knotted warps, 300' each (3/4" and 5/8" nylon) - Deployed in a 940 milibar storm in deep water 400 miles west of Cape Horn with sustained winds of 70 knots and breaking seas of 50' - Vessel capsized on 22 November 1990 despite the 12 long warps - Crew of two were rescued by the M/V *New Zealand Pacific*.

On 22 October 1990 Rich Wilson and Cape Horn veteran Steve Pettengill set sail on the 60-ft. maxi ocean racing trimaran *Great American* determined to break the 76-day San Francisco to Boston record set in 1853 by the clipper *Northern Light*. Apart from wanting to beat the record, it was also Rich Wilson's goal to heighten public awareness of the activities of the American Lung Association and to prove the viability of corporate sponsorship in sailing. Wilson is a severe asthmatic.

Sailing out of San Francisco Bay Wilson and Pettengill put "pedal to the metal" and tried to imagine their opponent, *Northern Light*, beginning to trail behind. Having records of *Northern Light*'s daily runs, they had their imaginary opponent in view, so to speak, trailing behind all the way down the coast of California and then Mexico. In skirting hurricanes *Trudy* and *Vance* off Mexico, however, the lead changed hands a few times as the ghost of the 200-ft., three-masted clipper ship would overtake the trimaran, only to be later overtaken herself. Once past the equator, Wilson and Pettengill began bashing full bore into the southeast trade winds. The going was rough and took a heavy toll in equipment failures. After passing Pitcairn Island they began to line up their approach to Cape Horn - and "the mother of all storms."

It began as a low system that "exploded" (to quote the words of meteorologist Bob Rice) into a 940 milibar storm, with *Great American*'s number written all over it. Approximately 600 miles from Cape Horn the storm said hello to Wilson and Pettengill when the trimaran broached, tripped on her big daggerboard, and Wilson was thrown violently out of his bunk. The two dazed men found that they had to raise *Great American*'s huge daggerboard all the way up to improve steering and avoid tripping on it.

Steve Pettengill then let out five knotted warps, 300' each, slowing the boat down a little. On the next day the boat broached again with the five warps in tow. But she side-slipped smoothly - raising the board had definitely helped. Pettengill added three more 300' long knotted warps. On Wednesday morning, 21 November, the boat's barograph tracer hit rock bottom. Four additional knotted warps were then added, making a total of twelve (12) to bring the speed back down to 9 knots in 70-knot winds and 50-foot seas.

On Thanksgiving morning, some 400 miles west of Cape Horn, a graybeard swept over the *entire* boat (this trimaran is 60 feet long and 40 feet wide!) carrying away the two wind generators. *Great American* then rushed down another steep mountain. The combined drag of the twelve knotted warps were not enough to keep her properly aligned. She slewed to starboard, probably dug the port ama, heeled, and capsized. The two men, fortunately OK, immediately donned their immersion suits, activated the 406 MHz EPIRB, and resigned themselves to the business of survival. As they were sorting out the debris in the inverted main hull, "the grandfather of all waves wrenched the water-laden trimaran out of the water, spun her, and slammed her violently back down, upright again." (Quoting from Wilson's article in *SAIL*).

So, *Great American* was right side up again! But the mast and the rigging were in pieces on deck and trailing in the water. The cockpit was awash and the main hull looked like a submarine, with the winches at sea level. Everything was in shambles. Everything had broken free down below. They wondered whether they would have been better off if they had remained upside down. Somehow, in the freezing cold, they managed to sort things out and get a little hot nourishment. Meanwhile, Scott Air Force Base in Illinois had received a "hit" from the EPIRB. Additionally the ARGOS, which had gone off when the second wave righted the boat, had alerted a base in France, which alerted Atlantic Rescue. AMVER (automated merchant vessel emergency routing) then found the nearest ship to be the *New Zealand Pacific*. In a feat of brilliant maneuvering, Captain Dave Watt brought his 62,000 ton ship - the world's largest refrigerated container carrier - alongside the awash *Great American* at 3:30 am in the dark. With the 815-foot ship rolling severely, Captain Watt coordinated the throttles and bow thrusters with such precision that Rich Wilson and Steve Pettengill were able to step onto the rope ladders hung down from the cliff-like side of the ship. They were then taken inside, cared for, and taken to Vlissingen, Holland.

Three years later, Rich Wilson and his new crew mate, Bill Biewenga, set out again from San Francisco. This time Wilson accomplished his goal. On April 7, 1993, *Great American II* finally arrived in Boston, 69 days and 20 hours out of San Francisco, beating *Northern Light*'s record by six days. Wilson is currently head of *Ocean Challenge*, an educational institution dedicated to linking classrooms all over the world with ongoing adventures. *Ocean Challenge* has an interesting web site that readers may wish to explore: *www.sitesalive.com*

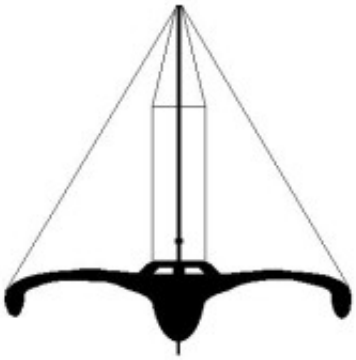
D/T-10 Trimaran, Newick

Trimaran, Newick

40' x 28' x 3 Tons

36" Dia. Galerider

Force 8-9 Condition



File D/T-10, obtained from Deborah Druan, Farmingham, MA. - Vessel name *Greenwich Propane*, hailing port Greenwich, CT, ocean racing trimaran designed by Richard Newick, LOA 40' x Beam 28' x Draft 5' 6" (2' 6" board up) x 3 Tons - Drogue: 36" Diameter Galerider on 250' x 5/8" nylon braid rode - No bridle - 5/8" Stainless steel swivel - Deployed in a gale in deep water about 400 miles NE of the Azores with winds of 40-45 knots and seas of 18 ft. - Vessel's stern yawed 10° - Speed was reduced to about 3 knots during 10 hours of deployment.

Debbie Druan is the United States' foremost female multihull skipper - America's Florence Arthaud. She has won numerous first-to-finish trophies to date, the latest on her Formula 40 racing trimaran, *Toshiba*. Doubtless she will make it to the Whitbread. Debbie is also commodore of the New England Multihull Association and has written numerous articles about ocean crossing and heavy weather tactics in the journal of the NEMA. In May 1994 she arrived in Bermuda with David Koshiol and Joe Colpit to deliver the 40-ft. Newick trimaran, *Greenwich Propane*, to Plymouth, England. The owner of the boat, John Barry, was to race it in the 1994 Two Star Double Handed Transatlantic Race from Plymouth to Newport. On the Horta to Plymouth leg of the crossing Debbie and crew ran into a gale. The following is a transcript of her report, appearing in the September 1994 journal of the NEMA (reproduced by permission):

> *The gale hit us on May 23. We were 838 n.m SW of England and 424 n.m. NE of the Azores. It was good to know about the low in advance because by noon when it started building rapidly we knew why. We went from the full main, jib, and spinnaker to just the jib, surfing at 10-12 knots down 8 ft. seas in 18-22 knots of wind. We decided to just take the main down and not deal with reefing. We weren't racing and just needed to get the boat to England in one piece and on time, so we played it conservative. By 5:00 PM as the wind and waves increased we just kept rolling in more and more jib and took the rotation out of the mast. We were still going just as fast. It was tiresome, wet and cold on watch, so we went to a 2 hours on and 4 off system. Late that night it had moderated down to 30 knots and 12 ft. waves, so we started thinking the worst was over.*
>
> *The next morning we started getting hit by rain squalls and an increase to 40 knots and 18 ft waves. There wasn't much jib left out so we started wondering what we were going to do when we*

ran out of jib. The problem was that the boat didn't have a barometer and we had no way of telling if we were moving along with this storm, or if it was intensifying. After much discussion between the pros and cons of setting the para-anchor or the Galerider, we decided on the Galerider because it seemed out of the question to turn the boat up broadside to the 18-20 ft steep seas to set the anchor off the bow. So we pulled out the Galerider and got it ready just in case. It wasn't the high wind that concerned us but the fact that the boat just was not steering down the steep waves very well. Occasionally she would surf madly down the face of a wave, the rudder would cavitate, we'd lose control and go down a wave sideways. You only needed for this to happen once and the boat could trip over itself. As Joe had once capsized in another trimaran, he was familiar with the warning signs.

Finally, after 24 hours of hand steering down these steep seas David, who was on watch, yelled down to us "hey these suckers are getting bigger, we better do something." As another large wave slammed us sideways, you could hear the nervousness in his voice. They were over 20 ft now. We determined that we must be moving along with this system, as the wind was supposed to change direction after it had passed, and it hadn't. We needed to stop and let it pass by us. We were all worried. None of us had ever set out a drogue before. The Galerider was constructed of thick 2" webbing in a criss-cross pattern with a 3 ft diameter opening. Attached was 6 ft of 3/8 chain and a 5/8 swivel. The line was 250 ft. of 5/8" nylon braid. The blocks on the ama sterns weren't strong enough to be used for a bridle, so we used the main stern anchor cleat to secure it.

While David steered, I made sure all the line was flaked and ready to pay out of the bag in the cockpit, and Joe stood on the main transom with the drogue. He looked like he was standing over the edge of a huge cliff with 20 ft deep troughs and 250 ft to the next wave crests. Joe took a wrap around the cleat and gently dropped the Galerider off the stern: instantaneously the Galerider took hold and you felt the boat take a huge tug backward. The transom was pooped instantly as a wave overtook us. Joe paid out 150 ft of line. We waited, wondering if the anchor cleat was holding. You could see the Galerider riding the crests of the waves, so he paid out another 100 ft of line to take the strain off the cleat. Now you could see only the line riding in the waves. Soon we were surrounded by mountains of waves and they just came up, passed under the boat, and away. We were calmly and slowly going down wind at three knots.

Our first reaction was "why hadn't we put it out sooner?" Even without a bridle, the Galerider stayed centered off the stern. It only yawed back and forth a little. It was now easier to steer. For anti chafe gear we used a rag on the cleat and kept and eye on it. Ten hours later the wind and seas had moderated enough and we simply pulled the drogue back in. Joe from the stern pulled it in hand over hand, waiting for the line to go slack between waves. David tailed the end of the line on the runner winch into the cockpit.

Two days from the onset of this low we were able to put the full main back up. For the next 800 n.m. to Plymouth we'd have 2-3 days of wet, bumpy and cold conditions to one day of dry and warm.... The last 300 n.m. was a beat to weather. As we were worried about the rig we sailed the boat as conservatively as possible. We made our approach to England by the Lizards.

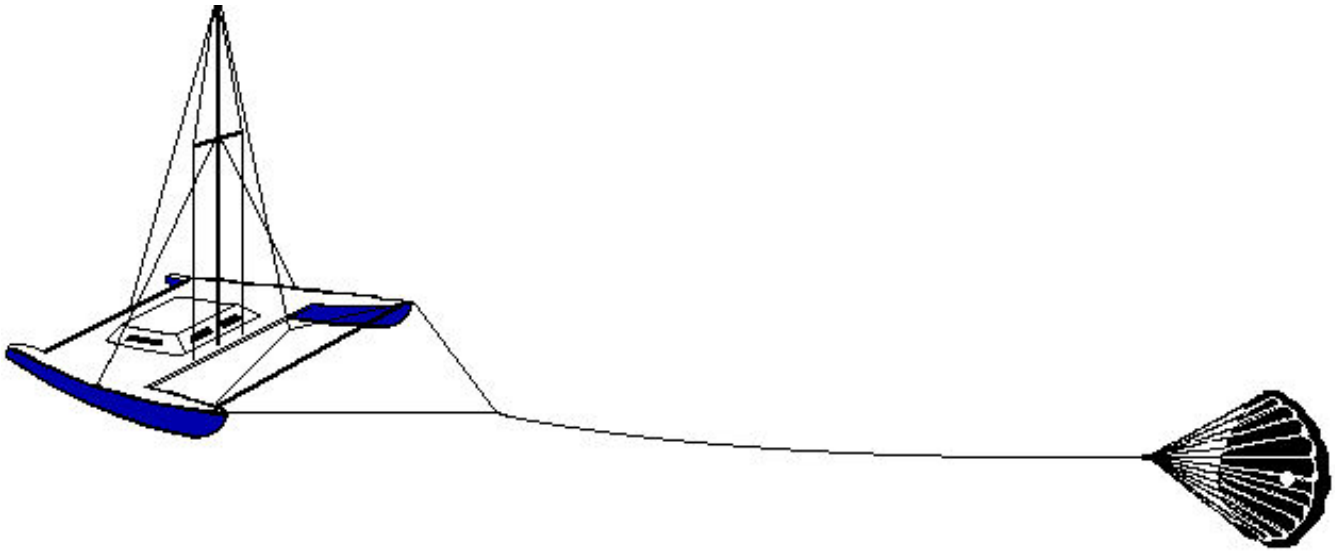
Sea Anchors on Catamarans

S/C

S/C

Files Relating to Sea Anchors

Used by Catamaran Sailboats off the Bow



"The important thing is to break through a breaking sea without being thrown by it - you need to be physically pulled through the breaking sea for a few seconds, and that takes a sea anchor. You can go backwards some, the tether line can stretch, and that is OK. The first part of the breaker is what turns you over. If the breaking wave can't start rolling the boat over, you'll be safe."

Walter Greene,
quoted by Chris White in *The Cruising Multihull*
(Courtesy of International Marine Publishing Co.)

S/C-1 Catamaran, CSK

S/C-1

Catamaran, CSK

65' x 30' x 22 Tons

28-Ft. Dia. Parachute Sea Anchor

Force 8 Conditions

File S/C-1, obtained from Bruce Reid, Costa Mesa, CA. - Vessel name *Rose Marie*, hailing port Vancouver, BC, catamaran, designed by Vince Bartalone, LOA 65' x Beam 30' x Draft 3' 3" x 22 Tons - Sea anchor: 28-ft. Diameter C-9 military class parachute on 500' x 1" nylon three strand tether and bridle arms of 60' each, with 5/8" galvanized swivel - No trip line - Deployed in gale force winds in shallow water (40 fathoms) off Point Conception, California, with winds of 40 knots and seas of 15-20 ft. - Vessel's bow yawed 5° - Drift was *upwind* at 2 knots, induced by current.

Rose Marie was on her way to Vancouver from Newport when she ran into gale force winds off Point Conception - the "Cape Horn of the Pacific." The skipper put out the 28-ft. diameter C-9 parachute when progress against headwinds began to diminish. The strong coastal current that flows northward hereabouts caused the para-anchor to tow the big catamaran upwind! Because water is some 800 times heavier than air, large sea anchors should be used with caution where there are local currents, especially in close quarters. The sea anchor will pull the boat with the current, regardless of the intensity and direction of the wind. If the current is going your way, then fine and well. If not, be warned that the sea anchor may tow your boat over a ledge, across fishing nets, a shipping lane or into other hazardous areas. Transcript:

> *We were conducting sea trials of our newly launched C/S/K designed catamaran. We had departed Newport Beach on 9 June 1984 with the intention of making our way north to Vancouver B.C. On the evening of June 11 we anchored at Coho, an open roadstead just southwest of Point Conception, along with six or seven fishing boats and two other cruisers. The winds were northwesterly at 28 knots, gusting to 38 knots, and the seas were about 15 ft., which continued to build during the night. By early dawn the fishing vessels all departed in the direction of Santa Barbara, along with one of the cruisers. The other cruiser, a Westsail 32, raised sail and headed out to sea. At around 5:30 am we motored out to see what the conditions were... the 2 am weather report was 35 knots gusting 45, with seas of 15-21 ft. We continued on course for about an hour and a half when the wind shifted to the north by northwest and our progress began to diminish. The Westsail 32, under sail and engine, passed ahead of us on a port tack and seemed to be taking a lot of green water. Standing on our cabin top my eye level is about 18 ft. above the waterline and in several of the troughs I could not see over the approaching wave. The 6 am report*

described the sea as 18-26 ft. and I am sure they were all of 18 and occasionally 26 ft.

Within one mile or so of Point Arguello, the Westsail 32 turned and ran back toward Point Conception.... Though we were not in any trouble, we decided to deploy our 28' diameter parachute and take a rest. We had covered only nine miles in about three and a half hours. My windspeed indicator averages out most of the gusts, so the peak winds are not known, but while lying to the parachute the wind rarely fell below 40 knots, and on occasion we saw 50 knots.

Standing about a mile and a half offshore, lying abeam to the sea under minimum power, we slowly deployed the parachute off the port bow, letting it stream off to weather about 30 to 40 feet. We then snubbed off the rode and watched the chute fill and come to full shape. We then fed out the rode until it was a full 500 ft. out to windward, then secured it to the bridle, in turn secured to the port and starboard bow bollards. Everything became quite peaceful. We took reference sights on the shoreline and went below for breakfast.

About twenty minutes later, I checked on our shore marks but could not identify them. I had a feeling of confusion and together with a crew member established a new set of reference marks on shore. Fifteen minutes later I went on deck and saw that the marks had shifted unexpectedly. What had confused me on my first sights was that I had expected our drift to be to leeward. After careful calculation we estimated that we were making about 2 knots to windward! We were making about the same progress to weather as we had been making motor-sailing, however, with everything shut down life had become so peaceful we had to refer to the windspeed indicator to verify the winds had not decreased and in fact had increased slightly.

After about two hours we decided to practice picking up the parachute and attempted a hand over hand retrieval. A bit of foolishness. We then cast off the rode and began to motor up on the trip line float. Again another bit of foolishness. The float's relationship to the parachute was impossible to determine and in short order we had the parachute around a prop. After recovering all the rode and what we could of the parachute, we sailed off back around Point Conception. So far as we could determine, our cat has never shown any tendency to sail about while laying to a parachute (on 500 ft. scope). Whatever movement there may be is within a five degree arc. If the movement is in fact greater than that it is very difficult to identify it from the other motions, created by the sea state.

All my parachute retrievals since this event have been by a polypropylene trip line, however I find even with the help of various crew members recovering a chute on 500 feet of rode is always work, even when conditions are less hectic. So far as I am concerned, getting to port ahead of a storm is the best tactic. But if that is impractical, lying to a parachute on a bridle, head-to-wind, or even with the sea quartering, is by far the safest and least wearing storm tactic I have tried to date.

S/C-2 Catamaran, Gemini 3000

S/C-2

Catamaran, Gemini 3000

30' x 14' x 3.5 Tons

24-Ft. Dia. Parachute Sea Anchor

Force 7 and 8 Conditions

File S/C-2, obtained from R.P. King, McCune, KS. - Vessel name *King Kat,* Gemini 3000 catamaran, designed by Robin Munster and Tony Smith, LOA 30' 6" x Beam 14' x Draft 4' 6" (1' 6" board up) x 3.5 Tons - Sea anchor: 24-ft. Diameter military chest reserve on 300' x 1/2" nylon three strand tether and bridle arms of 40' each, with 1/2" galvanized swivel - Full trip line - Deployed in an Atlantic gale in deep water near Flores Islands (Azores) with winds of 35-40 knots and seas of 10-15 ft. - Vessel's bow yawed 10° - Drift was reported to be minimal.

King Kat was the fifth production "Gemini" catamaran to be built by Performance Cruising, Inc. of Mayo, Maryland. It was a prototype, without the large pilot house that has since become a characteristic of the Gemini. It was purchased by Dr. and Mrs. Robert King, who sailed her to Europe in 1984, this being the first Gemini to have crossed the Atlantic - a great many more have crossed since. Your author received a letter from the Kings in 1985. The envelope had a French stamp on it. Transcript:

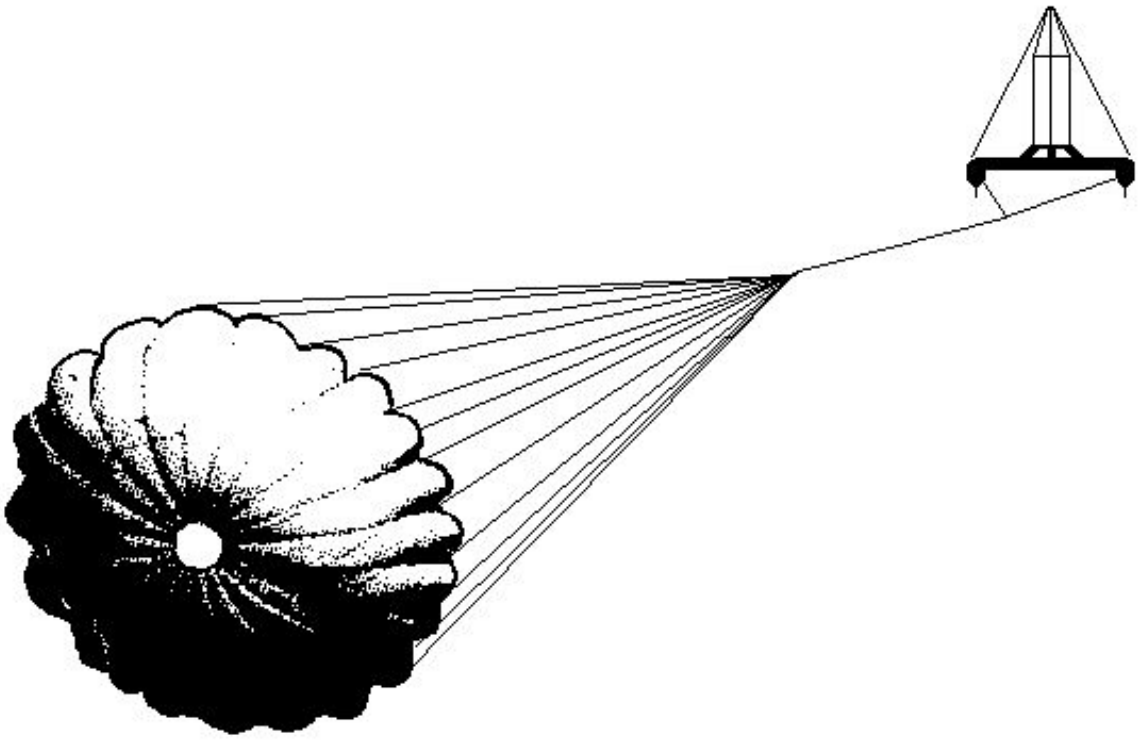
> *Dear Para-Anchors International, we received your newsletter. Since you mention testimonials, we are glad to contribute ours. We cannot equal the high drama of some of your other testimonials; but we hope we can always use our para-anchor because we choose to - not because we have to. A trans-Atlantic sailor sold us his spare para-anchor in the spring of 1984. In June, my wife and I left Tampa Bay for England in our 30' Gemini. We are both 56 years old. These synopses, mostly from the log, explain why we would not be without our para-anchor:*
>
> *June 19: Had rough, wet night. Winds over 30 knots, waves of showers, irregular 12 ft. waves from all directions. Autopilot out. Jib alone since 0330. Gave it up at dusk and tried para-anchor for first time. Boat swung directly toward wind, still active in the waves, but much slower, easier motion. Both slept like babies. It works!*
>
> *June 20: Woke refreshed and sailed on. Still overcast. Third day no celestial fixes. Worried about reef west of Bermuda. Set para-anchor before dark. Later saw beacon clearly. Good night's sleep (then went into Bermuda refreshed).*

July 11: Waves have been building for five days with winds usually over 30 knots. We must be running with the storm. Autopilot out again. Another day under storm jib alone. Winds today 35-38 knots steady, gusts to 45 in squalls. Para-anchor deployed 2100 hours. Boat dipping bows under breaking waves (about every 20th wave). Slept soundly for 12 hours!

July 12: Arrived off Flores (Azores) Island about midnight. Set para-anchor to sleep until morning. Need daylight to enter the tiny, rockbound unlit harbor. Checked position with beacons. Don't think we drifted a foot in 8 hours.

July 29: Hit by fast-moving front. Winds hit 45 with gusts up to 55. Had para-anchor out before then, however. Good evening playing scrabble.

We have logged 20,000 miles on King Kat *including passages to the Caribbean and back, and to Europe and back. In short, the para-anchor gives us the option of taking a breather whenever we choose. It's like being able to call "time out." A para-anchor takes the fear and sweat out of passage-making.*



S/C-3 Catamaran, Prout Snowgoose

S/C-3

Catamaran, Prout Snowgoose

37' x 16' x 6 Tons

12-Ft. Dia. Sea Anchor

Force 9 Conditions

File S/C-2, obtained from William E. Masters, Columbus OH. - Vessel name *Rhayader*, Snowgoose catamaran, designed by Prout, LOA 37' x Beam 16' x Draft 2'6" x 6 Tons - Sea anchor: 12-ft. Diameter *Para-Tech* on 300' x 3/8" nylon three strand tether and bridle arms of 12' each, with 5/8" galvanized swivel - Full trip line - Deployed in a whole gale in the Bay of Biscay, and also in a low system near the Bahamas with winds of 35-60 knots and seas of 20-30 feet. - Vessel's bow yawed 10° - Drift was estimated to be 12 n.m. during 66 hours at sea anchor.

Rhayader, a handsome 37-ft. "Snowgoose" designed and built by the Prout brothers, was purchased in England and sailed across the Atlantic in April 1987. The owner, William Masters, used a 12-ft. diameter Para-Tech sea anchor in a gale in the infamous Bay of Biscay. Winds were then sustained at 45 knots, gusting to 60. The sea anchor was used again about a year later when *Rhayader* ran into a low system stalled off Bermuda. When a low system gets stalled for an extended period of time, even if it is only packing thirty knot winds it will eventually begins to generate huge waves and swells. On the DDDB form that Masters sent back he indicated that some of the combined seas were higher than 30 ft. On this second occasion *Rhayader* was tethered to the sea anchor for 66 hours. Transcript:

> *During the 66 hour period, the seas and wind averaged 040° True. Our drift was 262° True, probably tidal set onto the Bahamas Banks. Also, in April of '87 while sailing to the Canary Islands from England, we deployed the para-anchor off the Continental Shelf, depth unknown. Winds were easterly, sea from the northwest. Nasty. Seas were short and steep (200-250' crest to crest. Winds were steady 45 knots, gusts to 60 knots. Hove to the para-anchor for 22 hours. Drift was 2 n.m. west. Thanks, para-anchor, and of course the Casanovas. I wouldn't leave port without it.*

S/C-4 Catamaran

S/C-4

Catamaran

40' x 20' x 3.5 Tons

12-Ft. Dia. Parachute

Force 7 Conditions

File S/C-4, obtained from Sackville J. Currie, Blaney, Ireland - Vessel name and design unspecified, hailing port Tokyo, catamaran, LOA 40' x Beam 27' x Draft 6' x 3.5 Tons - Sea anchor: 12-ft. Diameter *Para-Tech* on 60' x 1/2" nylon braid with 1/2" galvanized swivel - Emergency deployment when the windward ama broke off in shallow water (100 fathoms) five miles off Cape Nojima, Japan, with winds of 30 knots and confused seas of 12-15 ft. - Occupants were taken off by a Japanese Coast Guard helicopter.

File S/C-4 illustrates the value of a sea anchor in one of many likely damage control situations. En route to Sendai this 40-ft. catamaran sailed out of Tokyo Bay and, rounding Cape Nojima to head north, ran into 30-knot winds blowing contrary to a local current.

After considerable heavy labor against 12-15' steep, confused and choppy seas the windward pontoon suddenly broke off, leaving the catamaran lame and disabled seven miles offshore, now rapidly drifting out into the open sea.

The owner's main concern was that the boat might tack and, with the one ama broken off, capsize. He immediately deployed a 12-ft. diameter Para-Tech sea anchor off the bow of the remaining hull. The sea anchor held the lame boat more or less head-to-sea, preventing capsize and at the same time keeping the crippled vessel from drifting out of the shipping lanes and into the great Pacific. With the situation temporarily stabilized and the motion of the yacht eased, distress flares were then launched which were spotted by a passing freighter. The captain of the freighter radioed the Japanese Coast Guard, which sent a helicopter to the scene and plucked the survivors off the multihull. The boat was then abandoned to the raging seas, still tethered to its 12-ft. diameter, orange-colored parachute sea anchor.

S/C-5 Catamaran, Walter Greene

S/C-5

Catamaran, Walter Greene

50' x 30' x 5 Tons

4-Ft. Dia. Sea Anchor

Force 9 Conditions

File S/C-5, obtained from Walter Greene, Yarmouth, ME. - Vessel name *Sebago*, catamaran, designed by Walter Greene, LOA 50' x Beam 30' x Draft 7' (20" board up) x 5 Tons - Sea anchor: 4-ft. Diameter *Shewmon* on 250' x 3/4" nylon braid tether and bridle arms of 50' each, with 1/2" galvanized swivel - No trip line - Deployed in a whole gale in deep water in the middle of the North Atlantic with winds of 40-50 knots and seas of 25-30 ft. - Vessel's bow yawed 45-60° - Drift was estimated to be 30 n.m. during 48 hours at sea anchor.

By way of a brief digression we should perhaps mention a previous experience of renowned multihull designer Walter Greene, an experience that ushered in a new era in SAR (search and rescue). Indeed the experience marked a point in maritime history when it became possible to ensure the safety and survival of human life at sea to an extent never before possible.

On 10 October 1982 Greene was sailing his 50' trimaran *Gonzo* to St. Malo, France, when it capsized in a violent North Atlantic storm 300 miles south-east of Cape Cod. The boat had been running before 30-ft. seas without a drogue when she was picked up and thrown by a huge wave - she broach-capsized when one of her bows dug into green water. Once over the initial shock of the capsize, Greene and his well-prepared crew jumped into action. In no time they had donned their immersion suits, lashed themselves to the upturned, floating, hull, and switched on the EPIRB - Emergency Position Indicating Radio Beacon.

It was the navigation officer on board TWA's flight 904 that first heard the lonely wailing of *Gonzo*'s EPIRB (the signal is swept audio tone, sounding like a miniature "wow-wow" police siren). The information was immediately relayed to the FAA's Oceanic Control at Islip, New York, which in turn informed Atlantic Rescue at Scott Air Force Base in Illinois.

At that time (1982) SARSAT - *Search And Rescue Satellite-Aided Tracking* - was not quite operational, but a participating Russian satellite, *Cospas*, was known to be overhead. Scott AFB obtained an uplink and sure enough, no sooner had *Cospas* signed on than it confirmed a "hit." The satellite then provided data and telemetry needed to pinpoint the position of the distressed vessel. Atlantic Rescue then broadcast an urgent *All Ships Bulletin*, and the tanker *California Getty* was diverted to the scene. At the same time, the Coast Guard Air Station at Elizabeth City North Carolina was briefed and advised to launch a C-130 search plane, which picked up *Gonzo*'s EPIRB signal, homed in on it and dropped two datum marker

buoys (which transmit additional homing signals on a different frequency).

The tanker *California Getty* was the first on the scene, but failed to effect safe rescue in the 25 ft. seas, standing off to windward to provide a "breakwater" for the disabled trimaran. And there she stayed, "like a big Saint Bernard," until the 210' Coast Guard Cutter *Vigorous* arrived on the scene.

One by one the three survivors were taken off to safety, concluding one of the most remarkable rescues in maritime history *-one of the first in which a satellite played an instrumental role.* (A quick reminder that SARSAT is now fully operational in most areas of the world and any sailor with a Class A EPIRB can access the grid to get a distress signal through to international Search & Rescue agencies).

Walter Greene happily went on to design many more multihulls and four years later used a sea anchor on board his 50' catamaran, the infamous *Sebago*. The 4-ft. diameter Shewmon sea anchor was deployed off the bow, but was too small to do a satisfactory job (the same sea anchor did a lot better when used off the stern - see file D/C-1.) The bows of the big catamaran yawed past 60° at times.

Shewmon sea anchors are available in many sizes, up to 33 feet in diameter. Literature published by Shewmon, Inc. would seem to indicate the need for an 8-10 ft. diameter Shewmon sea anchor for a boat the size and weight of Greene's *Sebago*.

Why did Walter Greene choose a 4-ft. diameter sea anchor instead? Likely he was worried about a bigger one being too "unyielding." Victor Shane ran into this same apprehension among other multihull sailors. To this day some of them will react with alarm at the very idea of tethering their boats to a large diameter, "unyielding" sea anchor in a gale.

S/C-6A Catamaran, Crowther

S/C-6A

Catamaran, Crowther

43' x 25' x 7.5 Tons

18-Ft. Dia. Sea Anchor

Force 9 Conditions

File S/C-6A, obtained from Josh Tofield, Tucson, AZ. - Vessel name *Ariel*, hailing port San Diego, catamaran, designed by Lock Crowther, LOA 43' x Beam 25' x Draft 3' 3" x 7.5 Tons - Sea anchor: 18-ft. Diameter *Para-Tech* on 250' x 3/4" nylon three strand tether and bridle arms of 75' each, with 5/8" galvanized swivel - Full trip line - Deployed in a tropical depression in deep water about 400 miles SE of Cabo San Lucas, Mexico, with winds of 45-60 knots and seas of 18 ft. - Vessel's bow yawed 10° - Drift was 2 n.m. during 20 hours at sea anchor (confirmed by GPS).

Several weeks after *Ariel* left San Diego for points south she ran into an unforecast loop of ITCZ - *Inter Tropical Convergence Zone* - at 21° 09' North, 106° 52' West. In his book, *Weather For The Mariner*, William J. Kotsch has this to say about the phenomena (Naval Institute Press, reproduced by permission):

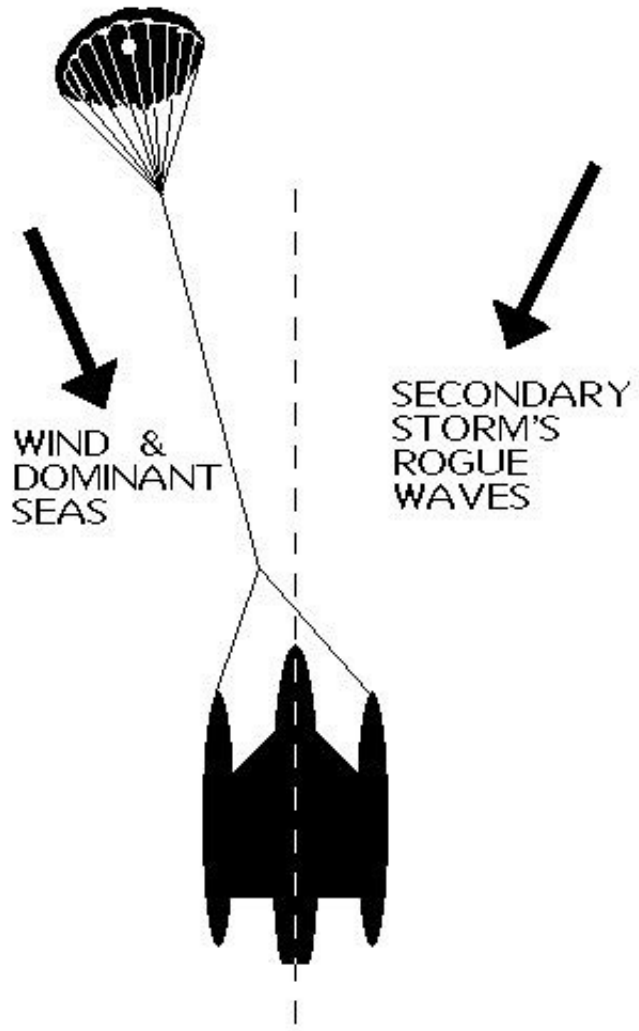
> "The ITCZ is usually characterized by strong, ascending air currents, a great deal of cloudiness, and frequent heavy showers and thunderstorms. The intensity does, however, vary greatly. Sometimes the ITCZ looks like a tremendous wall of black clouds, with the top extending to 55,000 feet and higher.... The width of the ITCZ varies from about 20 to 150 nautical miles, and as a general rule, the narrower the zone (i.e., the greater the convergence), the more intense is the weather associated with it. When the ITCZ is near the equator, only small and weak cyclonic circulations can develop within it. But when it migrates away from the equator (at least five degrees or more), the influence of the earth's rotation becomes great enough to transfer sufficient "spin" to the converging air currents to permit tropical cyclones, hurricanes, and typhoons to develop."

One really needs a chart of Mexican waters to appreciate the value of a parachute sea anchor in tight quarters. *Ariel* was about 100 miles off the Mexican coast proper, with the rocky islands known as *Tres Marias* to her lee. The crew consisted of owner Josh Tofield, his wife, and two small children. Tofield deployed an 18-ft. diameter Para-Tech sea anchor and "anchored" *Ariel* to the surface of the sea.

Tres Marias is a Mexican prison compound. There is a 20-mile forbidden zone around it and pleasure boats have been known to be rammed by gunboats for intruding into the zone. It being dark, and apprehensive about getting too close to the islands, Josh Tofield kept a close eye on the GPS readings.

Incredibly, he found that *Ariel* drifted no more than 2 nautical miles in the 20 hours that she was tethered to the sea anchor. Transcript:

> *Only 100 miles from Puerto Vallarta and with the Islas Tres Marias in our lee we got caught in a brief but fierce (unpredicted by WX or WXFAX) loop of ITCZ convection sucked up to our latitude. Winds of 45 knots sustained, gusts to 60 for 6-8 hours, with 30-35 knots sustained for 6-8 hours before and after. As long as the wind was blowing from the SE the seas were highest - but also most comfortable, as our catamaran rocked up and down in 18-ft. maximum seas, with 3-ft. breaking tops, and almost no side to side* [yawing] *motion. However, as the wind veered, large cross swell came under and slammed bridge & deck viciously - but no damage and no excess heeling.*
>
> *My alternative would have been to run off to the West - which we could have done - but I didn't want to as we would have been blown all the way to Cabo before the wind subsided.*
>
> *Only problem was the trip line. Perhaps I tied it on wrong to its small swivel, but it fouled fender severely and pulling in required anchor windlass and much bad language!*



ADJUSTING BRIDLE FOR BEST RIDE.

This is one of numerous files in which boats had problems with fouled up trip lines. Yet another reminder that FULL trip lines should be kept fairly taut at all times (see Fig. 39 and review last paragraph of file S/T-7). Also, the problem relating to cross swells mentioned by Tofield can in most instances be lessened by adjusting the lengths of the bridle arms on multihulls. By shortening one bridle arm and lengthening the other (Fig. 41) it is possible to rotate the bows into a direction more accommodating to changing sea conditions. If the wind and dominant waves have been coming from the north (0°), for example, and a secondary disturbance begins to squeeze in a different set of waves from the northeast (45°), the skipper

may wish to adjust the bridle arms so that the bows are pointing somewhere in between the two sets of waves (about 22°).

S/C-6B Catamaran, Crowther

S/C-6B

Catamaran, Crowther

43' x 25' x 7.5 Tons

18-Ft. Dia. Sea Anchor

Force 10 Conditions

File S/C-6B, second file (see S/C-6A) obtained from Josh Tofield of Tucson, AZ. - SAME VESSEL - SAME SEA ANCHOR - SAME BRIDLE & TETHER DIMENSIONS - Deployed in a storm in deep water about 800 miles northeast of Hawaii with winds of 50-55 knots and seas of 25 ft. - Vessel's bow yawed 10° - Drift was 5 n.m. during 72 hours at sea anchor.

This is the second file involving *Ariel*. In the previous file she successfully rode out Force 8-9 conditions on the same parachute with a 250' tether. In this file we see that the 250' tether was clearly too short when *Ariel* ran into a much heavier storm on her way back from Hawaii. The 250' x 3/4" tether was not long enough to provide adequate shock absorption, as a result of which the boat took a severe pounding. *Ariel*'s tether should have been *at least 400'* in this instance (the general rule of thumb being LOA x 10). Transcript:

> Ariel *departed Hawaii 11/10/91 with delivery skipper aboard. He has documented over 100,000 miles in deliveries for Compass Yacht Services alone. Approx. 800 miles NE of Honolulu a rapidly moving, intense LOW which was squeezing against a massive hi-pressure cell caught* Ariel *in the exact center of reinforced winds. Barometer dropped from 1018 to 1002 in 3 hours! (Weather Fax attached). Wind started one hour later and built to Force 10 where it stayed, never dropping below Force 9 in 48 hours. Waves were 25' (conservatively measured from the back of wave height and not from the troughs). Bridle (3/4" nylon) chafed completely through & had to be replaced with 5/8" backup bridle. Later one leg of the 5/8" bridle SNAPPED in the center when hit with very large wave, throwing* Ariel *backward, shearing the foam & fiberglass off of one rudder completely, and leaving only half of the other rudder (which later broke off). Crew eventually added 100-150' of anchor chain to the 250' of 3/4" nylon tether and rode out the rest of the storm.*
>
> *Recovery, using the "partial trip line" was very difficult. Engines both out because during the storm, while motoring up to relieve pressure on bridle (while changing it) a large wave submerged entire stern, forcing water up exhaust system and drowning the engines (exhausts 2' above waterline under aft bridge deck !!!!!) Jury rigging done after storm passed. Ariel was then sailed 1500 miles to San Diego. Moral of the story: USE LOTS OF PRIMARY TETHER! What is adequate for Force 9 is not adequate for Force 10!*

S/C-7 Catamaran, Wharram

Catamaran, Wharram

35' x 17' x 3 Tons

9-Ft. Dia. BUORD Sea Anchor

Force 8-9 Conditions

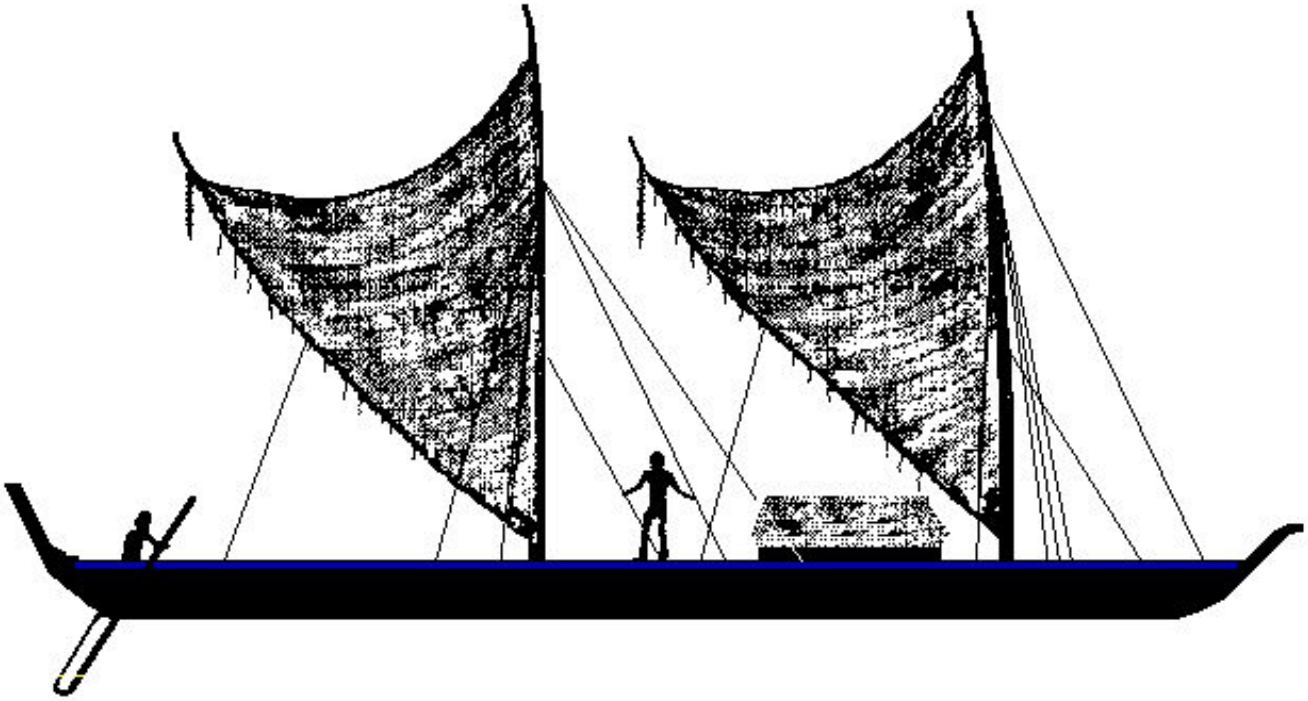
File S/C-7, obtained from Roger Ayers, Ft. Lauderdale, FL. - Vessel name *Marney*, hailing port Ft. Lauderdale, catamaran ketch, designed by James Wharram, LOA 35' x Beam 17' x Draft 2' 6" x 3 Tons - Sea anchor: 9-ft. Diameter BUORD on 300' x 1/2" nylon three strand tether and bridle arms of 25' each, with 1/2" galvanized swivel - No trip line - Deployed in a low system in 100 fathoms about 25 miles east Cape May, with winds of 35-45 knots and seas of 10-12 ft. - Vessel's bow yawed 30° - Drift was estimated to be 12 n.m. during 6 hours at sea anchor.

Marney, a 35-ft. Wharram "Tangaroa" was home-built by Roger and Marney Ayres, who have been chartering, delivering and crewing yachts on the east coast, the Caribbean and Europe. In June '85 they were sailing her to Florida when they were overtaken by a frontal system off the coast of New Jersey. The wind was blowing Force 7-8, contrary to a southerly current, producing steep, short-duration seas of 10-12 ft. They deployed a 9-ft. diameter BUORD. The parachute was not big enough to do an adequate job of keeping *Marney* pointed into the seas. Her twin bows were yawing about 30° off to each side - through an arc of 60°. The rudders seemed to be under inordinate strain as well. Transcript:

> *We were caught departing from Cape May with a good forecast of 10-15 knots. As the afternoon wore on and we reached out, the wind freshened. We decided to beat as far offshore as possible, which we did, finally reduced to storm staysail and a double-reefed main. In this, our first real blow in this boat, we were not operating as "professionally" as we might have, and concerned ourselves only with getting offshore in case the wind backed further to the east, not noting our exact position, etc. just beating on* [trying to gain ground].
>
> *The sea anchor was deployed from the bows, but allowed too much leeward drift (estimated 2-3 knots), and also allowed us to fall back off the steep, short seas, which had built up in the southerly current. I think that falling back off a larger 15 ft. wave at an angle, we broke both tillers. Note that a catamaran with two large transom-hung rudders, when backing into a trough and burying the sterns, exposes two blades, and two sets of cheeks to the force of the water, approximately 4 times the area of a typical trimaran spade rudder. It is therefore essential that*

this type of boat (like a Wharram) make no sternway, else use the sea anchor off the stern.

We are saving the BUORD for use as a "lunch hook," but now have a 24' diameter parachute for use off the bow.



The lineage and heritage of James Wharram designs lead back to the Aka Taurua, 60 ft. double-hulled ocean voyaging canoes with which ancient Polynesians explored and settled every island within 15,000 square miles of the greatest ocean on earth. These ancient mariners used "sea anchors" consisting of stones with holes drilled in them, tethered to the bows by means of hibiscus fiber rope.

S/C-8 Catamaran, Kelsall

S/C-8

Catamaran, Kelsall

36' x 20' x 4 Tons

18-Ft. Dia. Sea Anchor

Force 11-12 Conditions

File S/C-8, obtained from Rick Kazprzak, Kodiak, Alaska - Vessel name *Catherine Estelle*, hailing port Kodiak, "Tonga Tora" catamaran, designed by Derek Kelsall, LOA 36' x Beam 20' x Draft 18" x 4 Tons - Sea anchor: 18-ft. Diameter *Para-Tech* on 450' x 5/8" nylon three strand tether and bridle arms of 50' each, with 5/8" galvanized swivel - Partial trip line - De-ployed in a storm in the Gulf of Alaska about 350 miles west of Queen Charlotte Island, with winds of 70-80 knots and seas of 30-40 ft. - Vessel's bow yawed 10° - Drift was estimated to be about 5 n.m. during 48 hours at sea anchor.

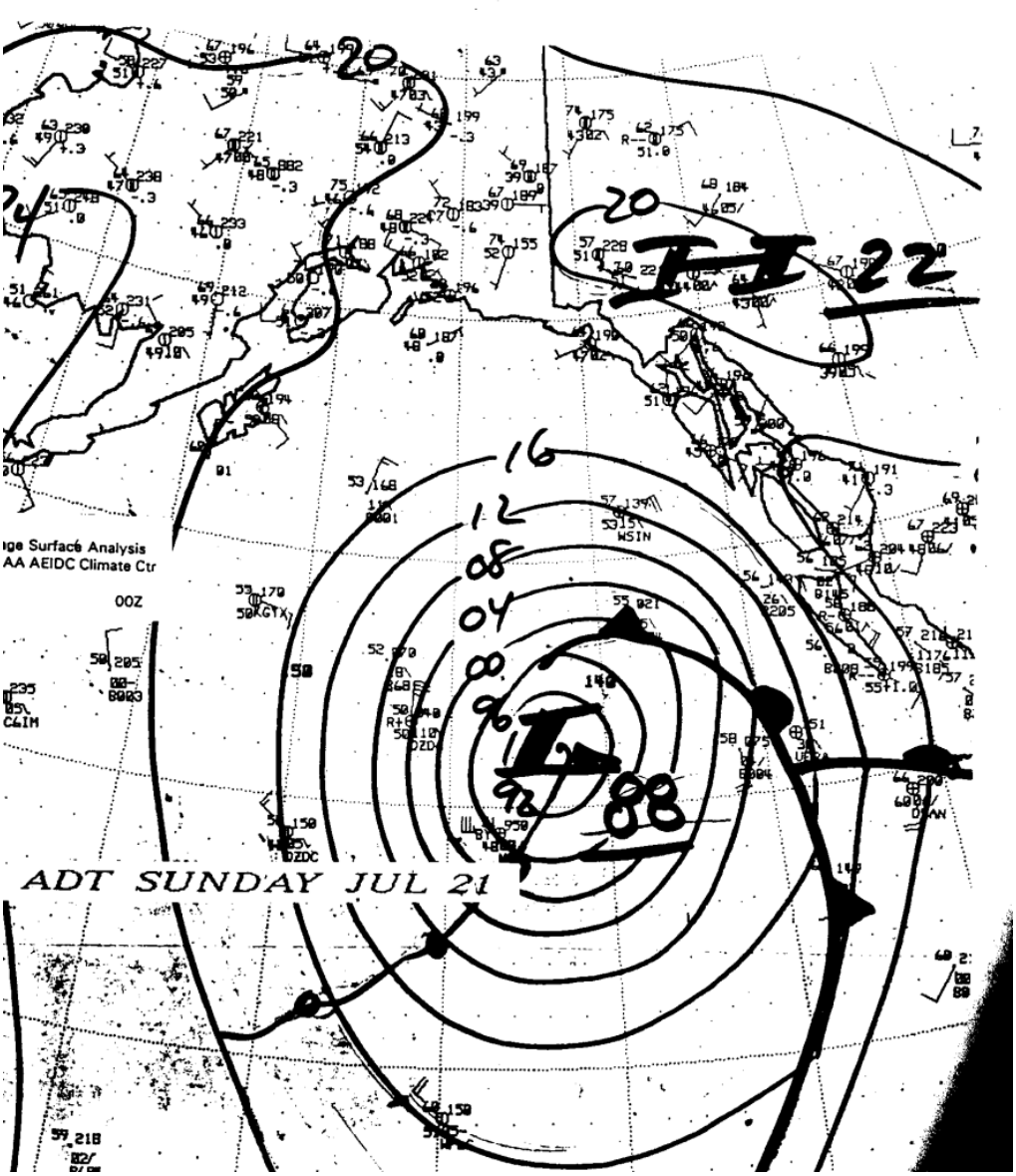
Linda Kasprzak read the second edition of the DDDB and urged Rick to equip *Catherine Estelle* with a Para-Tech sea anchor. She also saw to it that tether, bridle, hardware and all fitting were ready to take on the Gulf of Alaska.

Rick and Linda Kasprzak left Kodiak on 13 July 1991, headed for Vancouver Island, 1200 miles as the crow flies straight across the Gulf of Alaska. At the half way point they ran into one major storm, one gale, and one minor gale, spending a total of five days tethered to the sea anchor. There were some anxious moments.

The transcript of an official Coast Guard document (CG Juneau, Archive Number 2285) reads as follows: *Urgent Marine Information Broadcast - Communications have been lost with the S/V Catherine Estelle endangered by weather in position 53-05 N, 142-65 W. The vessel is a 37 ft. catamaran with 2 persons on board. Vessels in the vicinity are requested to keep a sharp lookout, assist if possible, and advise the nearest CG station.*

At the time of this urgent broadcast *Catherine Estelle* was being held to survival by the long rode leading the Para-Tech sea anchor. Transcript:

> *The storm we encountered was a major one with a very quickly dropping barometer (1 millibar every 1/2 hour). At the height of the storm we encountered 35-40 ft. seas. I believe I am under-estimating this as the seas were so big that our GPS could not get a fix at times, because it was being blocked out by the huge waves.*



Surface analysis chart of the Gulf of Alaska for Sunday 21 July 1991, showing the Aleutian Islands on the upper left, Alaska and Canada on the upper right, and Vancouver Island on the right. Catherine Estelle's position at this time was 53° 15' 42" North, 142° 36' 09" West, which would place her right in the center of the LOW. Note the 2200 mb HIGH to the north. (Courtesy of University of Alaska).

Wind speed increased at the start from 40 to easily over 70 knots. The seas were nothing but white spray, breaking crests and huge waves. We have lived in Kodiak for 15 years and so have experienced many a storm, but have never seen anything like we experienced during those 48 hours. The situation was so bad that we were dressed in survival suits and had the catamaran ready so that if we flipped, we could have access to our EPIRB, survival food and water.

The boat handled very well, but it was unnerving to be held to survival by a thin 5/8" line. Sleep was impossible. The sea anchor definitely saved the boat and I'm sure our lives. It operated flawlessly on those 2 days and the other 3 days during the other 2 gales.

We had 50' bridle arms that went through a specially made SS bow plate, but we had also built a U-bolt to this plate. The bridle was encased in 1/4" thick rubber tubing where it hit metal on the plate. We had a little trouble deploying the sea anchor, mainly because we have a seagull striker in front, plus 2 head stays. But once around all that, we were able to set the anchor just fine. Our catamaran rode these huge seas like a duck rides a wave on the sea anchor. But because the seas were so big, we did have a lot of noise due to waves slapping on the under-body.

The bottom line is that the 18-ft. para-anchor operated as you said it would, and with your help, my wife Lin's forethought, and a well-designed boat, we all did what should have been done and came through a very violent storm and survived with NO damage. Mr. Kelsall must be commended on his fine design of this boat.

Rick & Linda Kasprzak have since logged thousands of miles and used the same sea anchor in other marginal situations. In a letter to your author dated 16 September 1991, Rick wrote about one other episode. At the time Catherine Estelle was beating against 30 knot winds and 10-15' seas when a big wave slammed into her. There was a loud bang. A frantic search revealed that a weld had broken on one of her rudders.

The sea anchor was immediately deployed to bring the situation under control and wait for calmer seas. A radio call to the Canadian Coast Guard brought a response from a nearby fishing boat, with an offer to tow the catamaran to Bella Bella (the nearest port).

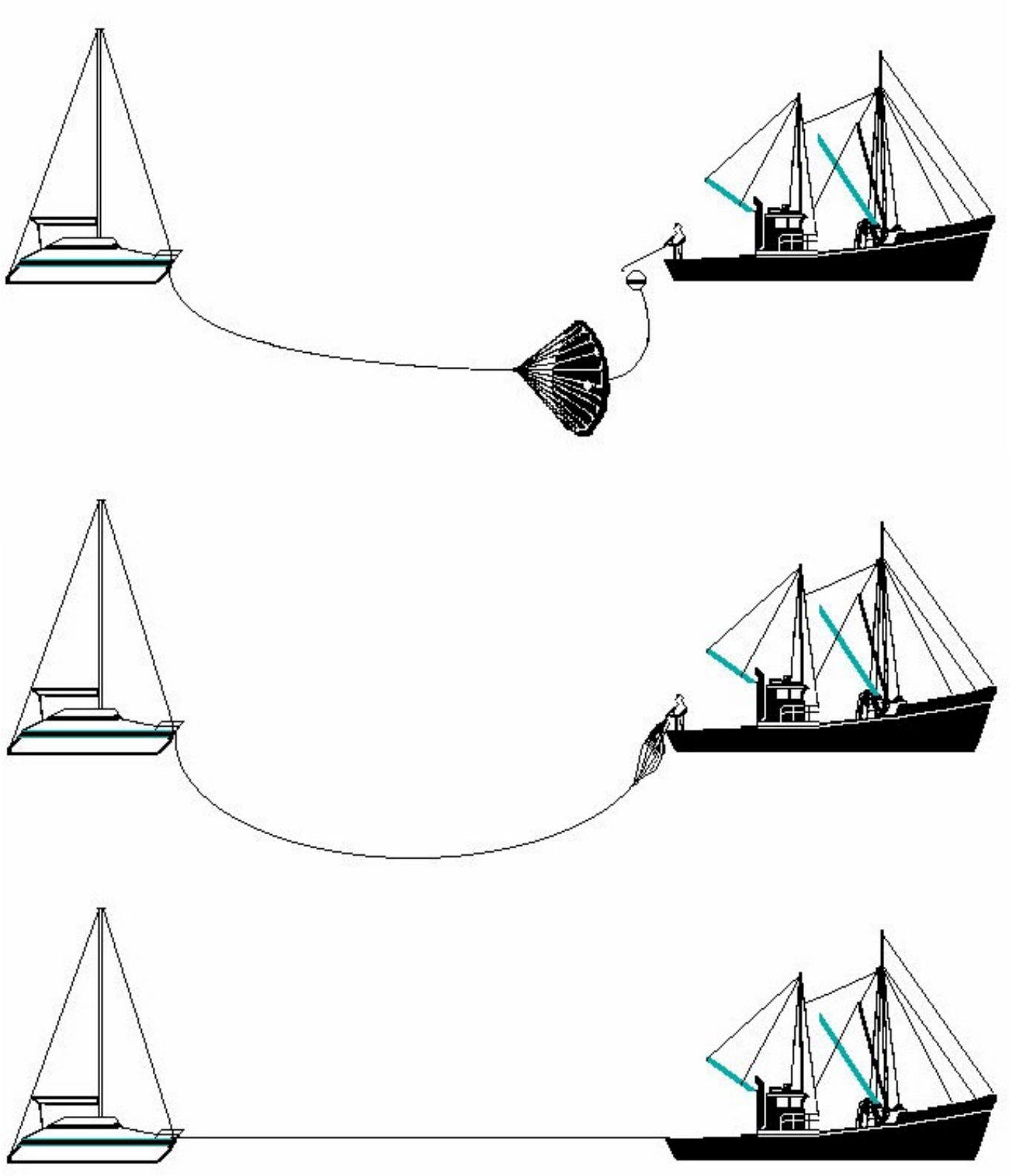
In the radio conversation that followed, the skipper of the fishing boat expressed concern about the initial pick-up and transfer of tow line in rough seas. He said he had seen more damage occur in this transfer than in any other situation in all the towing experiences he knew of. Rick Kazperzak:

I said to the captain of the fishing boat, "No problem! Just pick up the trip line connected to the red buoy, pull the chute in, bag it temporarily on deck, then cleat the tether and start your tow."

The fisherman had no problem doing this. He towed *Catherine Estelle* to a small bay in Bella Bella, and then released the tow - dropped the parachute back in the water and went on his way. Rick Kasprzak:

The point is this: here is another safety use of the sea anchor - towing. Easy pick up of tow line and easy release.

NOTE: When it come to tow lines the Coast Guard will not go along with the above proposition. It has always been the policy of the US and Canadian Coast Guards to use nothing but their own tow lines in all operations. They will not tow a vessel with anything else because they don't want to be liable for failure of the rope - and damage or injury resulting from that failure. See also Captain Bob Proulx's Coast Guard experience in File S/M-23. However, the above proposition is eminently logical when receiving a tow from a friendly fishing boat or pleasure vessel.



EASY TOW LINE TRANSFER

S/C-9 Catamaran, Crowther

S/C-9

Catamaran, Crowther

36' x 17' x 6 Tons

24-Ft. Dia. Parachute Sea Anchor

Force 8-9 Conditions

File S/C-9, obtained from Gary Jones, Rockville, MD. - Vessel name *Corinthian XIII*, hailing port Chester River, MD, "Witness" catamaran, designed by Lock Crowther, LOA 36' x Beam 17' x Draft 2' x 6 Tons - Sea anchor: 24-ft. Diameter military chest reserve parachute on 450' x 3/4" nylon three strand rode and bridle arms of 25' each, with 5/8" galvanized swivel - Full trip line - Deployed in low system in shallow water (12-15 fathoms) about 50 miles SE of Cape Fear, NC, with winds of 35-45 knots and seas of 8-12 ft. - Vessel's bow yawed 10° - Drift was estimated to be 5 n.m. during 10 hours at sea anchor.

Parachute sea anchors are worth their weight in gold in difficult coastal situations with the wind on the rise and the crew sick and exhausted. Their low rate of drift means that they require practically no sea room, making them the only viable means of stopping the boat and calling "time out" in close quarters. Transcript:

> *Wind and sea started building about 1800 hrs as we came up on Frying Pan Shoals. With the wind on the nose and the sea becoming choppy we weren't making any progress toward Charleston, South Carolina. At midnight the wind had turned the sea white and many waves were coming over the bow. We were heavy with provisions for a long cruise and five people were aboard. One crew member got sick and the rest were exhausted from fighting the weather.*
>
> *The prospect for weather during the next 8 hours sounded bad and we knew the chances of being set into the shoals were great, so we decided to set the chute. Holding onto the heaving deck with one hand and setting the chute was tough due to water coming over the bow. It took 1.5 hours to deploy the rig, but it worked great and gave us time to go below and get much-needed rest.*

S/C-10 Catamaran, Iroquois Mk II

S/C-10

Catamaran, Iroquois Mk II

30' x 14' x 3.5 Tons

12-Ft. Dia. Sea Anchor

Force 8-9 Conditions

File S/C-10, obtained from Rudolph L. Kirse, III, Palm Desert, CA. - Vessel name *Banana Split,* hailing port Palm Desert, Iroquois Mk II catamaran, designed by McAlphine Downie, LOA 30' 6" x Beam 14' x Draft 5' 6" (18" board up) x 3.5 Tons - Sea anchor: 12-ft. Diameter *Para-Tech* on 500' x 1/2" nylon three strand tether and bridle arms of 40' each, with 1/2" galvanized swivel - Full trip line - Deployed in a gale in deep water about 200 miles east of New York with winds of 40-50 knots and seas of 18-20 ft. - Vessel's bow yawed 10° - Drift was about 5-6 n.m. during 15 hours at sea anchor.

Rudolph Kirse III, singlehander, mariner and author, was sailing *Banana Split* to Bermuda from Montauk, Long Island, when the barometer began to fall. The first paragraph of the following is an excerpt from an article entitled *Gunkholing*, by Rudolph Kirse III, appearing in the March/April 92 issue of *Multihulls Magazine* (reproduced by permission). The second paragraph is a transcript of the feedback Shane Victor received from Rudolph Kirse III:

> *By 4 p.m. a storm had sprung up off the south New Jersey coast. It was traveling north, winds gusting to 45 knots and creating 20-25 ft. seas. By 5 p.m. all sails were down, and I was running before the wind... back to Long Island. With a lee shore fast approaching and night setting in, I decided to come about and set a para-anchor on 500' of 1/2" line, with an accompanying float and trip line. It did all, and more, of what it was supposed to do. According to both the GPS and the Loran, I drifted no more than a third of a mile per hour, with the bows held into the waves and only spray coming on board. By noon of next day, the storm had passed (later I learned that three boats had sunk, and one person was lost).*
>
> *Neither I nor the boat would be here without the sea anchor. This storm came up with no warning (VHF, NOAA, Fax, etc.). Everything worked well on deployment. Boat rode easily with some pounding on hulls (lee boards half down as per your suggestion) rudders up & lashed, virtually no pounding on cabin underside. Chafing was solved on bridle by putting "poly-tubing" on line, 3' sections before eye-splicing, then held in place by whippings. Float was 3' inflated ball type anchor float. At approx. 1:30 p.m. a commercial fishing boat ran over and cut the* [full] *trip line. Later on had many problems trying to get anchor in - dislocated my wrist while trying to winch in the parachute. Anchor was finally brought in by removing bridle from bow and floating it off, tied*

to four life jackets [then powering up to the recovery float].

S/C-11 Catamaran, Stiletto

S/C-11

Catamaran, Stiletto

29' x 16' x 1.4 Tons

12-Ft. Dia. Sea Anchor

Force 8 Conditions

File S/C-11, obtained from Thomas E. Cooke, Euclid, OH. - Vessel name *Battle Cat*, hailing port Sandusky, OH, catamaran, designed by Stiletto Catamarans, LOA 29' 4" x Beam 16' x Draft 48" (12" boards up) x 1.4 Tons - Sea anchor: 12-ft. Diameter *Para-Tech* on 300' x 1/2" nylon braid tether and bridle arms of 50' each, with 1/2" stainless steel swivel - Partial trip line - Deployed in a low system in shallow water (45 feet) on Lake Erie, about 30 miles NW of Cleveland with winds of 40 knots and choppy seas of 8-10 ft. - Vessel's bow yawed 10° - Drift was estimated to be about 300' per hour during 10 hours at sea anchor.

Another difficult situation involving a lightweight multihull, shallow water, low visibility (night), uncertain position, crew fatigue, impaired judgment, vicious squalls and nasty seas, all brought under control by the use of a parachute sea anchor. Transcript:

> *I have sailed Lake Erie now for four years with the sea anchor on my boat. This is the first time I had a real life-threatening situation where options were limited, and thank God the sea anchor was one of them. To make a long story short, we tried to beat a low pressure system moving in from the southwest, and couldn't. In our haste to outrun this system I made some bad navigation calls, and we ended up following a freighter for about an hour and a half out into Lake Erie's open water, mistaking its lights for the lights of Cedar Point Amusement Park at Sandusky Bay. By the time we figured out we were following a freighter, weather conditions began to deteriorate.*
>
> *It was 3:00 a.m. when we saw lightning in the west. Diminishing visibility along with increased wind and waves quickly followed. Within 15 minutes we went from 10 knots of wind, 1-2' waves, a starry sky and some lights visible on shore, to 20-25 knots of wind, 5-6' waves, a black sky, literally no horizon and thunder on the increase. The only means of navigation on board were two Horizon compasses. We had no auto-pilot and had been up for 20 hours. We were extremely fatigued and totally disoriented. With no horizon and our brains not functioning too well, (extreme fatigue does funny things to the mind) we decided to deploy the sea anchor and wait until daylight before doing anything else. We deployed the sea anchor in text book fashion. We have the DSB (deployable storage bag). Nothing fouled up, it was almost too easy. The boat slowly drifted downwind and when the rode ran out she swung straight into the wind. At that point we just rode the waves. We lashed sails down and made sure everything was secured and that was all there*

was to it. On board with me was my sailing buddy, Tom, and my two sons Michael & Bruce. Mike is 9 yrs. old, Bruce is 12 yrs. old and Tom is 37 yrs. old. We contacted the Coast Guard to let them know approx. where we were & what we were doing. At this time the wind was blowing a steady 28 knots & seas were building. It was hard to see how big the waves were with just a flashlight, but the white caps were all over & easy to see.

Tom & I went down below to get some sleep while my son Bruce sat in the cockpit and kept an eye out for freighter lights. By daybreak the wind was blowing steadily in the upper 30's and low 40's, occasionally hitting 48 & 50 knots. The waves were averaging 8' with 3 sets of 10'+ waves every 13th wave. The high wind & waves lasted about six hours & eventually died down to 20-25 knots and 5-6' waves. While we were on sea anchor, listening to channel 16, the Cleveland, Detroit and Fairport Coast Guards were looking for two fishing boats reported overdue the previous night. Both were power boats, one with two adults the other an 18' Bayliner with two adults and three children on board. I can't tell you the compassion we had for them knowing what they had to be dealing with, and at the same time the security we felt while at sea anchor. By the way, both boats and all aboard were found safe the following day, having been blown across the lake to Canada.

Eventually when the wind & waves died down we just powered up to the chute trip line, pulled it, the chute collapsed, we pulled it on board and the rest is history.

A few observations:

1) I never ever thought I would be caught out on Lake Erie in those conditions and survive to tell about it.

2) The sea anchor worked better than I had ever imagined. The boat rode the waves beautifully, up and down, never burying a bow. Came close, but never happened.

3) We would get sea sick only if we went down below and kept our eyes open. If we went down to sleep we were OK. We spent most of our time in the cockpit looking at the waves and how well the sea anchor worked.

4) The boat yawed very little, almost unnoticeably. We tracked drift by movement past commercial fishing nets.

5) The security we felt while being at anchor under those conditions was unbelievable. I would never have thought it possible.

6) After this experience, it is my opinion that no boat should venture offshore without the safety and security of a good sea anchor, tailored for specific boats. At the time, the sea anchor was more important to us than any other piece of safety equipment we had, including the VHF and EPIRB.

S/C-12 Catamaran, Prout

S/C-12

Catamaran, Prout

39' x 18' x 9 Tons

18-Ft. Dia. Sea Anchor

Force 9-10 Conditions

File S/C-12, obtained from Sackville J. Currie, Blaney, Ireland - Vessel name *An t-Iompodh Deisiol*, hailing port Sligo, Ireland, "Escale" catamaran, designed by Prout, LOA 39' x Beam 18' x Draft 3' x 9 Tons - Sea anchor: 18-ft. Diameter *Para-Tech* on 400' x 5/8" nylon braid tether and bridle arms of 60' each, with 5/8" stainless steel swivel - Partial trip line - Deployed in a whole gale in deep water about 90 miles northeast of Casablanca, Morocco, with winds of 45-52 knots and seas of 15-18 ft. - Vessel's bow yawed 20-30° - Drift was estimated to be 7-8 n.m. during 36 hours at sea anchor.

Sackville J. Currie is the envy of every landlubber on the planet earth. Having sailed multihulls all over Japan as Prout's agent over there, he had the Prout brothers custom-design a 39-ft. Escale for himself, which he named *An t-Iompodh Deisiol* (pronounced *Aan Umple Jesshul*), Gaelic for "the place of turning sunwise."

After launching her in 1993 in Ireland he went on a three year - 18,000 mile - cruise. He sailed her down the Iberian Peninsula to North Africa, and then across the Atlantic to Brazil. After spending six months in Brazil, it was on to Venezuela, and then exotic Central American locations, and then the Leeward Islands, and finally onto Miami.

His article entitled *Xcalac Con Escala*, appearing in the November/December 1996 issue of *Multihulls Magazine*, gives the reader an inside view of what modern catamaran cruising is all about. Reading it will make any sailor's mouth water.

Imagine exploring the Caribbean on a seaworthy, handsome, luxurious, comfortable catamaran. Imagine swift passages to Trinidad and Tobago, Port of Spain, Bonaire and the Dutch Antilles, Curacao, Aruba, Cartagena, Bay Islands of Honduras and Roatan. Imagine a leisurely foray up Guatemala's *Rio Dulce*, which is navigable forty miles inland and is punctuated by numerous lakes that teem with gentle manatees. Imagine exploring the heart of the Central American rain forest on a spacious, ocean going catamaran, using twin diesels to power into mile-long winding canyons festooned with lush vegetation, cormorants, snowy egrets and thousands of green butterflies, to say nothing of running into the occasional lost Mayan city. Some people have all the luck.

Sackville's J. Currie's good luck is more than earned by his careful attention to details and planning, however. He knows the territory, so to speak, picking his routes and seasons carefully, always ready and prepared to run the unexpected gauntlet. And the gauntlets that Currie has run include a number of vicious ladies, among them *Opal* and *Roxanne* - hurricanes that devastated Yucatan and Guatemala in 1994. Currie barely managed to escape with the skin of his teeth.

Ah but then a miss is as good as a mile!

And as for the storms that he couldn't avoid, well that's what the parachute sea anchor was for. He deployed one in a nasty blow on the way to the Canaries from Casablanca. The bows of the Escale were yawing 20-30°, occasionally knocked to 40° by breaking waves. Currie said he was not worried about it, seeing how that it was a shock absorbing mechanism. (The yacht absorbs much of the shock of a breaking wave by pivoting on her CLR). A few lives were lost elsewhere in this storm. Transcript:

> *From Casablanca we set off for the Canaries. Within 24 hours the wind was up to F-7 on the nose, and still rising. Gale/storm lasted for 3 full days. For the first 12 hours we sailed into it to get searoom. About 95 miles off the African coast we hove to under staysail. The boat lay 50° off the wind and waves. Made 2 knots of drift, also took a lot of damage from waves crashing into our side (cockpit dodger broken, autopilot, wind instruments and GPS out of action). Once we deployed the parachute, we took waves on the bow, much better. The new deployment bag works very well. Motion on parachute was not nice though, we got seasick and some whip-lashing at stern.*
>
> *We used a partial trip line with two fenders. The polypropylene trip line got twisted up - we will try a swivel here next time. In retrospect we should have deployed the parachute earlier, then we would have had no damage. To recover, we waited till wind and seastate moderated, then motored up to the fender.*
>
> *We also use the parachute when we want a rest or when we have to go up the mast at sea, and to avoid nighttime landfalls, deploying it when still 20 miles offshore, and retrieving it in the early hours to allow arrival in daylight.*

S/C-13 Catamaran, CSK

S/C-13

Catamaran, CSK

65' x 30' x 22 Tons

24-Ft. Dia. Parachute Sea Anchor

Force 10+ Conditions

File S/C-13, obtained from Captain William H. Price, Valdez, Alaska - Vessel name *Rose Marie*, hailing port San Diego, catamaran, designed by Vince Bartalone, LOA 65' x Beam 30' x Draft 3' 3" x 22 Tons - Sea anchor: 24-ft. Diameter military reserve parachute on 600' x 1¼" nylon braid rode (no bridle, but reefed mizzen flown), with 5/8" galvanized swivel - Full trip line - Deployed in a low system in deep water about 1250 miles SW of Los Angeles, with winds of 55-60 knots and seas of 20 ft. - Vessel's bow yawed 20° - Drift was 11 n.m. during 20 hours at sea anchor.

This is the second file involving the catamaran *Rose Marie*. In the previous file (S/C-1) she hove to a 28 ft. diameter C-9 parachute off Point Conception, California, where a strong coastal current pulled her directly upwind against 35-40 knots of sustained wind.

In this file she ran into a winter storm on her way to Hawaii from San Diego. Captain William H. Price (200,000 miles experience) was delivering the boat to her new owner in Singapore at the time. No bridle was used on this occasion, just 600 feet of 1¼" nylon braid leading to the centrally located anchor roller (CAUTION: multihulls should always use full width bridles anchored to the extreme outboard ends of the hulls). Transcript:

> Rose Marie *departed San Diego for Honolulu 25 January 1993. Pt. Loma light finally slipped below the horizon in the twilight hours. The next eight days saw variable winds NW to SE up to 20 kts. as a succession of frontal systems swept our course to Hawaii.* Rose Marie *had a personal computer and WFAX on board by means of which every readable weatherfax transmission was captured and stored for planning and review. The afternoon of February 2, noon position 22° 54' N and 137° 47' W, some 1256 miles out, the wind went light and we were forced to keep pace by motorsailing through the evening hours.*
>
> *By the mid watch a breeze had hauled SE and piped up so that the main required a double reef put in. The yankee and mizzen were struck, and we carried on with deep reefed main and stays'l. February 3 at 0600 hrs. saw 35 knots SE across the deck and continuing to freshen. Nothing in the way of a front showed on the latest WFAX to warn of what was coming, though it was obvious what was happening. 1000 hrs. saw wind 40 kts rising to 50, and 20 ft. seas breaking sporadically down on the weather side. Rain came horizontally so hard as to sting the face. Motion aboard the*

cat was so irregular. Any movement but hanging on was a chore. Seas trying to cross our course got their tops trapped between the hulls and hammered the underside of the bridge deck mercilessly. The decision was made to lay to the parachute anchor until the wind blew itself out. The frontal squalls had been lasting only about 12 hrs. in previous encounters.

Upon attempting to round up and drop sail it was discovered that the steering did not respond to turns on the wheel. In fact the rudders were free to flop, lock to lock, with the rolling pressure of the seas. An axle pin had come adrift from one of the rudder cable turning blocks. The cable was completely slack and one rudder quadrant was already in the process of dashing itself to destruction against the stops! Without stops, the large flag rudders were free to swing around and bang the hull (foam core construction probably would not stand much of that action).

A 24 ft. dia. chute was deployed from the weather waist and bow, after careful flaking out of the rode, trip line and float to avoid any fouling. The float and [full] *trip line over first and streaming out downwind very nicely. Next the swivel-parachute connection went in and sunk well down. The* [lightweight] *canopy itself was wetted before hand pretty well by rain, and went over last in a heap. The parachute blossomed and immediately there was strain applied to the rode. The entire 600 ft. of rode paid out under control from purchase turns around the windlass drum and snubbing horns. The last point of fairlead was the anchor roller mounted just to the port of the headstay tack.*

Rose Marie *came round to within a couple points of SE immediately. The mizzen was then reset with the reef in and bowsed taut on center between sheet and vang tackle. This brought her right up into the wind and made her lie within a point on the port bow.*

By 1130 we were lying to, very steady in 50-60 kts of breeze over the deck. Damage control parties were sent into the steerage compartments of both hulls and the rudder stocks blocked into submission. The starboard quadrant was smashed beyond use and had to be replaced. The only other casualty, indeed fatality, was our faithful wind generator, "WINDY." He lost an arm at 60+ kts across the deck, throwing it down hard against the mizzen and into the deck right between my feet. Failure was due to the irregular pitching about of his perch up on the mizzen. While his arms were trying to make perfect circles [gyroscope effect], *complex pitch and roll changed the direction forces on them and metal fatigue did the rest. The crew had to belay his remaining arm with a halyard to prevent his efforts continuing in the unbalanced state.*

Lying-to, we were able to walk normally about the ship. Except for the 20 ft. plus rise and fall with each wave there was little indication below of conditions outside. Parachute was 24 ft. diameter military surplus. It was the back-up to the original main 28 footer which had rotted and was discarded prior to departure. 5/8" Galvanized jaw & eye swivel and 5/8" galvanized shackle connecting rode to parachute. 600 Ft. x 1¼" dia. yacht braid nylon rode with a thimble spliced into the eye at the overboard end. Cylindrical inflatable fender (approx. 2 ft. long x 10" dia.) float, secured to canopy head by 50 ft. ½" yachtbraid line. Trip line - 3/8" dia. x 600 ft. yellow polypropylene line, secured to float line eye on the surface.

Notes: *The anchor rode had to be pinned into the fairlead roller with a 3/8" bolt and chafe guarded with a 3 ft. length of heavy hose lashed solidly about the section stretching and*

contracting through the fairlead. In the end the fairlead was bent to weather about 15 degrees, and the retaining bolt bent up in a distinct vee-shape by the rode pitching up and trying to escape [when the bows were pointing sharply down]. *600 Ft. was adequate for those conditions. It served very well, though I could have wished for more in the locker, had the seas been higher, or more frequently breaking.*

S/C-14 Catamaran, Edel Cat

S/C-14

Catamaran, Edel Cat

35' x 19' x 3.5 Tons

15-Ft. Dia. Sea Anchor

Force 8-9 Conditions

File S/C-14, obtained from Jack Goodman, Arlington, VA. - Vessel name *Cat Morgan*, hailing port Lusby, MD, catamaran, designed by Maurice Edel, LOA 35' x Beam 19' 10" x Draft 2' 10" x 3.5 Tons - Sea anchor: 15-ft. Diameter *Para-Tech* on 350' x 3/4" nylon braid tether and bridle arms of 25' each, with 5/8" stainless steel swivel - Partial trip line - Deployed in a gale in deep water about 150 miles WNW of Bermuda, with winds of 40-50 knots and seas of 15-20 ft. - Vessel's bow yawed 10° - Drift was estimated to be 6 n.m. during 12 hours at sea anchor.

Bermuda bound sailors seem to be high on King Neptune's hit list. Transcript:

> *We were sailing to Bermuda from the Chesapeake Bay with the '95 Bermuda Cruising Rally. The second and third days it rained and blew. We were either beating in one squall, or becalmed and waiting for another one. The fourth morning found the wind blowing straight from Bermuda and strengthening. The waves grew much larger and more irregular than they should have been with 40 knots of wind. Very awkward. We seemed to be in between two different weather systems. The forecast was uncertain and we were growing tired. (We later found out that we had been sailing in the southern quadrant of a counter clockwise eddy, with the current against the wind. Had we beat southward ten more miles we would have been in much calmer seas).*
>
> *By noon the irregular - pyramid shaped - waves had increased to 20 feet, so we decided to try out our 15 ft. diameter Para-Tech sea anchor. We took all sail down and ran with the wind at nine knots until the parachute was rigged and ready. With our outboard motor running at full bore we were just able to turn the boat 45° into the wind. I then dunked the parachute bag and float into the water on the windward side of the bow. Even though I was aware that the trip line could foul, and was therefore careful in full daylight, it still got wrapped around the shrouds of the parachute. The chute still opened, and since the* [partial] *trip line was not close by, I let it go (I could not have pulled it back anyway).*
>
> *I slowly let out 350' of the 400' x 3/4" nylon braid rode and cleated it off to the port bow. Using a rolling hitch, I tied a 5/8" Dacron line to the 3/4" tether, let out 25 feet and cleated it off on the starboard side* [re: Fig 38 in File S/T-6]. *I then uncleated the port side and eased it out until the bridle sides were of equal length and re-cleated it. The boat rode bow to the wind, veering no*

more than 10° to either side. No water came on deck. Aside from the noise of the wind - and the going up and down like a mad elevator - it was quite comfortable inside. We cooked and ate a large steak dinner, left one crew member on watch and went to bed.

At midnight the wind dropped to about 20 knots and the boat sat 90° to the wind. We decided to retrieve the parachute. Motoring into the wind only allowed the chute to sink, causing more strain on the line. We found the best strategy was to wrap the line around a sheet winch and take in slack after every wave. This kept the chute close to the surface and was quite easy, albeit slow. When the chute was close enough we grabbed a shroud line with a boat hook and pulled it aboard. No strain on the boat or hard work - just two hours of time.

Notes: *During the 12 hours with the sea anchor we drifted 6 miles east, with the wind from the southwest. I now believe that after the wind dies down a little and my boat wants to lie beam to the seas, I will tie the parachute off the stern until it is time to pull it in. When we got to Bermuda I removed the trip line. Getting the chute back is secondary. If we ever need to use the parachute again we won't mind the extra hour required to pull it in. Also, in order to set the sea anchor, the next time I will heave-to with only the reefed mainsail* [sheeted in tight], *instead of using the motor to bring the head up into the wind to deploy the parachute. One of the nice things about the Edel Cat is that the cleats are on top of a rounded deck with NO CHOCKS. The bridle lines went directly from the cleats to the parachute touching only the smooth deck or forward aluminum cross beam at extreme angles, hence hardly any chafe at all. From now on we will always carry a parachute when offshore. Not just for storms, but equipment failure and extreme fatigue.*

S/C-15 Catamaran, Bailey

S/C-15

Catamaran, Bailey

40' x 24' x 5 Tons

18-Ft. Dia. Sea Anchor

Force 11+ Conditions

File S/C-15, obtained from Rob Mansell-Ward, UK - Vessel name *Orinoco Flo*, hailing port in the UK, catamaran, designed by Nick Bailey, LOA 40' x Beam 24' x Draft 8' (18" boards up) x 5 Tons - Sea anchor: 18-ft. Diameter *Para-Tech* on 400' x 5/8" nylon braid tether and bridle arms of 50'(?) each, with 5/8" stainless steel swivel - No trip line - Deployed in a storm in the Agulhas current 98 miles from Richards Bay (South Africa) with winds of 70 knots and seas of 45 ft. - Angle of yaw and rate of drift unspecified.

Christmas 1995 Victor Shane received this feedback from Commander Rob Mansell-Ward from Durban, South Africa. Transcript:

> *Dear Para-Anchors, you asked for accounts of your product in use. Herewith my experience, together with the mistakes I made and the outcome. I hope it is instructive to future users and yourself, and that an element of* Schadenfreude *will make it as enjoyable for those who read it as it was miserable for us. The boat,* Orinoco Flo*. I built her myself. She is a fairly "hi-tech" catamaran of 40', vacuum-bagged Airex/glass sandwich in epoxy. Carbon wingmast. Daggerboards, lifting rudders, transom hung. Spartan but tough - not a race-boat.*
>
> *We are entering the final stages of a pretty long circumnavigation which took us from the UK across Biscay (January '94) to the Canaries. Across the Atlantic to the Caribbean, thence through the Canal to Costa Rica, on via Isla Coco down to the Galapagos and on to Easter Island - September '94. Thence conventionally across the Pacific via the Tuamotus, French Polynesia, Tonga and Fiji to Brisbane, Australia. We went southabout Australia via the Bass Strait and hung in the Southwest of Australia, surfing before continuing to Indonesia via Darwin (from Northwest Cape 1,500 miles to windward - what a joy!) We set sail on October 21st from Sumatra for Mauritius, and left La Reunion Island for Africa just ahead of intense tropical cyclone* Agnelle*. We were 24 hours out of Durban in 28° South and 34° East, prematurely congratulating ourselves on being clever sailors not to get cycloned, when we got Southern-Oceaned instead.*
>
> *This is not the place for a discussion of the peculiarities of the weather in this part of the world. Suffice to say, for one reason or another - it's a bit of a bastard. Weather reporting in this area is hampered by a paucity of satellites and shore stations. In addition, the South African weather*

center is in Pretoria [inland]. *It appears they give a priority to the farmers, according to Chris Bonnet of the Ocean Sailing Academy here in Durban. I enclose a weatherfax from the day before we got hit. You see there are four secondaries and I doubt that this is the whole story. The most severe weather I had experienced before (I was in the British Royal Navy in the middle sixties and joining HMS* Jaguar *in Mauritius steamed directly into a tropical cyclone on my first night on board!) was an English Channel storm - also the product of secondary depressions forming along the cold front of a tired larger depression. A further point is this: the High coming in behind the front intensified quite dramatically, reaching something over 1040.*

The crew consisted of myself and two young, non-sailing surfers - one English, one Kiwi. At 0600, 30 November 1995, I remarked in the log that we had "8 oktas of stratiform cloud" and a sunrise "definitely by Turner." Also, I saw my first Wandering Albatross since the Great Australian Bight. I wrote, unfortunately in the circumstance, quoting the Ancient Mariner:

And all averred I'd killed the bird

That made the wind to blow

I should add that we'd been at sea a fair while, and these were by no means odder-than-usual remarks. The wind had backed North. I expected a bit of a fuss along the lines you get when two Southern Highs change places. The wind goes round the clock with a puff before giving something like a steady tradewind again. I thought we were too far North to get storm winds. I see from the log we averaged 9 to 10 knots for the following 10 hours. At 1500 the wind backed further to NW and dropped to zero at 1600. At 1900 we had a partially clearing sky followed by a lot of lightning. Then, by starlight, we noted the approach of some distinctly sinister low-level black clouds - like smoke almost. I rebuked Jon who was watchkeeper for dropping all sail, and insisted that he haul it all up again! (Oh the folly of experience!) Suddenly we had very strong wind from the SW. We belayed hoisting the jib which we had been in the process of reefing (no roller-furler... Orinoco Flo *is fractional-rigged and has a relatively small, 20 sq. meter jib) and hove-to on the port tack.*

Heaving-to under wingmast is a relatively new item in the seamanship manual. I had read about it twice, once when the delivery crew of a Tektron 35 cat described it in Multihull International Magazine (they were delivering it to Europe from Canada) and again when Randy Smyth and a French crew, having a go at the Jules Verne Trophy on a French cat,- "parked her," in their words, in 80-knot winds off Cape Horn. ***You lower your windward daggerboard halfway, raise your leeward one totally; you rotate the mast to windward and tie your tillers off to lee,*** *and the result (for us) was a fairly controlled fore-reach at 3.5 knots 100 degrees off the wind. In other words, we made WNW. Overnight we made 35 miles in that direction. I seem to remember thinking that Mozambique was about 36 hours away!*

The disadvantage of heaving-to in this manner is that you are beam on to the seas. My log is neither enlightening nor coherent from this point on. I did seem to write down that the Ampair (wind generator) was "going moderately ape" (not Cruising Club medal stuff this). There is then a bit of a gap overnight whilst Mark and I sat up in foul weather gear anxiously watching the sea through the doors of the saloon. Nothing too spectacular at first. But we were impressed when

some whitewater pitched over the boom whilst filling the cockpit. That is a clear pitch of at least nine feet, and if that was the top 20% of the wave perhaps.... Shortly thereafter the wind built to something well in excess of storm force and certainly achieved 70 knots. (American friends on the yacht Mora *were in Richards Bay 98 miles from us at the time of the storm and the wind was recorded at 69 knots in the harbor there). Quoting from an article by Dr. Eckart Schumann, "Giant Wave - Anomalous Seas of the Agulhas Current:"*

"Many waves, in fact, break because of their extreme steepness. The mechanism involved is not only a `squeezing up' of the wave profile but also an actual transfer of energy between the current and the waves. The extent of the transfer depends upon the current's strength and the wave's period.... a shorter-period wave will increase in height more than a longer period wave."

So the earlier "smaller" big waves were steeper because of

A) shorter wave length,

B) stronger current.

Remembering your remarks about the sailor who was hauled up-wind by his para-anchor off Pt. Conception, when we finally got out the para-anchor we discovered from the GPS that the current temporarily reversed under the weight of the sustained storm force wind and we made 1/2 knots northwards for a while. So, the fully-developed sea produced a longer wave-length and the current reversal reduced the energy transfer to the wave. Hence the more orderly later, larger, fully-developed sea.

On with the tale. By eight in the morning my nerves were fairly stretched (I'm not terribly tolerant of sustained fear). I looked out at what the dawn revealed and felt distinctly depressed with the situation. There was a very big sea running and some quite impressive chunks of whitewater breaking off the top. I've been surfing for thirty years and my two crew members were good surfers. We had surfed very big waves at Ombak Tujuh in Java. Surfers tend to call wave size down on what an oceanographer might call it. We reckoned 45 ft. I guess it was the doublers and triplers that kept us a bit shaky. Still, we probably wouldn't have set the para-anchor if the following had not occurred. (What? Go up on that scary trampoline netting and get strained through it like a pilchard? Not on your life.) A wave struck us hard on the port quarter at 0800. The port tiller - jerked by the movement of the rudder through the water as the boat slid sideways under the weight of the wave - snapped like a twig. (The tiller was constructed of laminated mahogany and carbon fiber). The thought of breaking the second tiller overcame our inertia and we decided the para-anchor had to be deployed.

Having managed without the para-anchor for two years and 30,000 miles, and having bought it on the principle that if you have an umbrella it certainly won't rain, I'm sure you will understand that the instructions had long since gone adrift, dissolved no doubt, in the solution of seawater and other more or less toxic effluent that swills about in most well-ordered cruising boats from time to time. In addition, the carefully spliced bridle lines and clean, break-free rode that had been set aside for use with the para-anchor two years previously had long since been co-opted into more worthwhile employment as anchor lines, mooring lines and baggy-wrinkle for crossing-

the-line ceremonies. Some was lost, some chafed-through and some broken. In the event, the para-anchor went out without a float, without a recovery line, without a bridle and with four knots in the rode. In addition I made the mistake of placing the anchor chain next to the parachute and that made recovery a particularly tedious procedure. However I did remember the critical point - TO GET LOADSA LINE OUT. And it took quite a while to get it all out, one meter at a time as the bows pumped it up. Actually, we were lucky to get it out at all as I did set up a bridle which fouled - we released it prematurely and started to run over it as we continued for-reaching relentlessly. And you have to know: the load is phenomenal once the 18' diameter parachute pops open.

We came up head on to the seas. Bliss - Hamlet cigar, TV-ad music (Pachelbel's Canon). We still stressed a bit on the perfectly reasonable assumption that our cocktail of lines & chain, and our cat's cradle of knots (double sheetbends) would certainly part. But no... the worst that happened from then on was a sharp jerk as the bows were yanked down as we came up over a big steep one. Neither shall I describe the view from the netting down into the hellish pit of a steep one, nor the view up onto the deep blue walls with the crests hanging up there - awful and sublime, and slightly higher than the sky - nor the absurdity of clinging to the netting with your toes and fingers like a Galapagos Marine Iguana while deploying the para-anchor, because all that is an accepted part of the fun of going sailing. Thanks... the thing works! We actually slept that night as the storm blew itself out! We will get it more right the next time, though, as they say in Morocco, "only Allah is perfect."

S/C-16 Catamaran, Crowther

S/C-16

Catamaran, Crowther

40' x 26' x 2.75 Tons

16-Ft. Dia. Sea Anchor

Force 9 Conditions

File S/C-16, obtained from Dr. Gavin LeSueur, Mallacoota, Australia - Vessel name *Windswept,* hailing port Mallacoota, catamaran, designed by Lock Crowther, LOA 40' x Beam 26' x Draft 2' 6" x 2.75 Tons - Sea anchor: 16-ft. Diameter *Para-Anchors Australia* on 300' x 3/4" nylon braid tether and bridle arms of 28' each, with 5/8" galvanized swivel - No trip line - Deployed in a storm in shallow water (40 fathoms) in the Bass Strait with winds of 45-58 knots and seas of 30 ft. - Vessel's bow yawed 20° - Drift was estimated to be 12 n.m. during 6 hours at sea anchor.

Dr. Gavin LeSueur is an Australian country doctor who lives in Mallacoota, Victoria. He is also among the world's leading multihull safety experts, having weathered storms, used a wide variety of drag devices on different multihulls, and pioneered an adjustable drogue that is now being manufactured by Para-Anchors Australia. The intrepid doctor *windsurfed* 750 miles from Melbourne to Sydney in 1982. He has written three books - *Windswept, The Line*, and *Multihull Seamanship Illustrated* (distributed in the United States by *Multihulls Magazine*). Transcript:

> *In January 1988 I raced two-handed from Sydney to Auckland (1000 nm) on my catamaran,* D Flawless. *This was a 37' x 24' x 4600 lbs. open bridgedeck offshore racing catamaran. My crew was 21 year old Catherine Reed* [wife to be]. *After rounding the northern tip of New Zealand, the fleet was hammered by cyclone* Bola. *This tropical cyclone followed an unusual route and was unforeseen by me due to lack of high seas forecasts at the time, because of an industrial dispute at the Australian Meteorological Bureau! By the time we realized what was on the way (we first heard about it on New Zealand commercial radio stations!) we were in 60 knots plus and 25-35 ft. seas - with a lee shore 30 miles away!*
>
> *I carried a 12-ft. parachute made by Para-Anchors Australia on board without a float or trip line, and with 300 ft. of nylon anchor line. I was unable to set the parachute. The conditions were such that it was not possible to crawl forward on deck due to the sea state and wind. It was like trying to move with your hands full on the roof of a car going along a bumpy road at 80 mph.* ***We had removed all sail (and boom) except a small storm jib, lashed the helm over to drive the boat into the wind, and raised both daggerboards.*** [Emphasis added.] *Thus* D Flawless *tracked at 70 degrees off the wind for the next 36 hours. We moved at about 2 knots, passing the edge of the eye and were ejected out of the "bad" quadrant. Wind strengths on land reached 96 knots. It was not*

pleasant huddled in the hull in our survival suits, awaiting the capsize that did not happen. The boat remained remarkably intact and we sailed into Auckland to finish the race.

En route back to Australia two months later we struck a 43 ft. humpback whale at 3:00 am in 25 knots of wind. We were surfing with our centerboards not fully raised. The whale awoke as we embedded our port centerboard in its back. It took off with the centerboard, the case and a good portion of the side of our port hull. The mast came down and speared itself through the remaining "good" hull! Over the next 45 minutes the catamaran wrenched itself to pieces. There were four of us on board at the time and we were 60 miles off the Australian coast. So close, and yet so far.

With no option but to get into our life raft we left the tangled wreckage and joined many of the foam sandwich hull pieces drifting downwind. The life raft was an Australian Yachting Federation approved offshore raft. Sea conditions deteriorated to 45 knots and 20 ft. waves. We were on the edge of the continental shelf and occasional seas were higher and breaking. We were capsized out of the raft four times! The parachute drogue on the water ballasted raft was useless. The only way we could stop capsizing on most waves was to dive to the windward side of the raft on each wave. It worked some of the time. We were rescued nine hours after hitting the whale. Rescue was quick and by helicopter (thus accurate wind and sea condition measurements). We had drifted over 20 miles in that time and rescue was effected due to our initial Mayday, missed radio schedule, EPIRB (which later failed - waterlogged), hand-held VHF radio (helicopter got a directional fix on this) and rocket flares. We were in good condition in survival suits, with extra water and flares over and above what was already in the raft.

Catherine and I now sail three handed with our three year old daughter (and dog - but she doesn't count). We have continued to experiment with drogues and parachutes and have used both many times since. I have no major problems with our parachute system. We use a 16-ft. diameter one made by Para-Anchors Australia, and carry 400 ft. of braided nylon rope. We do not use a swivel, or a trip line. The parachute has a float on 30 ft. of line on it's vent hole. Only once have we added a catenary weight down the line with a snatch block. We used a 25 kg CQR. In the 40-knot conditions it made little difference and it was a trial. We winch the line in while motoring up to the float. The bridle is a separate line and is tied to the tether with a rolling hitch. When the load is taken back on the tether in the cockpit, the rolling hitch is easily undone.

NOTE: Dr. LeSueur was a participant in the rough and tragic 1988 Round Australia Race in which he used and destroyed several drogues (see also File D/C-8).

S/C-17 Catamaran, MacGregor

S/C-17

Catamaran, MacGregor

36' x 18' x 2.5 Tons

12-Ft. Dia. Sea Anchor

Force 9-10 Conditions

File S/C-17, obtained from H.L. Andersen, Copenhagen, Denmark, - Vessel name *Silver Heels*, hailing port Copenhagen, catamaran, designed by MacGregor, LOA 36' x Beam 18' x Draft 18" x 2.5 Tons - Sea anchor: 12-ft. Diameter *Para-Tech* on 400' x 5/8" nylon braid tether and bridle arms of 40' each, with 1/2" stainless steel swivel - Partial trip line - Deployed in a whole gale in deep water 120 miles NW of Cape Finisterre, Spain, with winds of 45-55 knots and seas of 20-30 ft. - Vessel's bow yawed 30° - Drift was estimated to be 12 n.m. during 23 hours at sea anchor.

Silver Heels is a MacGregor 36 catamaran, modified with hard deck and small cockpit. Her Danish owner H.L.Andersen has put close to 110,000 blue water miles on her, having crossed the Atlantic a number of times. In September 1995, en route to Ibiza, Spain, he ran into what BBC radio first announced as "severe gale, Force 9" shortly to be followed by those dread words, crackling as they do over the shortwave bands: "FORCE 10 IMMINENT." Transcript:

> *For my modified MacGregor 36 catamaran (see articles in* Multihulls Magazine, *Nov/Dec 1992 & July/August 1994) I use the 12' para-anchor. First time I deployed the sea anchor was in a Force 10 storm (BBC Radio 4) 120 miles NW of Cape Finisterre (Spain). This severe gale was the first major low pressure of the 1995 fall season to sweep across the North Atlantic, reaching from Portugal to the Irish Sea, a huge area, and I had nowhere to run to, ergo I put all my faith in the para-anchor.*
>
> *I am convinced it saved the catamaran and me. The backing wind (to storm) made the seas real nasty. The temperature dropped to 7° C in the cabin. I'll never forget how peaceful it became as soon as the para-anchor took command. It was a blessing - rain and wind whipped the seas but we lay still.*
>
> *My mistake was to attach the bridle to the 400' tether using a bowline instead of a proper splice & thimble, and that's where the line eventually chafed through. But it held for 23 hours. I did not use a full trip line - only a partial one & two floats, regrettably, but I was worried about the lines tangling since I had to deploy everything in the middle of the night. After I lost the para-anchor several freak waves went right over the hulls, so I used the spinnaker* [as a jury-rigged sea anchor]. *But it got ripped to pieces after 1½ hours and I had to hoist a storm jib and sail the cat*

through the worst of the seas for 6 hours, after which it moderated and I headed for La Covina, Spain [sea anchor replaced there].

I used the new para-anchor 50 miles off Beaufort Inlet, North Carolina, and twice in the Mediterranean, both Force 8 - sudden gales with little sea room. After 110,000 nautical miles I still have a lot to learn about the para-anchor. I now attach a length of chain between the bridle and tether, and use a full trip line. Deployed correctly, I am sure the para-anchor will protect my vessel and my hide in the future.

S/C-18 Catamaran, Island Spirit

S/C-18

Catamaran, Island Spirit

34' x 22' x 6.7 Tons

18-Ft. Dia. Sea Anchor

Force 8 Conditions

File S/C-18, obtained from Colin Kenny, Riebeek, South Africa - Vessel name *Manx*, hailing port Cape Town, catamaran, designed by Phil Southwell, LOA 34' x Beam 22' x Draft 3' 4" x 6.7 Tons - Sea anchor: 18-ft. Diameter *Para-Tech* on 500' x 5/8" nylon three strand tether and bridle arms of 60' each, with 5/8" stainless steel swivel - No trip line - Deployed in a gale in deep water about 800 miles ESE of Rio de Janeiro with winds of 35-40 knots and seas of 30 ft. - Vessel's bow yawed 20° - Drift was estimated to be 17 n.m. during 40 hours at sea anchor.

Colin Kenny sailed *Manx* to a first place finish (multihull class) in the 1996 Cape Town to Rio Race. He deployed a para-anchor because of a combination of injury and bad weather on the return trip. Transcript:

> *We took part in the Rothmans Cape to Rio race in* MANX, *a 35' Southwell-designed catamaran*

displacing 6.7 tons. She was fitted with an Aerorig - the first unstayed carbon rig seen in this country. After a race dogged (if you will excuse the pun) by light winds, we arrived in Rio in 26 days 4 hours to finish first overall in the multihull category by a matter of 40 hours.

After spending three weeks in the islands south of Rio, we left for Cape Town on 25 February. We were sailing double handed, myself and Sue, who has only been sailing for the past year. The winds were SE instead of the anticipated westerlies. Heading south with a view to picking up the south westerlies we made good progress.

On the afternoon of 4 March, after having put in a third reef because of increasing winds and a deteriorating sea state, I was struck by the boom whilst returning to the cockpit and knocked unconscious. I was only out for about five minutes but had sustained a nasty gash on the head, which bled profusely. After coming round, I was in a confused state of mind and Sue sought assistance by putting out a PAN PAN radio call, but to no avail. We were more successful when we tried Inmarsat C. In addition, we finally raised Cape Town Radio and received the necessary medical advice. Being so far from land (our position was 33° 30' S and 31° 25' W) all we could do was monitor vital signs for the next 12 hours and hope for the best. Suffice it to say that those were the longest hours imaginable. Fortunately there were no complications.

Twenty four hours after the accident, we had even more drama. We were on a reciprocal course heading NE (in case we needed assistance). Sailing with triple-reefed main and no headsail (damaged the previous day) and using engines for improved direction in very strange, mountainous seas, we were concerned as to how we were going to make it through the night. In addition I was extremely weak after the accident. On the radio we heard that Tigress*, a 38' Prout catamaran* [in the same region]*, had deployed her para-anchor. Speaking to them on the radio they were astonished at the difference in outlook subsequent to deploying the anchor. They urged us to do the same.*

I had some misgivings as I did not have the necessary primary float, trip lines or recovery float. Instead we lashed two fenders together to act as the primary float, and a small fender as the recovery float, but without a [full] *trip line. With great difficulty, we deployed the anchor to windward. I say with great difficulty since we did not have a trampoline to walk on - it had UV degraded and been ripped away by constant wave action. Since our bridle was to be cleated to primary cleats on the cross-beam and backed up by secondary cleats on the bow, it was tricky, to say the least, to crawl forward and cleat the bridle ends and get the tether through the stanchions on the cross-beam, thereby ensuring that they would not snag and run free. The para-anchor was deployed off the starboard (windward) bow. Initially it looked as if we had made a mistake, as the tether was swept under the bow and I had visions of it passing below the keel and snagging the sail-drive. I snubbed the tether, the anchor began deploying and the bow started to swing around. We released more tether, snubbing the line at intervals until the full 500 feet of tether was out on 60 foot bridles.*

It was miraculous how easy the boat felt - as if someone had switched off the wind and sea conditions. Yaw was minimal - 10° (if that) to either side. It had taken us a fair amount of time to prepare both ourselves and the anchor, but we had no idea how satisfying our efforts would prove to be. It was now 20:00 and we settled down to a peaceful night. At 01:30 Sue, braving the black

night, high seas, 35 knots of wind (and no trampoline), checked the bridle [leading directly off cleats, no chocks] *for chafe - nothing! Similarly at dawn - no chafe. After lying at anchor for 40 hours, we were surprised to find no signs of chafe. I can only think that because we had a longer rode out than ordinarily required, the stretch of the nylon was such that there was next to no additional stress on the boat and the cleats, and hence the rode....*

At 10:00 on 7 March, after 40 hours at anchor, we hauled it in - the rode was pulled through the bow roller and winched in using the winch on the boom. The two larger fenders (primary float) were missing, but the small additional fender we had attached to the float line was still there. The chute was partially collapsed and, as a consequence, tangled. However it was clearly still functioning, although not as effectively.

After visiting Tristan da Cunha for a medical check-up, we encountered four gales on the trot, but the sea state was never as severe as that which we had encountered on the Bromley Plateau. We sailed under storm jib alone, which proved effective. There were times when we took a lot of water over the boat, however the conditions were never bad enough to deploy the para-anchor again. But the simple knowledge of how effective it had been and that we could deploy it again and expect the same results gave us a great deal of confidence (not over-confidence!) in our ability to sum up the situation and continue sailing. We had an ace up our sleeve. We arrived back in Cape Town on Easter Monday, 8 April 1996. To say that I was impressed with the para-anchor would be a gross understatement - I am mightily impressed.... Any multihull skipper that goes to sea without a para-anchor is being foolhardy.

S/C-19 Catamaran, Catana

S/C-19

Catamaran, Catana

44' x 23' x 6.2 Tons

18-Ft. Dia. Sea Anchor

Force 12 Conditions

File S/C-19, obtained from a number of reliable sources. - Vessel name *Bayete*, hailing port London, UK, designed by Lock Crowther & C. Barreau, LOA 44' x Beam 23' x Draft 5' 11" (2' 2" boards up) x 6.2 Tons - Sea anchor: 18-ft. Diameter *Para-Tech* on 400' x 5/8" nylon braid tether and bridle arms of 60' each, with 5/8" stainless steel swivel - No trip line - Deployed in a severe Mediterranean Mistral in deep water about 150 miles South of Marseille, with winds of 80 knots and seas of 25-30 ft. - Vessel was capsized for undetermined reasons with loss of four lives.

The following information concerning the tragic capsize of *Bayete* came to Victor Shane by way of a number of sources, among them Jean Pierre Prade of Catana, to whom we are grateful, and George Brandes, who was kind enough to forward numerous French newspaper articles concerning the tragedy, to whom we are also indebted. Brandes is the owner of a sister ship almost identical to *Bayete*.

From a number of French newspapers, among them *Le Var (nice-matin)*, Victor Shane - with the assistance of a translator - has been able to obtain the following outline. On 3 November 1995 a severe Mediterranean Mistral packing 80-knot winds and 25-30 ft. seas struck two yachting "flotillas" without much warning. Numerous sailboats participating in the *Transat des Alizés* ("Transatlantic Trade Winds Rally" - from San Remo to Point-à-Pître) and the *Transat des Passionnés* ("Transatlantic Rally for Sailing Enthusiasts" - from Hyères to Santa Cruz de Tenerife in the Canaries) were devastated by the storm offshore about 150 miles south of Marseille. While French meteorological services were at first blamed for the disaster, they did broadcast the morning of Friday, November 3, two storm warnings calling for Force 10 winds. Others found reason to criticize the race organizers and participants for their "lack of judgment" for going ahead with the race instead of seeking safe haven somewhere.

As EPIRBs were activated and maydays started coming in, rescue planes and helicopters of the French government, as well as French Naval forces, went all out to do what they could under trying circumstances. A hundred vessels set out on the *Transat des Alizés;* four were lost. According to press reports filed at the time the Italian yacht *Parsifal* sank with one dead, five missing (afterwards lost). Three members of the crew of *Cristalin 3* were also helicopter-lifted to hospitals on Minorca. From the dismasted *Maiaco 2* off Marseilles came distress calls and the efforts to save it and *Parsifal* went forward

feverishly. Three persons of French nationality were rescued from *Maiaco 2*. The yacht *Ango 2* was also dismasted. A vessel setting out from Cagliari rescued that crew and put them aboard a Greek freighter making for Marseilles.

As for the *Transat des Passionnés*, it was *Bayete* - the subject of this DDDB file - which signaled two dead, two missing and one survivor. Richard Charington survived twelve hours in frigid waters until a French Navy helicopter could make the 200 kms through the storm to save him. Charington was exhausted and suffering form hypothermia when the helicopter reached him. He said "I saw one of them drown!" before fainting.

From Chantier Catana's initial *Communiqué concernant l'accident de BAYETE* ("Communiqué concerning the BAYETE accident") Victor Shane - with the assistance of a translator - has been able to infer the following hypothetical scenario. We would like to emphasize that it is *hypothetical* - we are not dealing with known and verifiable facts. The capsize occurred in pitch black night. According to reliable sources, among them Catana's Jean Pierre Prade, the sole survivor - Richard Charington - was not a sailor, took no part in the setting of the para-anchor, was in his bunk at the time and, apart from possibly hearing a loud noise prior to the capsize, is to this day unclear about what might have happened:

Bayete chose not to leave at the beginning of the *Transat des Passionnés* on Tuesday, November 1, 1995 because of winds announced for that very evening. Friday morning *Bayete* got weather information from an unknown "German source" which called for increasing calm. To wit, *Bayete*'s first few hours at sea were in fact under a light spinnaker, and later under power, a confirmation to the crew of the forecast they had received.

A large swell with no wind made the crew seasick. At mid-day a wind arose from the northwest and quickly gained in force. *Bayete*'s crew, already worn out with seasickness, reduced sail. By nightfall the conditions were already serious - crew exhausted, no one with the strength to take the wheel - and it was decided to set out *Bayete*'s safety gear, a "para-anchor" or heavily reinforced parachute to be submerged as a sea anchor and to be fixed to the vessel by a nylon line 150 meters long. Around eight in the evening (20h) the para-anchor was made fast by a bridle attached to the port stem and to the center of the forward beam - (French: *Sur Bayete le para-anchor est ammarré par une patte d'oie sur l'étrave bâbord et le centre de la poutre avant vers 20h*). The entire crew had taken shelter inside, two remaining dressed for rough weather while the rest undressed for bed. Around ten (22h) the vessel heeled sharply to port, the starboard hull lifted up and *Bayete* capsized.

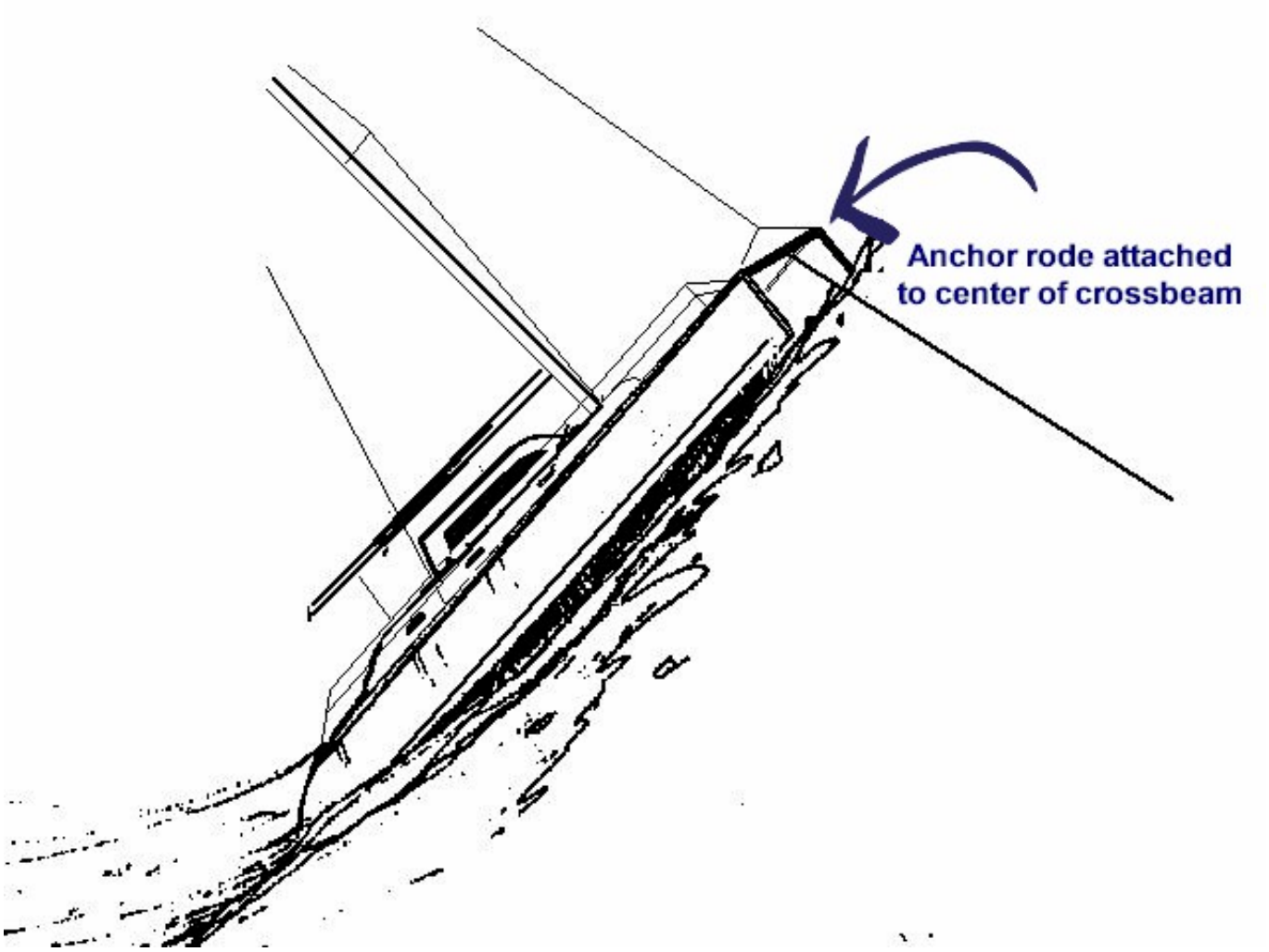
The five crew made it to the survival deck - (French *panneau de survie* - the flat underwing area between the two main hulls). They found the anchor line lying across the vessel between the hulls, a fact which led them to think the vessel had pitchpoled to stern.

One of the crew set off with a rescue buoy [EPIRB] which he activated outside the vessel, but unfortunately a wave tore the device out of his hands. The helicopter which came to the rescue found the buoy right away but took a number of hours to find *Bayete* because the moon was no longer to be seen. When the vessel was at last found only one survivor was winched aboard the helicopter and taken to Toulon in a state of severe hypothermia.

The most reliable report of conditions is that of the C.R.O.S.S. MED rescue team, which noted 70 knot winds at 340°, which whipped up to 80 knots at the time of the rescue, and that in seas eight meters high. A number of vessels were in distress at the same time. *Parsifal* sank with six souls lost and three other vessels were abandoned following helicopter winching off of the crew after sustaining serious damage.

In subsequent fax communications Jean Pierre Prade informed Shane that the capsized *Bayete* had been towed to Corsica. She was not too badly damaged. None of the mooring cleats had been broken. Naval personnel had indicated that the para-anchor was still made fast. The forward aluminum beam, housing the seagull striker and the anchor roller, to which one leg of the bridle seems to have been led, was broken in the middle, "but the break was in the direction of the pull of the stay, probably on account of the strains on the rig when the vessel was capsized."

Like Jean Pierre Prade, we can only agonize and speculate as to what happened. Perhaps the catamaran was struck by a rogue wave. Perhaps the "half-bridle" that seems to have been used, in spite of instructions to the contrary, did not afford sufficient leverage to keep her fully facing into the seas. Or perhaps the lines and/or parachute were not correctly deployed in the dark and partially fouled, or perhaps it was any combination of the above. At this stage, instead of engaging in idle speculation, one should rather focus on what *is* known, and what *could* have been done to preserve the lives of those men. For example, since it *is* known that the forward aluminum cross-member was broken in the middle, and since one leg of the bridle does seem to have been led over the anchor roller situated there, Victor Shane feels compelled to take this opportunity - once and for all - to close this window of vulnerability on ocean going catamarans. **Never attach one arm of the bridle, or even a single anchor rode, to the crossbeam - it just is not strong enough.** See the Catamaran Bridle Advisory for the correct attachment of a bridle.



Pitch-up attitude showing how an anchor line leading over the bow roller situated in the middle of the relatively weak aluminum cross member may buckle it downward. Note that the strong downward pull of the anchor on the aluminum cross member is being opposed by thousands of pounds of displacement load as the steep wave tries to "lift" the boat horizontally. This sort of scenario might easily be encountered in a storm while at regular anchor inshore, or at para-anchor offshore. Note also: should the aluminum cross member break and the yacht capsize, the anchor line will likely fall between the hulls, perhaps giving the impression that the yacht had pitchpoled backwards.

This was a terrible tragedy. Terrible because, with just a little more planning and foresight four lives might have easily been spared. It was reported that the sole survivor was the only one wearing a life vest, for example. The use of safety harnesses may have kept them from being swept off the slippery underwing. All might easily have come through in survival suits, or wet suits, and/or a life raft. *Bayete* was equipped with everything from microwave oven to radar to desalinization unit to the latest electronics and numerous safety devices, including a certified life raft. Tragically, four lives were still lost when she capsized.

Apart from re-emphasizing the need for full-width bridles there is another - much more important - lesson

to be learned here as well, namely that one should always have a plan to put into effect in case of capsize. As evidenced by the 118-day survival of *Rose-Noëlle*'s crew after she went over (File S/T-7), capsize need not be the end of the world. To quote the words of renowned multihull designer Jim Brown:

> *A multihull capsize is not by itself an ultimate disaster. There is a wide gap between capsize and actual loss of life. Given the proper preparations and equipment, and a suitable capsize survival technique, turning over is not nearly as threatening - as final - as the familiar once-and-for-all finish of a boat that's sunk.*

Sea anchors and drogues, properly rigged and deployed, will go a long way to prevent capsize on multihulls. Clearly however, beyond a certain point, say Force 12, a great deal will remain uncertain regardless of the tactic being used. Beyond such a point there is a crying need for a standardized *capsize protocol*.

The fundamental safety asset that multihulls have is that 99% of them are *unsinkable*. *Bayete* may have capsized, but unlike the monohull *Parsifal* she did not sink. *Parsifal* went down to the bottom. *Bayete* has been re-fitted and is now sailing the Mediterranean again. Although she turned turtle, there was nevertheless that sufficiency of food, water and flotation in her upturned hulls to sustain human life, at least until rescue. What was lacking here was the means - carefully laid out plan - for utilizing them.

Multihull sailors - *in particular those sailing modern catamarans* - MUST have a capsize survival strategy before they go offshore. All crew members must be informed as to what that strategy is, where the equipment - survival suits, EPIRB, life raft, emergency lighting, portable VHF, calamity pack, etc. - are located, and how they can be reached and activated in the initial period of panic and disorientation that usually follows capsize - those are the critical moments. The crew must be made to understand that capsize is not the end of the world. They must be handed a concrete guideline - standard procedure - to this effect. We have placed the skeletal framework of such a guideline in Appendix VII of this publication.

Four members of the sailing fraternity were lost in this tragedy. Jean-Claude Batault, *Bayete*'s owner, his brother Philippe, associates Henri Cailau and Pascal Metois are no longer with us. We are all diminished by their passing. We bid defiance to the sea in honor of their memory, resolved to double our efforts against an ancient adversary. This means heightened awareness, education, preparation, organization and readiness. It means never taking anything for granted about the sea, and always remembering the last paragraph of the official inquiry on the Fastnet tragedy of 1979:

In the 1979 race the sea showed that it can be a deadly enemy, and that those who go to sea for pleasure must do so in the full knowledge that they may encounter dangers of the highest order.

S/C-20 Catamaran, Crowther

S/C-20

Catamaran, Crowther

49' x 24' x 8 Tons

15-Ft. Dia. Sea Anchor

Force 8-9 Conditions

SW gale vs Agulhas Current

File S/C-20, obtained from Jean Claude Barey, Montreal, Canada - Vessel name *Chasse Galerie II*, hailing port Montreal, Spindrift catamaran, designed by Lock Crowther, LOA 49' x Beam 23' 6" x Draft 3' x 8 Tons - Sea anchor: 15-ft. Diameter *Shewmon* on 300' x 3/4" nylon three strand tether and bridle arms of 40' each, with 5/8" galvanized swivel - No trip line - Deployed in a whole gale in 500' of water about five miles SE of Port Elizabeth (South Africa) with winds of 40-45 knots and seas of 17-20 ft. - Vessel's bow yawed less than 10° - Drift was estimated to be 8 n.m. during 42 hours at sea anchor.

Jean Claude Barey took *Chasse Galerie II* on a circumnavigation in 1991. After transiting the Suez Canal he sailed her down to Durban, East London, Port Elizabeth, and was en route to Cape Town when he ran into a blow on the continental shelf, in close proximity to the Agulhas current. Transcript:

> *The conditions were not bad, but we could not take long tacks against the wind, because we were too close to the Agulhas current. We then used the sea anchor. Other boats without sea anchors decided to run back* [to Port Elizabeth] *after a few hours because they were not making progress to windward. Our Shewmon sea anchor worked well in those conditions. The boat was very steady (less than 5° yaw I will say).*

The Gulf Stream and the Kuroshio (Japan) notwithstanding, the Agulhas is likely the strongest and most articulated current on earth - with a reputation for breaking ships in two. Because of it, the southeast coast of Africa represents a gauntlet that mariners need to run with great care and prudence. Charts of the region warn: "Abnormal waves of up to 20 meters in height, preceded by a deep trough, may be encountered in the area between the edge of the continental shelf and twenty miles to seaward thereof. These can occur when a strong southwesterly wind is blowing."

The Agulhas runs mainly from northeast to southwest, following the two hundred meter contour of the continental shelf and dissipating over the Agulhas Bank south of Mossel Bay.

SW gale vs Agulhas Current

If the Agulhas could be likened to a great river - moving 80 million tons of water per second at speeds of up to six knots - the high-crested waves that form on it during southwesterly storms would be akin to the tidal bores that travel up the Amazon and the Bay of Fundy.

Since the current extends to depths of more than 1000 meters, and since it generally does not intrude onto the shelf regions, but tends to lie just offshore of the shelf edge, evasive procedure for cruisers has always been to *stay clear of the area seaward of the edge of the continental shelf.* What many sailors do after leaving Durban is to sail offshore just far enough to "kiss and ride" the current south, but not so far that they can't make a hasty retreat out of its axis and duck inshore at the slightest indication that there is a southwesterly gale brewing.

As always, the cardinal rule is *never leave according to clock or calender, nor have a deadline at the other end.* According to literature forwarded to Victor Shane by Chris Bonnet, Principal of the Ocean Sailing Academy in Durban, the best time of the year to travel south is January to March.

The gauntlet from Durban to East London is 250 miles with absolutely no safe place to duck into in between. Bonnet advises sailors to wait for a favorable window. Leave Durban at the tail-end of a southwesterly blow when the barometer has topped out, preferably at about 1020 milibars. Clear customs and immigration at the advent of a southwesterly, which will normally blow from 36 to 48 hours, then sail on to the two hundred meter line as soon as possible as this is where you can obtain a several-knot boost from the current.

It also means that in the event of not reaching East London before another southwester, you can quickly duck inshore and avoid being caught in the middle of the current - where sixty foot walls of water have been known to break ships in two. You will find that on average the two hundred meter line will give you a distance offshore - between Durban and East London - of approximately ten miles.

The gauntlet from East London to Port Elizabeth is shorter - 120 nautical miles. Kiss and ride the current, move inshore if caught. The Port Elizabeth to Cape Town leg is a little safer as there are decent places to anchor or put into - Knyasna, Cape St. Francis or Krombaai. But watch the charts and proceed with caution as there are rocks and reefs all about.

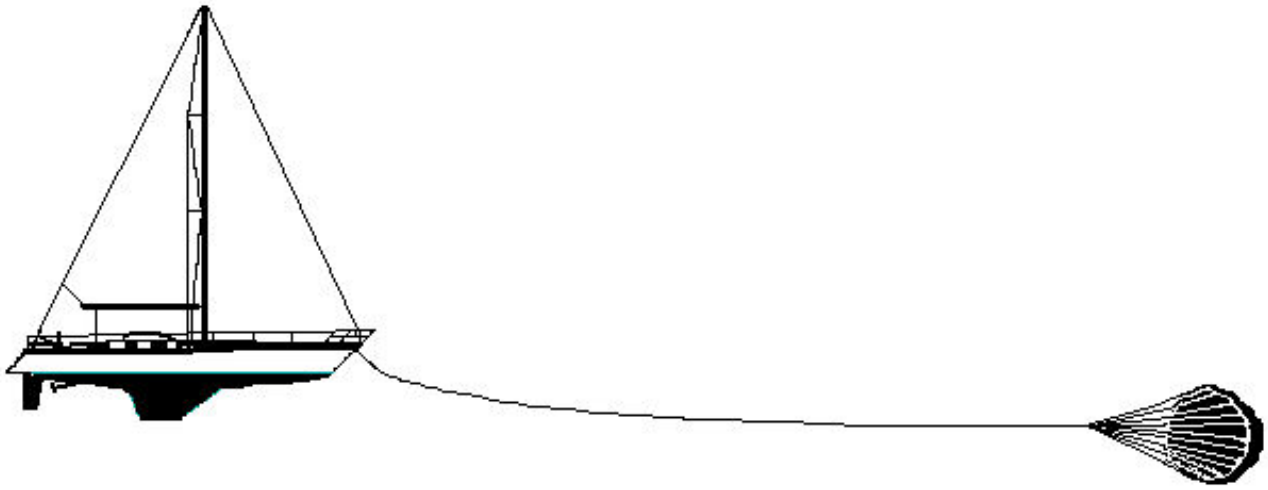
Sea Anchors on Monohulls

S/M

S/M

Files Relating to Sea Anchors

Used by Monohull Sailboats off the Bow



"In the 1979 race the sea showed that it can be a deadly enemy and that those who go to sea for pleasure must do so in the full knowledge that they may encounter dangers of the highest order."

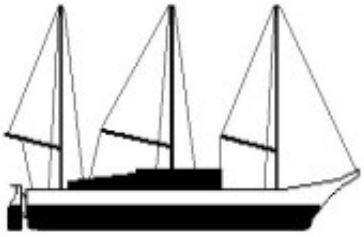
From the official inquiry on the Fastnet tragedy of 1979

S/M-1 Canoe, "Tilikum" (Voss)

Canoe, "Tilikum" (Voss)

32' x 1.5 Tons

22" Dia. Cone Type Sea Anchor



File S/M-1, derived from the writings of John Claus Voss and Norman Kenny Luxton - Vessel name *Tilikum*, converted Siwash Indian war canoe, hailing port Victoria B.C., LOA 32' x Beam 5' x Draft 36" x 1.5 Tons - Sea anchor, four-foot long, 22-inch diameter canvas cone used in conjunction with a mizzen sail - Deployed in numerous storms during voyage from Victoria B.C. (May 19, 1901) to Tahiti, Australia, South Africa, and finally England (September 2, 1904).

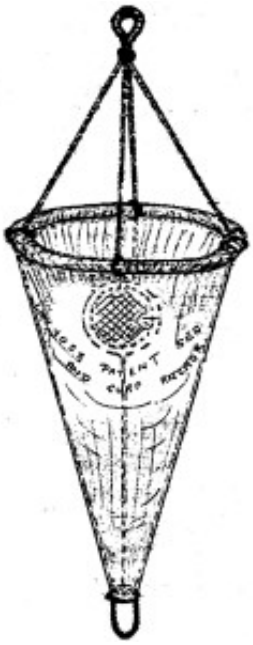
This is one of the earliest recorded cases of a small sailing vessel using a sea anchor to negotiate heavy weather offshore. Mention of the use of the device is made in *The Venturesome Voyages Of Captain Voss* and *Luxton's Pacific Crossing* (Gray's Publishing, 1968 and 1971). Both books have been out of print but Grafton Books has recently issued a reprint of the former, now entitled *Venturesome Voyages*, in its "Mariner's Library" series.

Little is known of the life of John Voss, the father of drag devices. He was born in about 1854, some say in Newfoundland, others Nova Scotia, and yet others Sweden. His seafaring life seems to have begun in 1877 when as a young man he went to sea in large sailing vessels. By 1901 he was a hardened seaman, having served as master on many sailing ships plying the fur trade from Victoria to Yokohama. Much controversy surrounds him in his later years. Some maintain that he was eventually lost at sea. It is more likely, however, that he died in San Francisco in 1922, while earning a living driving a bus there.

The vessel making the remarkable 1901-1904 circumnavigation was a converted 32-ft. Siwash Indian dugout which, according to her owner, had been in many Indian battles on the West Coast of British Columbia. She was given the name *Tilikum*, a Chinook word meaning "friend." During the voyage to the South Pacific the crew of the *Tilikum* consisted of John Claus Voss, captain, and Norman Kenny Luxton, mate. The two later fell out with each other. Voss's attitude toward the sea was a very conservative one. He was not one to take anything for granted out there and dealt with the unpredictable forces of nature in a cautious, methodical way.

Wrote Norman Luxton, "Voss's ideas were very much more scientific in weathering a storm... he knew his business, and he learned it by going easy. I only once ever saw Voss take a chance. He never gave a storm any benefit of any doubt, and he never sailed until he even lost a sheet, always anticipating trouble.

Many's the hell he has given me for not taking in sail when perhaps I should have." (*Luxton's Pacific Crossing*.)



Captain Voss Patent Sea And Surf Anchor." From a hand sketch believed to be Voss's own. (Courtesy of the Maritime Museum of British Columbia).

Voss told Luxton about how he would heave-to in a storm on what he called, a "sea anchor." He had gotten the idea from an old sailor in the North Sea. *Tilikum*'s sea anchor consisted of an iron barrel hoop about twenty two inches in diameter, with a four-foot canvas cone sewn on (see image).

It was used in a total of sixteen heavy gales during the three year circumnavigation. To quote Luxton, "Once, for seventeen days the *Tilikum* rode to such an appliance and a drag, and never shipped a cup of water. The weather was composed of samples of everything that the misnamed Pacific could put up."

Voss maintained that a stationary hull was better able to retain its buoyancy - rise to the seas. The same hull moving at speed through the water, he argued, was "held down by suction" and susceptible to great damage by boarding seas. In *Venturesome Voyages* he appendixed some twenty paragraphs of advice, where we find the following:

> *I will go a little further, claiming - and I have absolute confidence in doing so - that on no occasion while in charge of a vessel which was hove-to under storm sail in a violent gale, have I shipped a sea that caused any damage to ship or outfit, even though the storm sails had been carried away by the force of the wind. And the same applies to the small boats I have sailed on long cruises when they were hove-to under sea anchor and riding sail.* (***Venturesome Voyages,* Grafton Books, 1989.)**

Voss's philosophy was to go into a defensive posture - heave-to - long before the seas built too high or began breaking. Head sails were first dropped and the vessel made to head up into the seas. The sea anchor was then lowered and its cable let out. The heavy mizzen was then set as a riding sail. Thus, if the bow fell off to one side it could only yaw so far before the sea anchor and the mizzen brought it back to face into the teeth of the gale. Using this tactic, Voss and crew were able to survive a 1912 typhoon off the coast of Japan in *Sea Queen*, a little yawl, 19 feet on the waterline! The outer fringes of the typhoon lifted the roof off Yokohama Station and drove a large steamer ashore.

This idea of "a cone and a riding sail" has entered into the folklore of heavy weather tactics. To this day your authors receive inquiries about the so-called *Voss method*. Both the Coast Guard report (CG-D-20-87, *Investigation of the Use of Drogues to Improve the Safety of Sailing Yachts*) and the Wolfson RORC report have concluded that small, cone-type sea anchors are generally ineffective and unstable on their own. Both indicate the need for larger devices for use off the bow.

Earl Hinz renders a similar verdict in *Understanding Sea Anchors And Drogues* (Cornell Maritime Press, 1987). It has to be pointed out, also, that small conical sea anchors tend to put inordinate strains on rudders and their fittings as well.

Lin and Larry Pardey have modified and modernized Voss's method of heaving-to with great success on their own boats. They have replaced Voss's small conical sea anchor with a larger parachute-type device, and his canvas mizzen with a modern storm trysail. Using these they have ridden out various storms with success - see Files S/M-3 & 4.

In 1965 *Tilikum* was restored and moved into the Maritime Museum of British Columbia in Victoria's Bastion Square. She - and her crude drag devices - can be seen there today, along with some other famous sailboats, among them John "Hurricane" Guzzwell's *Trekka*. A fact-finding mission to the Maritime Museum of British Columbia is highly recommend (read good excuse for a wonderful little vacation).

From Seattle take the high speed ferry to the delightful port of Victoria, then relax and immerse yourself in the sights, sounds and smells of a seafaring past. Stand on the wharf, close your eyes, and you may imagine that you hear the clanging of ship's bells and the noise and commotion that surrounds the arrival of a big, three-masted bark, after a difficult passage from Yokohama. The gaunt, tired Captain Voss leans silently over the rail. The first mate shouts orders as men with salt-crusted beards furl and tidy sails from their lofty perches up in the sky. Waiting on the wharf are the wives and children of the seamen, dressed in the attire of the late 1800s. A seagull cries out. The last yardarm is secured. The ship coasts to a perfect docking. Lines are heaved ashore. If you press your imagination a little more you may even see the horse-drawn carts lined up on the wharf, the horses flicking their tails impatiently.

S/M-2 Little Harbor 40 Yawl

Little Harbor 40 Yawl

39'11" x 11 Tons, Full Keel & Centerboard

24-Ft. Dia. Parachute Sea Anchor

Force 9-10 Conditions

File S/M-2, obtained from Charles W. Turner, Marblehead MA. - Vessel name *Mambo*, hailing port Marblehead, Little Harbor 40 yawl, designed by Ted Hood, LOA 39' 11" x LWL 29' 7" x Beam 11' x 11 Tons - Full keel with bronze centerboard drawing 10' 6" when down, (draft 4' 3" with board raised at sea anchor) - Sea anchor: 24-ft. diameter cargo type parachute on 120' x 1" dia. three strand rode & 1/2" swivel - Full trip line - Deployed in 1964 in deep water, approx. midway between Bermuda and Nantucket Light, within the Gulf Stream, with the wind estimated at between 40-60 knots with seas 25' and greater - Vessel's bow yawed 10° - Drift was estimated to be 40 n.m. during 12 hours at sea anchor - mainly due to the motion of the Gulf Stream.

Chapter eighteen of Coles's *Heavy Weather Sailing* is entitled *Twice Rolled Over*. It is about the trials and tribulations of the 39-ft. centerboard yawl *Doubloon*, whose 3/4-inch-thick bronze centerboard was "bent about 30 degrees, probably when it hit the water as the yacht came back to even keel after the roll over." *Doubloon* was forced to run before 60-knot winds off the Carolina coast in the spring of 1964. The skipper, Joe Byars, tried a variety of traditional tactics in an effort to "keep the sea."

First, he tried running before the wind under bare poles. It worked for a while, but after taking five full smashes from astern (resulting in one crewmember being temporarily swept overboard) he changed course and put *Doubloon* on a broad reach, trying to work the boat out of the storm and the Gulf Stream.

This new tactic seemed to work for a while. Three hours later, however, the yacht was unexpectedly struck by a breaking wave and knocked down on her beam end.

Byars tried lying a-hull next. With her centerboard down *Doubloon* lay quietly with her bow some 70° off the wind for four hours. Then, suddenly, a wave broke and rolled her completely - 360-degrees in about five seconds. Six hours later she was smash-rolled for the second time. All the crew sustained injuries - Byars broke a rib - and there was havoc down below.

The next day the crew managed to improvise "sea anchors," one of which consisted of a working jib, with

the head attached to the tack to create more drag. Two mattresses were also lashed onto the remains of the stern pulpit in order to create windage aft. *Doubloon* took no more knockdowns.

A few months later, in June 1964, another sailboat called *Mambo*, practically identical to *Doubloon*, encountered similar conditions in the same area of the Gulf Stream, but used a parachute sea anchor. *Mambo* was on the homeward leg of the Bermuda Race when, at daybreak, the wind freshened from the NE and quickly built up to Force-9. This was followed by a build-up of the seas, and it wasn't long before the waves were big enough to completely blanket the wind when *Mambo* was in a trough.

Mambo's skipper, Charles W. Turner of Marblehead, Massachusetts, a moderately experienced sailor, had the boat running before the seas initially. A short time later, as conditions continued to deteriorate, a trusted and more experienced crewmember suggested that it seemed high time to turn the boat around and face into it.

The decision was then made to try to heave-to in the traditional way - by using sails. However severe cross-waves made it impractical to do this.

Another crewmember then pointed to the 24-ft. diameter para-anchor on the cabin sole which the owner had purchased. He stated, "Since you had us practicing with that thing off Marblehead, why not try it now?" The skipper decided that this was a good time to try it, since the man who had ridiculed it in Marblehead now appeared to favor its use.

It took three tries to accomplish proper deployment. On the first attempt the parachute blew under the bow until the keel was on top of it. It was then pulled back, straightened out and again tried. This time it flew up in the air, reaching a position where a mizzen staysail would normally be flown. It was again recovered.

On the third attempt it stayed in the water and, as the boat drifted back, it was payed out to the full length of its line, with the trip line float right above it. The line was secured to a bow cleat, although they were not sure it would hold. *Mambo* then faced nicely into seas of about 25-30 ft. In this posture she rode out the rest of the storm safely, albeit cork-screwing annoyingly because of the cross-seas which were running up the troughs. *Mambo*, tethered to the 24-ft. diameter para-anchor, sustained no knockdowns or "barrel rolls" as did her sistership, *Doubloon*.

S/M-3 Pocket Cruiser, "Seraffyn"

Pocket Cruiser, "Seraffyn"

24' 7" x 5 Tons, Full Keel Cutter

9-Ft. Dia. BUORD Parachute

Force 8-10 Conditions

File S/M-3, derived from writings of Lin & Larry Pardey - See article on "Heaving To" in August '82 issue of *Sail* Magazine, also pages 268-274 of *Seraffyn's Oriental Adventure* (W.W. Norton & Co., 1983) and the Pardeys' book entitled *Storm Tactics* (Pardey Books, 1995) - Vessel name *Seraffyn*, pocket cruiser, built by Lawrence F. Pardey, LOA 24' 7" x LWL 22' 2" x Beam 8' 11" x Draft 4' 8" x 5 Tons - Full Keel - Sea anchor: 9-ft. diameter Naval Ordnance (BUORD) parachute on 250' x 5/8" nylon three strand rode with Pardeys' own bridle arrangement & 3/8" galvanized swivel - No trip line - Deployed in the Gulf of Papagayo off Mexico and in the North Pacific during storms with winds of 40-70 knots - Bridle arrangement held the bow 50° off the wind - Drift was estimated to be about 5/8 of a knot.

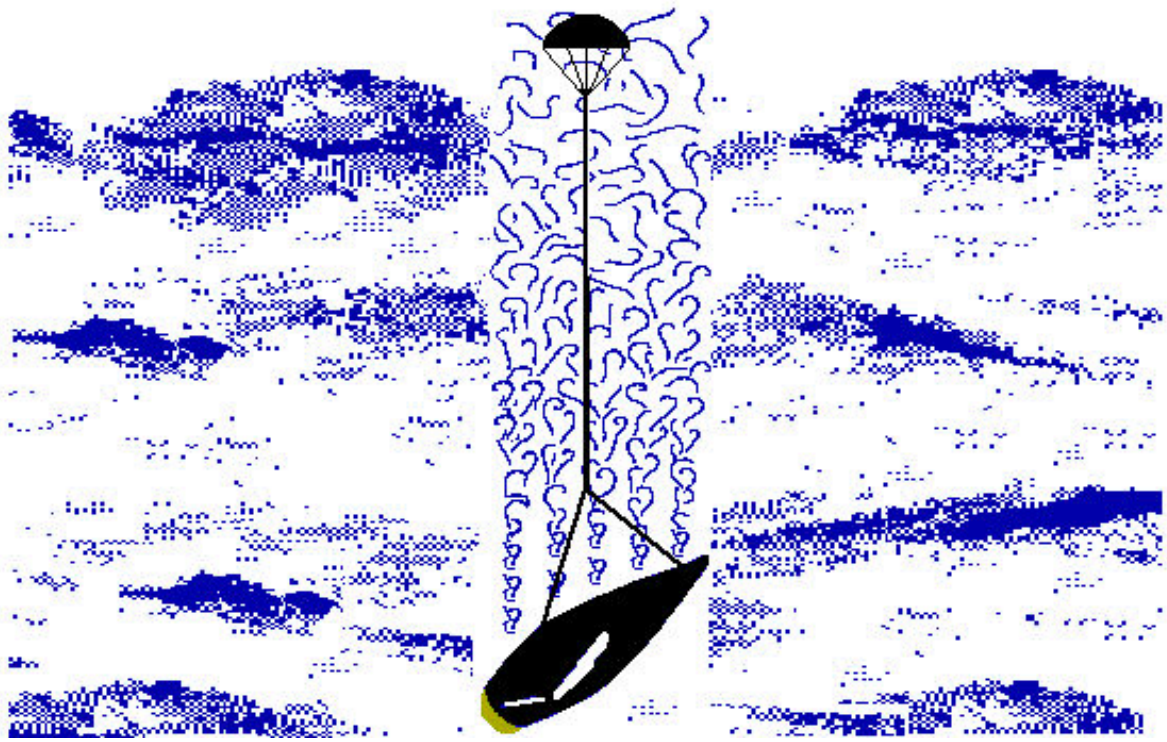
Blue water veterans Lin and Larry Pardey have been using para-anchors since 1970. The one they used on *Seraffyn* was BUORD MK 2 MODEL 3. This parachute is government surplus and has been in use by fishermen for decades. The canopy is fabricated from heavy, nylon mesh material and it has sixteen shroud lines of 1000 lb. Dupont braid. Patrick M. Royce, author of *Sailing Illustrated,* did a series of tests on this parachute in 1969 and nicknamed it *Two Pennant Storm Anchor* (see page 157 of *Royce's Sailing Illustrated*).

Your author refers to these parachutes as "BUORDS" because they were originally developed for anti-submarine warfare use by the Navy's former BUreau of ORDnances - now Naval Sea Systems Command. Carrier-based S-3 Viking aircraft use such small diameter, heavy gauge parachutes to deliver torpedoes and other ordnances from the air. On page 269 of *Seraffyn's Oriental Adventure* the Pardeys show two photographs of the BUORD MK 2 MODEL 3. There is also a picture of Larry Pardey holding one up on page 36 of *Storm Tactics*.

In their original article in *SAIL*, Lin and Larry reported using this para-anchor in conjunction with a steadying sail in the Gulf of Papagayo (off Mexico) in gale force winds. The steadying sail would luff and flog violently as the boat was frequently pulled head-to-wind. Then it would fill and the head of the boat would fall off. This cycle would repeat itself once every four or five minutes - an uncomfortable and noisy affair. So Larry Pardey later rigged up an adjustable fairlead that kept the bow some 45-50° off the

wind, at the same time causing the triple-reefed main to fill quite nicely and dampen the roll. This made the boat heel and lie much more comfortably. As a bonus, Larry found that in this attitude (45-50° off the wind) the boat would "scrape her keel" as she slid slowly downwind, leaving in her turbulent wake a significant "slick" that smoothed the seas, lessening their effect on the boat and gear. "You would be amazed at how this slick breaks down waves and steals their power," wrote the Pardeys to your author. Here is an excerpt from subsequent correspondence (reproduced by permission):

> *We have a preference for the BUORD surplus chute because 1) it is heavily built, with shrouds on our's almost strong enough to lift* Taleisin, *2) it can be purchased quite inexpensively second hand, 3) as it is heavy weight fabric it does not have a tendency to fill with wind when you are deploying it, 4) we have used it since 1970 without problems, and finally, 5) because its fabric stretches when unusual strains come on it, the fabric becomes porous and lets some water sieve through, this absorbs shock loads.*
>
> *Add this to the stretch of the nylon anchor line and we feel that the catenary curve-effect of chains or weights is redundant. We prefer a dead simple system - no floats, no trip lines, no catenary chains. We are also concerned about the move to bigger and bigger chutes. The bigger they are, the harder they are to store, handle and use. We are not sure they stop drift much better - once a chute is 8 to 15 feet in diameter, the drifts recorded by us on our boats, and during tests with modern sailboats off the Cape of Storms* [South Africa], *showed that the drift rate with the relatively small BUORD chute was about the same as that listed throughout the* Drag Device Data Base *for boats using much larger chutes, a drift of between 5/8 and one knot. For monohulls laying at a hove-to position, a smaller chute, combined with the considerable drag of the keel, as shown in the diagram, will produce a wide, effective slick. We can see that multihulls laying head to wind would need the largest chute possible as only the sea anchor is working to create a protective slick.*
>
> *A further thought on chain. As chafe in the bowroller or fairlead is a major concern with any nylon anchor rode (onshore or offshore), we have considered using a 30 foot length of chain for the inboard end of the rode. But as we have not yet done so, we can make no actual comment on this idea.*



PARDEY BRIDLE ARRANGEMENT

Sea anchor rode is led off the bow. Pennant line from cockpit winch causes the bow to lie 50° of the wind. Storm trysail is set and the tiller lashed to leeward. As the boat is pushed downwind her keel begins to shed vortices, which gradually merge into a turbulent field upstream. The intense mixing effect of this turbulence will tend to cancel molecular rotation - the stuff that waves are made of. Note that this strategy requires *square* drift. The boat must not forereach - sail out of her protective "slick." The Pardeys have practical suggestions for ensuring that it does not in their book, *Storm Tactics* - required reading.

To what extent does the turbulence generated by the square drift of the keel affect the shape and ferocity of the waves? The "slick" mentioned by Lin and Larry Pardey is not to be confused with the superficial effects of oil on the surface of the water. It is a more profound phenomenon. It has to do with the turbulent field created by a succession of vortices, technically known as the *Von Karman Vortex Street*.

Vortices are eddies, created by the motion of irregular shapes in fluids. They flow away from the boundary layer and gradually merge into a homogeneous turbulent field in which the turbulence in one part of the field is the same as that in any other part.

Since non-homogeneous ocean waves are created by the orbital rotation of water particles, anything that interferes with that rotation can have an effect in a seaway. Logically, and if the interference is great enough, the resulting turbulent field can de-stabilize - or at the very least smooth down - the wave formations directly ahead of the boat.

S/M-4 Cutter, "Taleisin"

Cutter, "Taleisin"

29' 6" x 9 Tons, Full Keel Cutter

12-Ft. Dia. BUORD Parachute

Force 11-12 Conditions

File S/M-4, obtained from Lin & Larry Pardey - Vessel name *Taleisin*, hailing port Victoria, B.C., cutter designed by Lyle Hess, LOA 29' 6" x LWL 27' 9" x Beam 10' 9" x Draft 5' 3" x 9 Tons - Full keel - Sea anchor: 12-ft. diameter BUORD on 250' x 5/8" dia. nylon three strand rode with Pardeys' own bridle arrangement and 1/2" galvanized swivel - No trip line - Deployed in 100 fathoms during a tropical cyclone about 100 miles off the Queensland coast, with sustained winds of 60-70 knots blowing contrary to the Australian Current, creating confused seas of 25' and greater - Drift was estimated to be about 15 n.m. during 56 hours at sea anchor.

The Pardeys are now cruising on board their new and larger boat, *Taleisin*. The sea anchor for *Taleisin* was a larger - 12-ft. diameter - BUORD parachute. On 1 November 1988, en route to Mooloolaba from Roslynne Bay (Queensland), *Taleisin* safely rode out a cyclonic depression off the Australian coast, hove-to the para-anchor and storm trysail, in the manner described in the previous file (S/M-3). In their latest book, *Storm Tactics*, Lin and Larry describe the storm as "an unseasonable typhoon rammed up against a ridge of high pressure." The wind was blowing contrary to the Australian current, near the Great Barrier Reef. Conditions were atrocious. From *Storm Tactics*:

> *We were forced to lie-to parachute anchor for over 56 hours in winds exceeding 70 knots. (Weather forecasters spoke of winds of 85 in our area). Wind blew against current in only 100 fathoms of water, creating breaking seas, which forced 400-foot freighters to heave-to. We have never before seen waves dangerous enough to stop ships. We could see two of them nearby, maneuvering to keep their bows into the seas for over 12 hours. Yet even in seas like this we were able to bring* Taleisin *through with the only damage limited to chafed lines, chafed nerves, and bruised bodies. Other sailors within 50 miles of us fared far worse; two lost their lives while using other tactics.*

Sometime in those fifty-six hours there was a formidable jerk as "an extra strong gust and an extra steep sea combined to head the boat up and tack." This caused Lin, who was sleeping down below, without the

lee cloth in place, to be thrown out of her bunk against the stove, banging up her teeth and ribs, fortunately not too badly, however. All in all, *Taleisin*, tough little ship, came through with flying colors. But Larry has since opted for a smaller 9-ft. diameter BUORD, which he considers more yielding and better suited to the use of the bridle and riding sail arrangement.

Again, the main idea behind the Pardey strategy is to create a turbulent field upwind, a "slick" that smooths the seas and robs the waves of a great deal of their power. The bridle is adjusted so that the boat lies about 50° off the wind, and the use of a riding sail (storm trysail, triple-reefed main, or combinations of other sails, depending on the particular hull and rig) increases the pressure of the wind on the boat.

The result is that boat, rode and sea anchor are, as a train, drift downwind at about 5/8 of a knot, churning up the sea and setting up the turbulent field ahead of the boat. Note that this is a little different from the traditional method of heaving to - the boat occasionally fore- reaching.

Again: The Pardey strategy requires *square drift*. The yacht should not zig-zag or fore-reach out of her protective slick. She must drift squarely downwind, her keel "scraping" the sea. Refer to *Storm Tactics* for more insights into the Pardey's method of heaving-to.

S/M-5 Steel Schooner

Steel Schooner

75' x 36 Tons, Full Keel

28-Ft. Dia. Parachute Sea Anchor

Force 10-11 Conditions

File S/M-5, obtained from Jeremiah Nixon, St. Louis MO. - Vessel name *Goodjump II*, hailing port St. Louis, steel Schooner, designed by George Sutton, LOA 75' x LWL 62' x Beam 15' x Draft 6' 2" x 36 Tons - Full keel - Sea anchor: 28-ft. diameter C-9 military class parachute on 600' x 1-inch nylon three strand rode, with 5/8" galvanized swivel - No trip line - Deployed in deep water during a storm near 39° 50' N, 49° 30' W (mid-Atlantic) with winds of 60 knots and seas of 18' - Vessel's bow yawed 10° - Drift was about 18 n.m. during 18 hours at sea anchor

Goodjump II was sailing to Portugal from the U.S. east coast. The skipper, Jeremiah Nixon, had purchased a para-anchor from the author's company. It was a 28-ft. diameter C-9 military parachute, converted into a sea anchor. This parachute has been a staple of the Armed Forces for decades, and is still in use by the Air Force. You can tell a C-9 by the colors of the canopy, either red and white, or a combination of red, white, gold and olive drab. C-9s have 28 suspension lines.

Shane Victor has handled hundreds of C-9's to date, each and every time with awe and amazement. Little wonder World War II pilots used to refer to their parachutes as "silken angels." Light in weight, resilient and strong, a military parachute (not to be confused with lighter sport parachutes) embodies eighty years of development and refinement. Government contracts require that C-9 parachutes be able to negotiate dynamic loads of 5,000 lbs. without failure - they have to be test-dropped from aircraft flying at high speeds with dummies attached.

When *Goodjump II* ran into a storm in the middle of the Atlantic, the crew decided to put out the chute. They had some initial difficulty in getting the big canopy in the water. The wind took hold of it on deck and it was almost airborne . The crew persevered, however, and finally had the chute properly deployed on 600 feet of nylon rode. *Goodjump II* rounded up into the seas, her bow nicely snubbed to her parachute sea anchor in 18-ft. seas. Transcript:

> *The para-anchor worked perfectly, we rode nicely. Learned the hard way to deploy it from the windward side of the boat by pushing it right into the water while holding it against the side of the boat. It got loose on our first effort on the lee side and went into the air.*

You asked the question of the angle and movement of our bow during the storm. I cleated the rode to the forward port cleat and as a result the bow held about 10° to the right of the wind and there was no swing from side to side that I noticed. In fact the deck was dry and there was no spray or pounding. The 600 feet of rode stretched and raised out of the water at the point of wave crest and then came back down with an easy controlled feeling.

We drank beer and ate chili during the worst and I got a solid 6 hours of sleep at a time when we had to wear a safety harness because of wind when we went forward to check on chafe.

No trip line is necessary. Just motor up to it and bring it up. These are some of the reasons why I consider this equipment the most important safety item on my boat.... I will never make an ocean passage without one on board. People must realize that ocean cruising can be safe if you go with the idea that you will go into a defensive position before the seas build too high. The flat-out philosophy of professional racers must be disregarded by the small crew cruising yachts

(**Note**: The problem of the wind inflating parachutes prematurely on deck can be minimized by wetting down the parachute beforehand. Nylon cloth is much more manageable and less likely to fly open in the wind when wet and heavy. The other alternative is to use a deployment bag.)

S/M-6 J-30 Sloop

J-30 Sloop

30' x 3.75 Tons, Fin Keel Sloop

9-Ft. Dia. BUORD Parachute

Force 11 Conditions

File S/M-6, obtained from Paul C. Brindley, Houston TX. - Vessel name *Heaven & Hell*, hailing port Houston, J-30 sloop, designed by Rod Johnstone, LOA 30' x LWL 25' x Beam 11' 6" x Draft 6' 6" x 3.75 Tons - Fin keel - Sea anchor: 9-ft. diameter BUORD on 300' x 3/4" nylon three strand rode with no swivel used - No trip line - Deployed during a storm in deep water in the Gulf of Mexico, about 120 miles Southeast of Galveston, with winds of 60 knots and combined seas of about 30' - Vessel's bow yawed about 10° - Drift was .5 -.7 knots during 4 hours at sea anchor.

This is the first file that Victor Shane documented after starting Para-Anchors International in 1981.He comments that it tends to stick in the mind, like that first high school date. It is an important file in other respects as well. The boat, a fin-keeled J-30, rode very well to the 9-ft. BUORD parachute. Up to that time conventional wisdom had it that sea anchors were useless on board so-called "modern fin-keeled sailboats." This was a turning point of sorts.

In a letter to Victor, dated 2 November 1986, Donald J. Jordan, author of widely publicized articles on capsize prevention and inventor of the *series drogue* wrote the following (reproduced by permission): "Dr. Brindley called and gave me a comprehensive description of his experience.... As you say, the J-30 rode very well in that type of wind and sea. This is the first well-documented instance of a modern sloop riding properly with a sea anchor from the bow."

The 9-ft. diameter BUORD pulled the bow of this yacht into 60-knot winds and 30-ft. seas in a satisfactory way. It kept it there for four hours. However, the crew had inadvertently omitted to use a swivel on the parachute terminal, and the canopy's rotation resulted in a fouled-up useless mess of parachute and kinked-up rode.

After retrieving the mess and stowing it the best they could the crew then used the boat's inboard engine to jog into the seas. Apart from a few near knock-downs, *Heaven & Hell* emerged from the ordeal intact. From Dr. Brindley's handwritten feedback:

> *The drogue* [meaning sea anchor] *worked well. We could have eaten soup below until it twisted shut as we had inadvertently left off the swivel. We made about .5-.7 knots sternway, checked by the Loran. It went to 4-5 knots when the chute twisted shut. I much preferred the bow into the waves.*

S/M-7 Pilot Cutter

Pilot Cutter

32' x 5 Tons, Full Keel & Cutaway Forefoot

9-Ft. Dia. BUORD Parachute

Force 8 Conditions

File S/M-7, obtained from Dennis Lueck, Pensacola FL. - Vessel name *Wind Song*, hailing port Pensacola, Pilot Cutter designed by Frank Parrish, LOA 32' x LWL 20' x Beam 9' x Draft 5' x 5 Tons - Full keel & cutaway forefoot - Sea anchor: 9-ft. Diameter BUORD on 300' x 1/2" nylon three strand rode with 1/2" galvanized swivel - No trip line - Deployed during passage of frontal trough in shallow water (6 fathoms) off the Florida coast with winds of 35-40 knots and choppy seas of 8 feet - Vessel's bow yawed as much as 90° off to each side in the gusts.

Wind Song, a brand new Pilot Cutter, was being sailed from Tampa to her home port of Pensacola when a weather front arrived. The crew decided to play it safe with the new boat and deployed a 9-ft. BUORD, in 6 fathoms of water, about 30 miles offshore and due west of Bayport, Florida. The parachute did not do a satisfactory job of pulling the bow of *Wind Song* into the seas. The boat would get beam-on to the seas in the gusts. Notwithstanding, the motion was still much better than lying a-hull. Here is a transcript of her owner's feedback:

> *After rounding up to deploy the sea anchor, we forgot to return the rudder amidships, so it was hard to port all night (and not discovered till morning). As a result (I believe) the boat would get beam-on to the seas in the gusts and then roll. As it was, the motion was still much better than lying a-hull....*
>
> *The rode did hit the bobstay and whisker stays quite often but did not chafe. We tried the "Pardey Bridle," but the snatch block stayed against the hull and we were afraid of chafe....*
>
> *Incidentally, the boat was brand new and we were bringing it home. It had been dead calm and we were motoring north about 50 miles north of St. Petersburg when the front came through. As we had no sailing experience with this boat and it was night, we elected to heave-to with the sea anchor. Today, with similar conditions, we would sail the boat reefed down.*

Why didn't the sea anchor pull the bow of this yacht into the seas? The problem of side-to-side yaw is related to the shape of the hull and keel, the position of the CLR (center of lateral resistance), the type of rig and the position of the CE (center of effort). It is most aggravated when the CLR is well aft and the CE well forward. This gives the wind a larger lever to push the bow off.

Boat design has always been the art of compromise and naval architects have seen the cutaway forefoot as something that enhances the course-keeping qualities of a yacht and lessens her tendency to broach in strong following seas. As long as such a yacht is sailing forward her underwater profile resembles an arrow in flight. The trade off, of course, is her behavior at anchor.

More than likely, however, *Wind Song* just didn't have enough wind. *Seraffyn* has unevenness associated with her underwater shape as well, but recall the Pardeys' words in File S/M-3, "If there was a lot of wind, the para-anchor held her pretty close to head to wind."

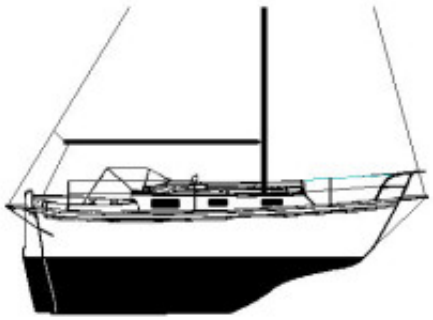
S/M-8 Vancouver 27 Cutter

Vancouver 27 Cutter

27' x 5 Tons, Full Keel & Cutaway Forefoot

9-Ft. Dia. BUORD Parachute

Force 7 Conditions



File S/M-8, obtained from Anthony Gibb, Victoria, B.C. - Vessel name *Hejira*, hailing port Victoria, Vancouver cutter, designed by Robert Harris, LOA 27' x LWL 22' x Beam 8' 6" x Draft 4' x 5 Tons - Full keel & cutaway forefoot - Sea anchor: 9-ft. diameter BUORD on 275' x 1/2" nylon three strand rode with 1/2" galvanized swivel - No trip line - Deployed during passage of frontal trough In deep water in the Tasman Sea with winds of 35 knots and confused seas of 12 feet - Vessel's bow yawed as much as 90° off to each side.

Hejira, a Harris-designed Vancouver 27 on a world cruise, crossed from Nelson, New Zealand, to Sydney, Australia in 15 days, a distance of 1,265 miles.

As with most other crossings of the Tasman this one was not a pleasant one. The crew was harassed by a confusion of waves and swells from both southwest and northeast, which harassment did not end until the last two days of the crossing.

During a period of 30-35 knot south-westerly winds and 12-foot seas the crew deployed a 9-ft. diameter BUORD. As in the previous file, the parachute did not do a satisfactory job. Transcript:

The BUORD never set straight forward off the bow. It remained directly off the beam. It gave one the feeling of lying a-hull. It was only when a particularly large wave approached and took up the slack in the rope that the BUORD brought the bow through the wave....

The only other time that the BUORD brought the bow into the waves was when, after 4 hours, I decided to pull it in. When the line was pulled in so that there was only 50 feet out, then it seemed that the bow wanted to stay pointed upwind. I did not leave it there long enough to test it, so I don't know what the BUORD would do in the long run....

Again it might be asked why the same parachute that pulled the bow of a fin-keeled J-30 into the seas (File S/M-6) would not do the same thing for a Vancouver 27. And again, the answer has to do with the

amount of wind, the keel configuration, the rig, and the relative positions of the CLR and CE on the different boats. The J-30 has a small, centrally located fin keel. The Vancouver 27 has a full keel with a cutaway forefoot. The J-30 had sustained winds of 60 knots. The Vancouver had winds of 35 knots.

A larger parachute sea anchor might have made a difference as well. We would like to emphasize that the canopies of these BUORDs are made of coarsely woven mesh material, "the sort of thing you would use to strain plankton out of the sea with" as one sailor described it. Although they have a nominal diameter of about 9 feet, they do not have the holding power of a 9-ft. diameter, zero-porosity sea anchor. Remember, they are designed for dropping torpedoes into the sea and need to have a great deal of "give" built into their canopies.

By coincidence, the Pardeys ran into Anthony Gibb in Australia, and had this to say to Victor Shane in another letter: "Later discussions make us wonder if he had enough wind, or possibly her laying so far off the wind might have been caused by her high bow, the tanks stowed on her foredeck and a very high deck house, combined with a cutaway forefoot."

S/M-9 Hunter 40 Sloop

Hunter 40 Sloop

40' x 9 Tons, Fin Keel

9-Ft. Dia. BUORD Sea Anchor

Force 9 Conditions

File S/M-9, obtained from Captain Jerry Sidock, Fort Myers Beach, FL. - Vessel name *Bounty Hunter*, hailing port Fort Myers Beach, Hunter sloop, designed by Warren Luhrs, LOA 40' x LWL 32' 6" x Beam 13' 6" x Draft 5' x 9 Tons - Fin keel - Sea anchor: 9-ft. Diameter BUORD on 300' x 5/8" nylon three strand rode with 1/2" stainless steel swivel - Full trip line - Deployed in a gale in shallow water about 100 miles off the coast of Venezuela, with winds of 40-50 knots and seas of 15 feet - Vessel's bow yawed 20°-30° off to each side - Drift was 11 n.m. (confirmed by Loran & Satnav) during 14 hours at sea anchor.

Bounty Hunter, a fin-keeled Hunter 40, was on her way to Rio from Florida when she ran into a gale some 100 miles off the coast of Venezuela. The owner of the boat, Captain Jerry Sidock, being single-handed and tired at the time, deployed a 9-ft. BUORD off the bow. In one of several telephone conversations with Victor Shane, Captain Sidock reported that the bow held into the seas in a satisfactory way, yawing as she would at ground anchor, 20-30° off to each side, but certainly no more than 30°.

Note the same parachute sea anchor being used by different boats with varying results. Compare *Bounty Hunter*'s underwater profile with those of the Pilot Cutter and the Vancouver 27 in the preceding files. *Bounty Hunter* has a more symmetrical underwater profile, her center of lateral resistance being a little closer to the center of effort of her rig. Additionally she was in stronger winds as well. Note however that her bow did yaw up to 30° off to each side, indicating that the yacht could do with a larger sea anchor

Captain Sidock knows the Caribbean Islands well. In his voyages to the Caymans, Jamaica, Roatan, Belize, Honduras, Guatemala and South America he often uses the BUORD off the stern for rest periods. There is then hardly any side-to-side yaw at all.

Note that there is nothing wrong with using a sea anchor off the stern for rest and recuperation, drift control and damage control in moderate conditions. Moreover, for non heavy weather use the rode need not be very long either. Deploy the parachute, pay out a hundred feet of line and cleat it off. Now you can rig the awning over the boom, prepare a meal in peace and relax for a while, the whole ocean your own private anchorage. From Captain Sidock's handwritten feedback:

I would like to say that I don't think that common sense would permit me to leave shore without my sea anchor. It is just too difficult at times to continue on when short-handed, or rather single-handed, as I am most of the time. It is at that time that I look for assistance from other sources, such as a sea anchor.

S/M-10 Hinckley Bermuda 40 Yawl

Hinckley Bermuda 40 Yawl

40' x 10 Tons, Full Keel & Centerboard

12-Ft. Dia. Sea Anchor

Force 8 Conditions

File S/M-10, obtained from the owner of the boat - Vessel name *Windswept,* hailing port Gloucester MA., Hinckley Bermuda yawl, designed by Bill Tripp, LOA 40' x LWL 28' 10" x Beam 11' 9" x 10 Tons - Full keel with centerboard drawing 8' when down and 5' with the board raised at sea anchor - Sea anchor: 12-ft. Diameter *Para-Tech* on 400' x 1/2" nylon three strand rode with 5/8" galvanized swivel - No trip line - Deployed during passage of frontal trough in shallow water (30 fathoms) off the coast of Maine, with winds of 35-40 knots and seas of 8-10 feet - Vessel's bow yawed less than 10° - Drift was estimated to be 2 n.m. during four hours at sea anchor.

The 12-ft. diameter Para-Tech sea anchor was deployed in a low system, about thirty miles offshore, near Portland, Maine. Transcript:

> *This was not a whole gale or survival storm. I was alone, wanted to rest, wanted to minimize drift, and wanted to experiment with my sea anchor. After deployment my yawl lay absolutely bow to the wind and waves with very little yawing. My boat does not have a cutaway forefoot, the board was up and the waves were not high enough to blanket the wind when the boat was down in the troughs.*
>
> *With 400 ft. of rode there was absolutely no shock loading at all. No feeling of either being pulled through the waves or falling backwards on the rudder. My boat rode like a duck up and over each wave always nose to the wind. Altogether a very pleasant, safe and secure feeling.*
>
> *The only two things I worried about were (a) commercial fishing interests in the area not seeing me and running over my anchor line, (b) cross waves approaching from the side of the boat and rolling her. With no sail set there is nothing to steady the boat side to side.*

The Hinckley Bermuda 40 has a symmetrical full keel with considerable overhang at both ends (the waterline length of the boat being only 28' 11"). This particular Hinckley also has an auxiliary centerboard, which was in this case raised at sea anchor. Even so, she behaved well and pointed very high into the seas, doubtless because of the aft windage of her rig. Look for the relative positions of the CLR and CE and you will see a recurring pattern in all the monohull files.

S/M-11 Venture 222 Sloop

Venture 222 Sloop

22' x 1 Ton, Centerboard Keel

12-Ft. Dia. Sea Anchor

Force 3-4 Conditions

File S/M-11, obtained from Harley L. Sachs, Houghton MI. - Vessel name *Gamesmanship*, hailing port Houghton, Venture 222 sloop, designed by Roger MacGregor, LOA 22' x LWL 18' 6" x Beam 7' 4" x Draft 4' 6" x 1 Ton - Centerboard swing-keel - Sea anchor: 12-ft. Diameter *Para-Tech* on 100' x 3/8" dia. nylon three strand rode, with 5/16" stainless steel swivel - No trip line - Deployed during passage of frontal trough in shallow water (7 fathoms) on Lake Superior with wind gusting to 20 knots - Vessel's bow yawed 10° with the swing-keel down and 45° with the swing-keel fully raised.

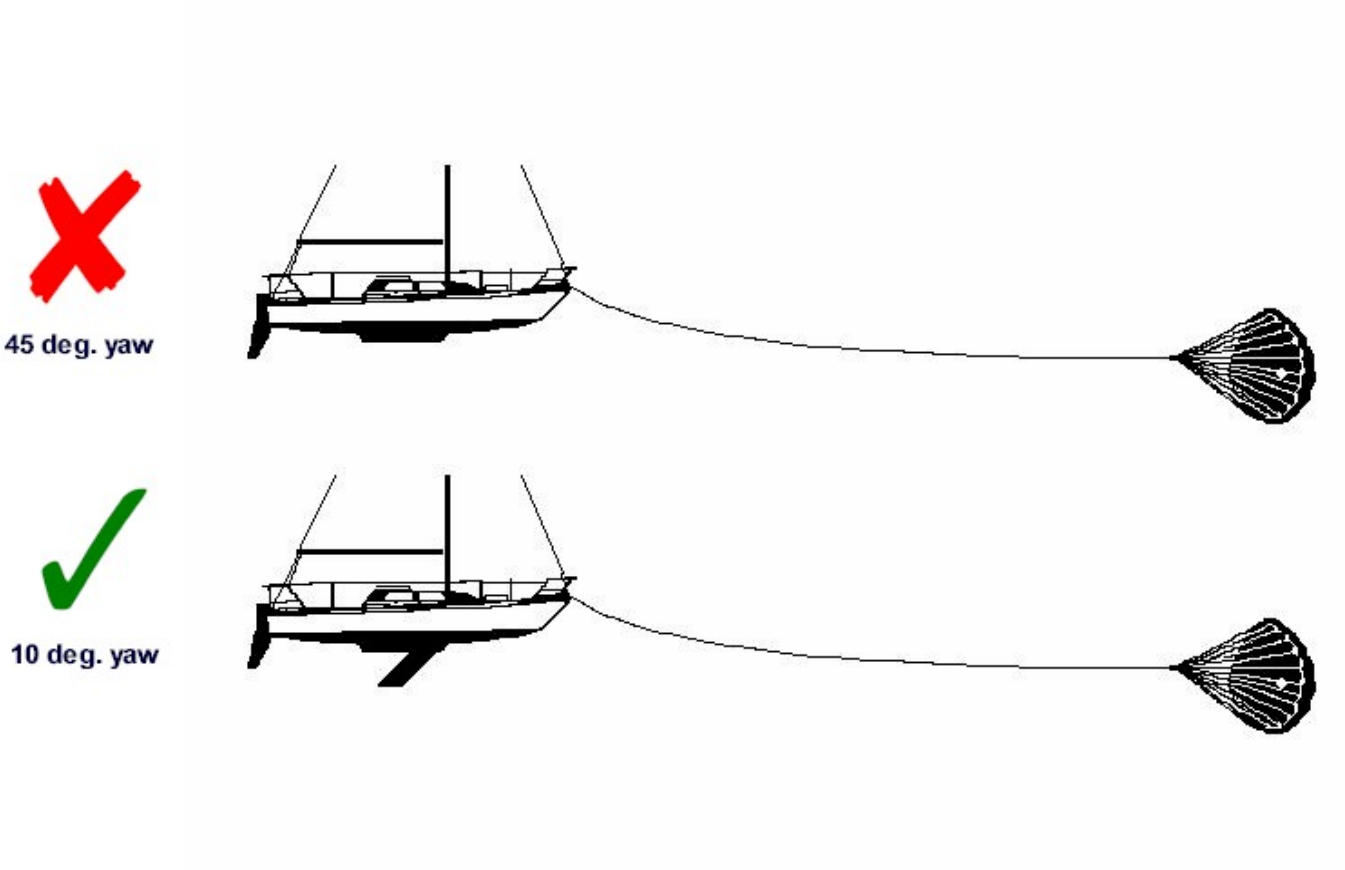
Way back in June 1988 Victor Shane sent a letter to the editor of *Cruising World Magazine*, asking for feedback on sea anchors and drogues. Mr. Harley Sachs read the letter and responded with the following feedback:

> *For your database: Vessel, MacGregor Venture 222 sailboat, swing keel, transom hung spade rudder, LOA 22 feet, weight about 2,000 lbs. Conventional wisdom (Chapman and the boating supply catalogs) suggested a 30-inch conical drogue sea anchor. This does not work with my boat.*
>
> *My wife and I decided to test this equipment on a breezy day with four-five foot waves on Lake Superior. I launched the 30-inch cone from the bow on about fifty feet of line and lowered all sail. The boat assumed a position with the seas abeam and would not face into the waves no matter what the rudder position was. With the sea anchor shifted to the stern, the result was the same. The motion of the boat was violent and I could hardly move about on deck.*
>
> *I hoisted a small riding sail on the back stay. This had an immediate, remarkable damping effect on the boat's motion but did not cure the beam-on attitude of the boat to the seas. The 30-inch conical drogue was pronounced a failure.*

Sachs turned out to be a multi-faceted sailor who was, among other things, writing a book on nautical

humor (*Irma Quarterdeck Reports*, Wescott Cove Publishing, 1990). Shane mentioned the similarity between his disappointing experience with the small cone and those documented by Adlard Coles in *Heavy Weather Sailing*, and then asked if Sachs would consent to trying out a 12-ft. diameter parachute sea anchor. This was to be a "controlled experiment" - same boat, same conditions, but a much larger sea anchor. He agreed, and Shane sent him the sea anchor. Three months later he tried it out in similar conditions and sent back the following report:

> *Subject: Test of 12-ft. diameter para-anchor. With westerly winds gusting to 20 mph after the passage of a cold front, we motored offshore to a point outside the Lower Entry harbor on Keweenaw Bay of Lake Superior. With the engine shut off we drifted about 1 knot downwind with the wind and waves off the stern quarter, the same attitude I experienced when unsuccessfully testing my 30-inch conical drogue.*
>
> *About a mile offshore, in about forty feet of water, I set up the 3/8" laid nylon rode to launch the para-anchor.... As instructed, I launched the float first, which functions as a pilot chute, drawing the para-anchor away from the boat as the boat drifts downwind. This could hardly be easier, for the chute slid overboard and in two or three minutes filled beautifully. Once it filled, it stuck in the water almost like a post and the Venture 222 bow came right up into the wind exactly.*
>
> *With the keel down the Venture did not yaw more than 10°. With the keel retracted, there was 30°-45° of yaw, as the Venture bottom has almost no lateral resistance with the keel retracted. Rudder was tied amid-ships.*



When retrieving the sea anchor, one cannot pull the anchor to the boat. One pulls the boat to the anchor, and that takes strength. I'm glad it wasn't a three ton vessel! Once I could reach the parachute strings, it was dead easy to spill the water out and haul it aboard. Took no effort at all, pulling one string. Once spilled, the para-anchor is a limp sack.

We did drift slightly with the anchor. In six minutes the bearing on the lighthouse half a mile away had shifted by ten degrees.... In spite of the holding power, the para-anchor is in a fluid, and the force exerted against it will cause it to slip through the water.

Apart from showing the improvement that can be expected with the use of sea anchor that is large enough, this file reveals something important about centerboards and swing keels as well.

It was previously thought that sailboats would yaw less at sea anchor with their centerboards and keels raised. Not so. At least not on this boat. Apart from tripping on the rudder as the boat surges backward, the CLR moves aft as well. With the CE now so far forward the bow will tend to yaw excessively. When the swing keel is again lowered, however, the CLR moves closer to the CE and the wind doesn't have the same lever. Notwithstanding, boards - and swing keels - should NOT be lowered all the way down in

storms.

CAUTION: Lowering board/s and keels, or lowering them all the way, may give the yacht something to trip over in life-threatening storms. By and large, and as an important rule of seamanship, boards and keels should be raised in heavy weather. Or at least raised enough so that the yacht can "slip-slide," and not have a large appendage to hang up on and trip over.

S/M-12 Carter 33 Sloop

Carter 33 Sloop

32' 7" x 4.5 Tons, Fin Keel

12-Ft. Dia. Sea Anchor

Force 8-9 Conditions

File S/M-12, obtained from Steven Callahan, Ellsworth, Maine - Vessel name *Karpouzi*, hailing port Lamoine, sloop, designed by Dick Carter, LOA 32' 7" x LWL 25' x Beam 11' x Draft 5' 6" x 4.5 Tons - Fin keel - Sea anchor: 12-ft. diameter *Para-Tech* on 250' x 5/8" nylon three strand with 1/2" galvanized swivel - No trip line - Deployed during a gale in deep water north of Bermuda, with winds of 35-45 knots and seas of 8-12 ft. - Vessel's bow yawed 30° off to each side with two opposing sets of waves approaching from dead ahead and dead astern - Drift was estimated to be 3.25 miles during 4 hours at sea anchor.

Steven Callahan is well-known for his best seller, *Adrift*. The book is a journal of the seventy-six days that he spent drifting in a life raft after his 21-ft. sloop *Napoleon Solo* hit an unidentified object and sank in the middle of the Atlantic on 4 February 1981. He journeyed to the limits of human despair in those seventy-six days, yet in the end cheated death and emerged a survivor. *Adrift* (1986, Houghton Mifflin Co.) won the Salon du Libre Maritime award and has been translated into twelve languages.

Callahan has been involved in many areas of the marine industry since 1968. He has logged tens of thousands of blue water miles, including one single-handed and three double-handed Atlantic crossings. A former contributing editor to *SAIL* and to *SAILOR*, he wa at the time of this writing associate editor of *Cruising World.*

Victor Shane delivered a 12-ft. diameter Para-Tech sea anchor to Callahan in 1989, for use and evaluation on board his boat *Karpouzi*, a fin-keeled Carter 33 sloop. The para-anchor was used a year later, in a Force 8 gale north of Bermuda. Here is a transcript of Callahan's feedback

On 28 May, 1990, Karpouzi *and her three merry crew were completing a delightful week of sailing from St. Martin, and approaching Bermuda. We planned to bypass the island and continue directly to Maine. Our weather, however, was deteriorating, and the forecast was for a day or so of rain and winds of 20 knots.*

By midnight the barometer began to fall more rapidly - about .05 inches per hour, and we were broad reaching fast under double-reefed main and working jib. We could hear Bermuda Harbor Radio, about

30 miles east of us. Harbor radio was busy with incoming traffic problems and reports of a developing low that no one had paid much attention to. Through the night they logged winds to 42 knots and predicted seas to 25 feet.

As we proceeded north, the wind strengthened and backed slightly so that we ran dead before waves that I estimate to have been 10-15 feet. All was under control. The barometer began to rise by 06:00 on 29 May and the wind lightened slightly for about a half hour, but then the wind came up hard again and continued to back. In a very short time we were hit with heavy head winds and significantly rising seas from dead ahead, while we continued to surf down 10 foot waves from dead astern.

In 50,000 miles of offshore sailing I have often dealt with heavy seas from a variety of directions, but that was the first time that significant waves approached each other from precisely opposite direction. This, of course, set up a dreadful sea state. When crests coincided, the peaks jumped skyward and the wave slopes were very steep. (Note, in the attached DDDB form, wave height, period, and length
are very *approximate values because they were all extremely variable due to 180° wave collisions - a bit like being in a blender). I estimated wave height by standing on the cabin top - my eye level about 10 feet above water.*

Karpouzi*'s beam is 11 feet, or the average size of the breaking waves, so I declined Neptune's invitation to get rolled by laying broadside to the waves. We could not carry much sail in the wind, and in any case, heaving-to or beating would put the boat too far off of the approaching waves, increasing the danger of being stalled, pushed back, and rolled. The* only *feasible solution was to put out the sea anchor. We decided to set the sea anchor just as we would a regular anchor.... We keep the anchor in its own locker in the head of the V-berth, with the rode flaked under it. This allows us to run the rode straight aft, out of the cabin, and forward over the anchor roller.... As I dunked the anchor over, we threw the engine in neutral and drifted back. The parachute opened perfectly and within thirty feet it began pulling, allowing us to pay out line and adjust things just right. A few waves towered above me and one slammed over the foredeck just irritatingly above boot level.*

We payed out about 250 feet of the rode and adjusted the length every 30 minutes to avoid chafe. This length proved enough; the sea anchor sometimes neared the surface so we could see it and it rode about a wave trough away from us. I chose not to use a tripping line to avoid any possible foul up, but we tied a huge Norfloat *ball to the float line, which we could easily see from far away.*

The boat did sway from side to side, creating huge side loads on the anchor roller cheeks, so be advised to use either very sturdy chocks or heavy roller. Ours was a heavy duty universal roller that is advertised for boats to 54 feet, but I believe the side loads on a 54 foot boat would have bent the roller in half. As it was, I was a bit worried. To control sway and remove these side loads, next time I will likely set the sea anchor from a regular chock and possibly haul it off to the side with a rolling hitch and secondary rode to lay 20 to 30 degrees from nose onto the waves. Note that the rode jumps up as the bow plunges downward, so whatever chock you use should have a positive lock across the top.

The only real problem we encountered was a very heavy loading on the steering gear. Karpouzi *is tiller steered and at first we just tied it off, but as large waves broke on her, she surged aft, stretching the anchor rode until stopped and pulled forward again. The rudder was yanked mightily by the backward motion and the tiller wiggled about like a snake. Our solution was to give the tiller a shock absorber, just*

as the nylon anchor rode acted as a shock absorber for Karpouzi. *We tied half inch shock chord to the tiller, which allowed it to move 20 or 30 degrees without much problem but prevented the rudder from going hard over, where it could shear off its fittings.*

> *After only four hours on the sea anchor, the wind continued to back and lightened, so that finally we were laying broadside to the now calming waves. It was quite uncomfortable and more dangerous than setting sail. With full throttle we were able to easily retrieve the rode as we steamed up to the pickup float, which we noted had enough windage to float to leeward of the anchor most of the time, so we had no worry about tangling the sea anchor lines. It was a simple matter to pick up the float, trip line, and anchor. Within 20 minutes all was stowed away and we were off.*
>
> *We drifted 3.25 miles in those four hours, which is a bit more than I expected, but currents around Bermuda are very uncertain. Further tests will compare* Karpouzi*'s normal drift rate with her drift with the sea anchor set. I will certainly be more eager to set the sea anchor in marginal conditions in the future.*

It is disappointing to note that *Karpouzi*'s bow was yawing 30° off to each side (i.e., through a total arc of 60°). By all tokens the sea anchor was big enough to have done a better job.

Victor Shane suspects that the conflicting waves - approaching from ahead and astern - might have had something to do with this. Certainly the angle of yaw will have a great deal to do with the amount of slack that finds its way into the system as well. Much of this slack can be a result of orbital rotation causing convergence between boat and sea anchor. Essentially the wind pushes the boat away from the sea anchor, keeping the system taut. Orbital convergence, however, can move the boat and sea anchor toward one another, introducing slack into the rode, sometimes by an amount equal to twice the wave height (twenty feet of slack rode in ten foot seas, for example). Callahan reports significant waves approaching each other "from ahead and astern." Here, not only do we have the rotation associated with the waves approaching from ahead, but also, possibly, the rotation associated with waves approaching from astern, as evidenced by the heavy loads on the rudder, mentioned. This combination could have the effect quadrupling the amount of slack - and attendant yaw - when the crests of the secondary waves coincide with the troughs of the approaching waves.

S/M-13 Bristol Channel Cutter

Bristol Channel Cutter

26' x 7 Tons, Full Keel

9-Ft. Dia. BUORD Sea Anchor

Force 8 Conditions

File S/M-13, obtained from Gary Kaye, Sidney B.C. - Vessel name *Mintaka II*, hailing port Vancouver B.C., designed by Lyle Hess, LOA 37' (with long bowsprit) x LWL 26' x Beam 10' x Draft 5' x 7 Tons - Full keel - Sea anchor: 9-ft. diameter BUORD on 300' x 5/8" nylon three strand rode with 1/2" galvanized swivel - No trip line - Deployed in a whole gale in deep water approx. 140 miles west of Coos Bay (Oregon coast) with wind sustained at 40 knots and seas of 20 ft. - Use of the "Pardey Bridle" arrangement held the bow 50° off the wind. Drift was estimated to be about 50 n.m. during 52 hours at sea anchor.

In August 1987 *Mintaka*, a Lyle Hess designed Bristol Channel Cutter, was headed for San Francisco from Victoria B.C., when she ran into a whole gale at about latitude 44° N, longitude 127° W, (some 140 nautical miles west of the Oregon Coast). Gary and Sandi Kaye deployed a 9-ft. diameter BUORD parachute, using the Pardey bridling method (see files S/M-3, 4). All told, this traditionally designed, heavily built cruising yacht was hove-to for 52 hours, the wind sustained at 40 knots and seas of 20 feet.

Since there were no written notes, opinions or observations accompanying the DDDB form that Victor Shane received from these intrepid sailors, it was likely a matter of routine seamanship. Victoria, has a rich seafaring history. It is the hailing port of *Taleisin*, as well as a number of other boats in this database. It is inspiring to find boats like *Mintaka* following in the Voss/Pardey tradition of safe voyaging under mast and canvas. When one of these boats get into heavy weather the crew members are not wanting for a tactic. They heave-to, ride out the storm, and quietly resume their cruising.

S/M-14 Carol Sloop

Carol Sloop

24' 6" x 2.7 Tons, Full Keel

9-Ft. Dia. BUORD Sea Anchor

Force 6-7 Conditions

File S/M-14, obtained from Walter Keintzel, Monterey, CA. - Vessel name *Deanna*, hailing port Monterey, "Carol" double-ender designed by Chuck Paine, LOA 24' 6" x LWL 20' x Beam 9' x Draft 3' 6" x 2.7 Tons - Full keel - Sea anchor: 9-ft. diameter BUORD on 300' x 1/2" nylon three strand with 1/2" galvanized swivel - Deployed in deep water off the central coast of California in low system with winds of 30 knots and seas of 10 feet - Vessel's bow yawed up to 80° - Drift was about 7 miles during 11 hours at sea anchor.

Victor Shane had the opportunity to take a close look at *Deanna* when she was moored in Santa Barbara harbor. This little pocket cruiser has a flush deck, with very low freeboard and a large full keel beneath. When *Deanna* is lying a-hull she is more or less anchored to the surface of the ocean by virtue of her big keel alone. Her rate of drift is further reduced because of her low freeboard. In general a yacht has to *drift*, to tug at a sea anchor, to cause it to fully inflate and function properly. In 60-knots of wind the same BUORD would have done a better job on this boat. A much larger parachute, say a 24-ft. diameter military chest reserve, would likely have pulled *Deanna*'s bow up much higher into the wind as well, even in the given 30 knots. Here is a transcript of the feedback obtained from Walter Keintzel:

> *Location was 55 miles true west of Pt. Sal, measured by the Loran. I don't recall the barometer reading, but it was "normal." Don't recall the wave length & period, because when I deployed the sea anchor at 20:00 hrs. I was very, very exhausted & numb.*
>
> *We lay at 80° to the nylon rode - almost parallel to the seas. I think this is because my flush-decked boat got lost in the troughs - not enough windage! With a riding sail on the back stay, I think it would work. As it was, it wasn't too bad.*
>
> *Mainly the anchor kept me in place for a stormy night, and kept my physical condition from deteriorating to the point where I needed to call the Coast Guard. Next day I ran into Morro Bay for rest & repairs.*
>
> *I'm very grateful for the parachute anchor. It was easy to deploy, but next time I'll certainly use a 300' trip line. Retrieval was like pulling a VW for fifty minutes!*

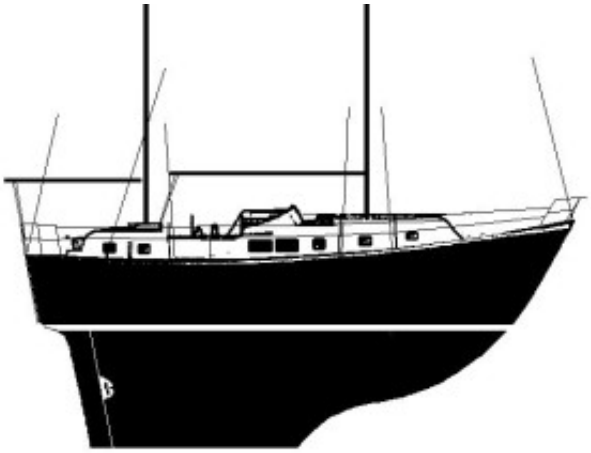
S/M-15 Whitby 42 Ketch

Whitby 42 Ketch

42' x 11.75 Tons, Full Keel & Cutaway Forefoot

12-Ft. Dia. Sea Anchor

Force 8 Conditions



File S/M-15, obtained from Bruce Stewart, Ithaca, NY. - Vessel name *Osteoflyte*, hailing port Ithaca, Whitby ketch designed by Ted Brewer, LOA 42' x LWL 33' x Beam 13' x Draft 5' x 11.75 Tons - Full keel & cutaway forefoot - Sea anchor: 12-ft. diameter *Para-Tech* on 300' x 3/4" nylon three strand with 5/8" galvanized swivel - Deployed in deep water 150 miles east of Cape Hatteras in a low system with winds of 35 knots and seas of 20 feet - Vessel's bow yawed 45° - Drift was about 2.5 miles during 20 hours at sea anchor.

Ordinarily the ketch rig places the CE (center of wind effort) a great deal more forward than sloop, cutter, or yawl rigs. Unless a mizzen can be flown most ketches will tend to "hunt" at anchor. Transcript:

We were 150 miles off Cape Hatteras in 20' seas and deteriorating weather, when we fouled our prop reducing sail. We needed a break so I decided to deploy the chute (this was the first time other than a fair weather practice). We sent the unit off the stern [flying set] *on a new 3/4" three strand nylon rode and it went out so fast I got a rope burn I'll never forget. The bow swung as expected and the rode went out a smooth bow skene chock with a good fairlead.*

We hung on the chute for 20 hours. The conditions were NASTY, but we could still get to the bow and fuss with the rode. We had a terrible problem with chafe. We tried "freshening the nip" and all sorts of commercial and fabricated chafe gear - it either split or migrated very quickly. In those conditions I think we would have lost the chute to chafe failure of the rode. The second problem was the bow "hunted" back and forth, giving us a most unpleasant motion, and may well have contributed to the chafe. Both of these problems make me question - would a bridle that held the bow a little off center help? And how do you deal with chafe when conditions are really bad?

A few comments. Despite my para-anchor being clearly undersized by your current brochure it held us like a brick wall and seems quite large enough. In 20 hours we drifted 2.5 miles by Loran. I didn't have a suitable trip line and was afraid of a tangle, so just used a float. When the wind dropped to 20-25 we decided to "pull in" the chute and get going. It took two of us (both 220 lbs. and in good shape) to pull us up to the para-anchor and 90 minutes of cranking the anchor windless and then tailing to the genoa winches.

S/M-16 Cape George 31 Cutter

Cape George 31 Cutter

31' x 9 Tons, Full Keel

12-Ft. Dia. Sea Anchor

Force 8 Conditions

File S/M-16, obtained from Steve Lockwood, Portland, OR. - Vessel name *Halo*, hailing port Portland, Cape George cutter designed by Nolan Atkins, LOA 31' x LWL 27' 6" x Beam 9' 6" x Draft 5' x 9 Tons - Full keel - Sea anchor: 12-ft. diameter *Para-Tech* on 300' x 1/2" nylon 3-strand and 50' of 5/16" chain, with 1/2" stainless steel swivel - Deployed in deep water about 100 miles northwest of San Francisco in a gale with winds of 35-40 knots and seas of 14 feet - Vessel's bow yawed up to 90° at times - Drift was about 6 miles during 20 hours at sea anchor.

In May 1993 *Halo* was en route to the Bay Area from Portland, normally a downwind run. When she ran into a southerly gale her owner tried beating into it for a while, and then decided to deploy a 12-ft. diameter Para-Tech sea anchor. *Halo* was sea anchored for 20 hours, drifting only 6 miles. Transcript:

> *Boat was held off the wind an increasing amount as wind strength increased. Very uncomfortable roll and some waves broke on deck. Our boat is exceptionally strong so we were not very concerned. We forgot to add a swivel, but noticed no difference in boat motion over time. There was some twisting* [of the nylon rode]*, but not severe at all. Rode was 300' x 1/2" nylon with 50' of 5/16" chain at sea anchor. Certainly no survival storm, but we thought it would be interesting to try it out and that a break from beating into the gale would be nice if we didn't lose too much ground.*

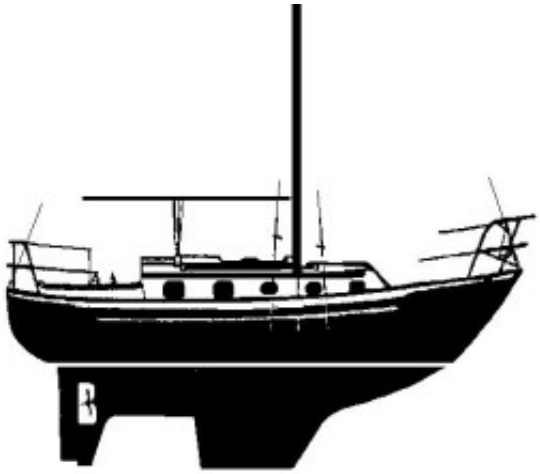
S/M-17 Crealock 34 Cutter

Crealock 34 Cutter

34' x 6.75 Tons, Low Aspect Fin/Skeg

12-Ft. Dia. Sea Anchor

Force 8-9 Conditions



File S/M-17, obtained from Sandy and Les Bailey, Honolulu, HI. - Vessel name *N'ISKU*, hailing port Honolulu, Pacific Seacraft cutter designed by Bill Crealock, LOA 34' 1" x LWL 26' 2" x Beam 10' x Draft 4' 11" x 6.75 Tons - Low aspect fin keel and skeg rudder - Sea anchor: 12-ft. diameter *Para-Tech* on 400' x 1/2" nylon three strand with 50' of chain and 3/8" swivel - Deployed in deep water near 15° 49' N, 159° 48' W, in a gale with winds of 40-45 knots and seas of 16 feet - Vessel's bow yawed 10° - Drift was 15 miles during 14 hours at sea anchor.

N'ISKU was en route to Palmyra Atoll from Honolulu, when she ran into something akin to a *Kona* storm. A 12-ft. diameter Para-Tech sea anchor was then deployed, which held the bow of the yacht into the seas in a most satisfactory way. Transcript:

> *This was not a survival situation in the usual sense. On this passage, my wife and I had endured four successive days of 25+ knot easterly trade winds, all from ahead of the beam, with 12 to 14 foot seas from the same direction. The boat handled beautifully and we never felt threatened nor out of control, logging 150 to 160 miles per day. Unfortunately, persistent* mal de mer *had flattened my wife from the first day and then a streptococcal throat infection laid me low. These tribulations significantly reduced the pleasure of the sail and severely taxed our stamina. Nevertheless, we maintained our watches and did not feel it was unsafe to continue as long as conditions remained the same - which they didn't.*
>
> *The wind piped up to 40 knots with higher gusts and veered a bit to the south. The seas built and became confused. The motion became most uncomfortable with a yaw component that made it very difficult for a couple of arthritic sexagenarians to get around. We then decided it was time for a little "rest and rehabilitation." We tried heaving-to under sail, but this did not prove satisfactory under those conditions. Over the side went the sea anchor and* immediately *our habitat became more livable. The major motion of the boat was now an almost gentle pitch, with occasional episodes of roll, but amazingly the uncomfortable yaw motion had vanished.*

We used a 12 foot Para-Tech nylon parachute specifically designed as a sea anchor in a deployable storage bag. A large fender (8" x 24") served as the primary float and a smaller dinghy fender (3" x 12") at the end of 100 feet of 1/4" polypropylene was the trip line. Our rode consisted of 200 feet of three strand 1/2" nylon, 50 feet of 5/16" BBB chain and a second 200 feet of 1/2" nylon for a total of 450 feet. Swivels were used to attach the nylon rode to the anchor and to the chain (overkill perhaps). The nylon rode was led through a bow roller to cleats. Sufficient rode was released so that the bright yellow canopy of the sea anchor was visible in the crest of an oncoming swell as we were atop the crest of another wave. Three to four layers of fire hose were used for chafe protection at the roller.

We did not observe surge or shock loads on the rode. The boat always seemed to head into the wind and seas at the same angle (<10°) and did not sail about at anchor. The entire system worked perfectly, probably because of a) the length of the rode, b) the catenary induced by the chain in the middle of the rode, and c) the boat and anchor were in crests and troughs in synchrony. By morning the winds had abated to about 30 knots and backed into the east. The crew, still bruised, but very much refreshed by a night of rest, was eager to head south again.

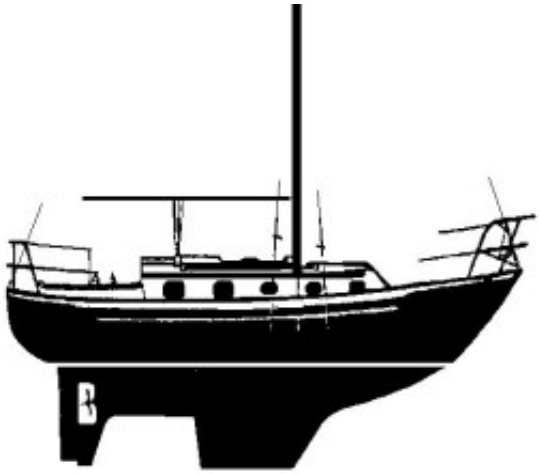
S/M-18 Crealock 34 Cutter

Crealock 34 Cutter

34' x 6.75 Tons, Low Aspect Fin/Skeg

15-Ft. Dia. Sea Anchor

Force 8-9 Conditions



File S/M-18, obtained from John R.S.Charlton, Oceanside, CA. - Vessel name *Fancy Free II*, hailing port Oceanside, Pacific Seacraft cutter designed by Bill Crealock, LOA 34' 1" x LWL 26' 2" x Beam 10' x Draft 4' 11" x 6.75 Tons - Low aspect fin keel and skeg rudder - Sea anchor: 15-ft. diameter *Para-Tech* on 300' x 1" nylon three strand with 1/2" stainless steel swivel - Deployed in deep water about 550 n.miles NE of Hawaii in a whole gale with winds of 40-50 knots and seas of 30 feet - Vessel's bow yawed 10° - Drift was reported to be "minimal" during 12 hours at sea anchor.

Fancy Free II was en route to Kaneohe, Hawaii from Oceanside, California in the month of January. She ran into a south-westerly gale and had to use her 15-ft. diameter Para-Tech sea anchor. Owner's handwritten remark reads thus:

> *Great product. Unfortunately, my helm was not lashed down securely - steering cable broke at quadrant. (Large wave lifted stern and rudder slammed over to "stops").*

Fancy Free II is a sister ship to *N'ISKU* (see illustration in previous file). Both of these Crealocks behaved very well at sea anchor, yawing less than 10°. Note that *N'ISKU* used 400' x 1/2" nylon plus 50' of chain, while *Fancy Free II* used 300' of 1-inch nylon, and yet both boats behaved equally well. In looking for causality one has to put on a Sherlock Holmes hat and try to find some basic virtue in Bill Crealock's design, something that makes these boats yaw so little - probably the closeness of the CLR to the CE - while not losing sight of other variables such as the rode length that determines the relative positions of the boat and sea anchor.

S/M-19 Aloha 30 Sloop

Aloha 30 Sloop

30' x 3.5 Tons, Fin Keel

9-Ft. Dia. Sea Anchor

Force 8-9 Conditions

File S/M-19, obtained from Richard Brooker, Winnipeg, Canada - Vessel name *Crocodile Rock*, hailing port Winnipeg, Aloha 30 sloop designed by Ron Holland, LOA 30' x LWL 26' x Beam 10' x Draft 6' x 3.5 Tons - Fin keel - Sea anchor: 9-ft. diameter *Para-Tech* on 400' x 1/2" nylon three strand with 3/8" swivel - Deployed in shallow water (50 fathoms) about 30 miles off the Oregon coast, NW of the mouth of the Columbia River, in a low system with winds of 40-45 knots and seas of 10 feet - Vessel's bow yawed 20° - Drift was 4 n.m. during 18 hours at sea anchor.

No written feedback accompanied the completed DDDB form. In answering the question, "How many degrees did this vessel yaw from side to side?" the owner has checked the "20°" box and written the words "very stable" next to it.

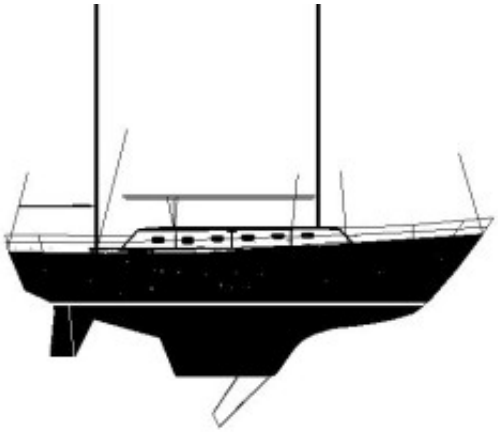
S/M-20 Hinckley 49 Ketch

Hinckley 49 Ketch

49' x 19 Tons, Wide Keel & Centerboard

18-Ft. Dia. Sea Anchor

Force 10+ Conditions



File S/M-20, obtained from delivery skipper Michael Auth, Worton, MD. - Vessel name *Pilgrim*, hailing port Oxford, Hinckley ketch designed by McCurdy & Rhodes, LOA 49' x LWL 43' x Beam 12' x Draft 5' 6" (9' with CB down) x 19 Tons - Wide keel & auxiliary centerboard - Sea anchor: 18-ft. diameter *Para-Tech* on 300' x 3/4" nylon three strand with 5/8" stainless steel swivel - Deployed in deep water about 95 miles east of Cape Hatteras (in Gulf Stream) in hurricane *Gordon* with winds of 50-60 knots and seas of 35 feet - Vessel's bow yawed 10°.

Pilgrim was caught in the web of hurricane *Gordon* in November 1994. With options exhausted, an 18-ft. diameter Para-Tech sea anchor was deployed - on the fly! It pulled the bow of the yacht right up into the seas (only 10° of yaw) and kept it there for fifteen minutes. However the sea anchor rig was lost shortly thereafter. With conditions worsening *Pilgrim* had to be abandoned, the crew being taken off by the Coast Guard. Transcript:

> *Possibly you have read or seen national news coverage including video footage of a dramatic Coast Guard helicopter sea rescue off the Virginia coast this past fall. Actually there were two sailing vessels that got caught in hurricane* Gordon *and fortunately all the crew from both vessels were successfully rescued by the Coast Guard. I was skipper on the vessel* Pilgrim*, a 1974, 49' Hinckley ketch sailing from St. Georges, Bermuda to Chesapeake Bay. The boat was in above average condition and had recently undergone extensive upgrading. I have accumulated approximately 70,000 sea miles delivering both power and sail vessels and as customary went through my usual pre-delivery checklist which included inspecting emergency gear.*
>
> Pilgrim *was equipped with a new 18' PARA-TECH sea anchor and all crew familiarized themselves with proper deployment procedures although we never really though we would have to use this gear. Typical! I thought I had a good "weather window" to make the 600 mile crossing. I not only had the Bermuda weather service's latest information, but had also retained the services of a private meteorologist - Bob Rice's Weather Window, Inc. All weather forecasts indicated Tropical Storm* Gordon *would track into the Gulf of Mexico and most probably weaken and pose*

no threat to us.

We departed Bermuda on Nov.14 and made good progress towards the Chesapeake. On Thursday Nov. 17, only 110 nm from the Bay but still in the Gulf Stream, we got hit by what was once a Tropical Storm, now declared Hurricane Gordon*!* Pilgrim *experienced serious problems and equipment failures in Force-10 conditions, which ultimately resulted in our decision to place a Mayday call and activate our EPIRB. Just prior to this we had deployed our PARA-TECH sea anchor. This was not an easy task as we were running downwind in 30-40' heavy breaking confused seas with sustained winds of 50 kts and greater. We managed to secure the tether of the sea anchor to our bow anchor, connected to chain and nylon rode. Once the sea anchor was thrown overboard, rode went out of the chain locker in a wild, uncontrolled, extremely fast and dangerous manner.*

The 18' diameter sea anchor worked excellent holding the bow of Pilgrim *into the wind and seas and allowing the crew to attempt emergency repairs under much more controlled conditions. We felt fortunate to have the PARA-TECH sea anchor and believed this would give us the opportunity to control the boat which we didn't have previously. However, about fifteen minutes after we deployed the sea anchor we noticed that the rode connecting it to* Pilgrim *was gone! Somehow, we'll never know exactly, the entire rode was gone from the chain locker! Conditions were so bad below we couldn't examine the chain locker to determine the cause of the problem but might speculate that: 1) The force acting on the rode, including the shock loads, (which were great) might have been too great and pulled the bitter end free. 2) Possibly the bitter end, however it was secured, had parted in some manner. 3) Possibly as some owners will do, tie a large knot in the bitter end so it won't pass through the deck opening, this could have pulled through the deck opening. 4) Also, some owners will secure a piece of wood at the bitter end to prevent the rode from running free. If this was the case, it could have broken and allowed the rode to run out. 5) Another theory, if the rode had been secured to an eye bolt or other securing device, it could have broken or pulled out too. Bottom line is that we did in fact loose our sea anchor which was doing it's job of helping to control the vessel. Consequently when we lost this gear we lost control and eventually had to abandon* Pilgrim*!*

Some suggestions I might offer to possibly avoid this type of situation would be: 1) Place a WARNING notice in an obvious location telling the user to check that the bitter end of the anchor rode is securely attached to a permanent strong piece of equipment that can take a strong shock load or force.... 2) Possibly design a better or easier way of connecting the sea anchor tether to the anchor and/or anchor chain.... The crew on Pilgrim *had a most difficult time trying to secure the sea anchor tether under extreme conditions (the usual conditions when you need to deploy this gear). Maybe a heavy duty snap shackle would work? When you're on the bow and it is rising and falling 30 feet or more, it is a most dangerous and difficult task to say the least!*

S/M-21 Hinckley Sou'wester 51 Yawl

S/M-21

Hinckley Sou'wester 51 Yawl

51' x 24 Tons, Full Keel & CB

24-Ft. Dia. Sea Anchor

Force 9 Conditions

File S/M-21, obtained from Captain Eric F. Roos, Mt. Desert, ME. - Vessel name *Windcrest*, hailing port Bar Harbor, Hinckley Sou'wester yawl, designed by McCurdy and Rhodes, LOA 51' x LWL 37' 6" x Beam 14' x Draft 6' (11' with CB down) x 24 Tons - Full keel & auxiliary centerboard - Sea anchor: 24-ft. diameter *Para-Tech* on 400' x 3/4" nylon braid and 100' of 5/16" chain with 3/4" stainless steel swivel - Deployed in deep water about 120 miles south of Nantucket Island in a whole gale with winds of 40-50 knots and seas of 20 feet - Vessel's bow yawed 15° - Drift was 14 n.m. during 23 hours at sea anchor.

Windcrest was en route to Bermuda from Bar Harbor when she ran into bad weather. Transcript of feedback obtained from Captain Eric F. Roos:

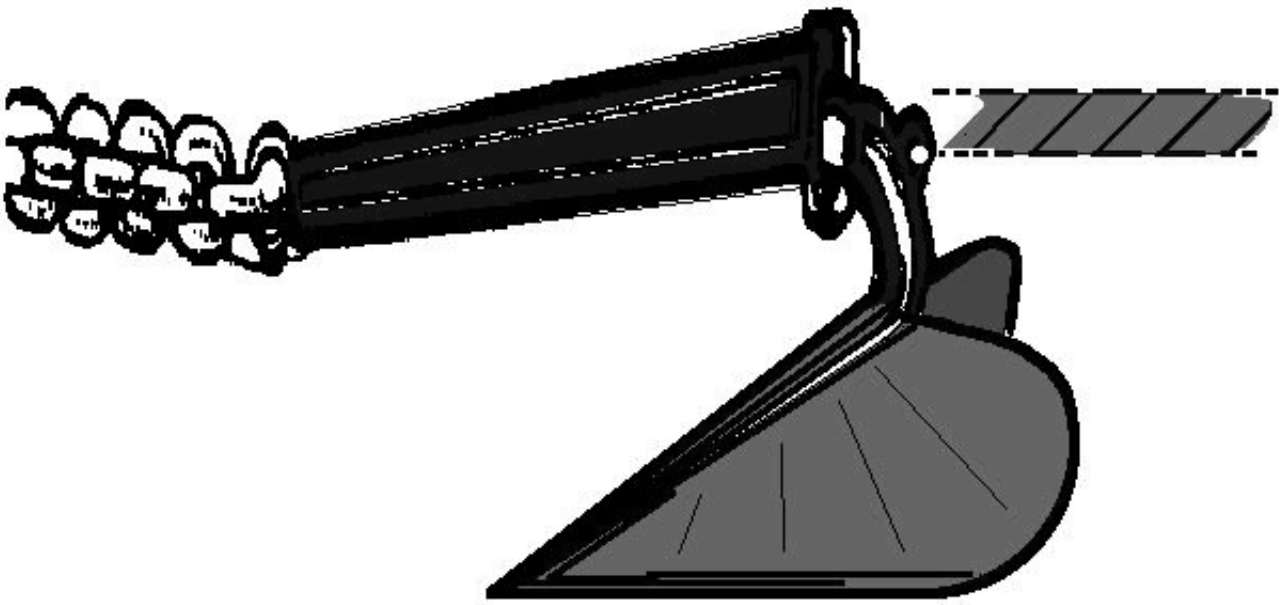
Para-Anchor was deployed due to deteriorating weather conditions close to the North wall of the Gulf Stream. Our weather forecast indicated that if we continued on our present course a large frontal system would pass over us just as we entered the Gulf Stream. We chose to sail away from the building seas near the stream and set our para-anchor while conditions were still tolerable and we still had daylight.

There was no sudden wind change, but rather a consistent increase in wind speed and building seas (max 50 knots with max 25-30' seas.) Since we deployed our para-anchor before conditions were too bad, the deployment was fairly straightforward. We chose to attach the shackle of the rode directly to our 60# plow anchor's welded cross-bar (v). *After seizing the shackles we let out the 400' rode, anchor and 100' of 5/16" chain over the stainless steel bow roller. The weight of the anchor and chain provided an excellent catenary to absorb the shocks we experienced during the worst conditions. Our biggest concern the whole time we sat on the para-anchor was the strength of the cross-bar on the plow anchor. Though it held just fine, I wonder if I should have used a different attachment point.*

Windcrest *performed very well while on the sea anchor. She yawed from side to side a total of 30°* [total arc]. *At one point the anchor chain jumped out of the stainless steel roller (we forgot to put pin through top of roller) and found its way down the starboard side and into the stainless steel chock causing only cosmetic damage. Due to the rugged nature of our chocks, we would intentionally place the chain in the chock in the future.*

After 23 hours the seas subsided to 15-20' and the winds moderated to less than 25 knots and began coming from a different direction than the seas. At this point Windcrest *insisted on pointing into the wind rather than the seas. This caused considerable rolling and was the ultimate reason we retrieved the para-anchor when we did. The smashing/crashing sounds below were enough to make a man go mad. The retrieval was straightforward but more difficult than the deployment. We felt it was next to impossible to retrieve the tackle in an orderly fashion. We ended up with a heaping mess of rode and para-anchor lines. However, when we repacked the gear at a later date it was not as bad as we had anticipated. In summary, I have nothing but good things to say about the para-anchor equipment and would not go offshore without one.*

(**CAUTION**: The steel anchor should be taken off in storms lest a breaking wave smash it against the boat.)



CAUTION**: A big, heavy steel anchor may provide added catenary shock absorption hanging on the rode, but in a Fastnet type storm it may also get turned into a lethal object if it gets smashed against the boat by a breaking wave. It should be taken off, and the rode attached the chain itself.**

S/M-22 Bristol Channel Cutter

Bristol Channel Cutter

26' x 7 Tons, Full Keel

12-Ft. Dia. BUORD Parachute

Force 11 Conditions

File S/M-22, obtained from Roger Olson, Costa Mesa, CA - Vessel name *Xiphias*, hailing port Los Angeles, Bristol Channel Cutter, designed by Lyle Hess, LOA 37' (with bowsprit) x LWL 26' x Beam 10' x Draft 5' x 7 Tons - Full keel - Sea anchor: 12-ft. Diameter BUORD on 300' x 5/8" nylon three strand rode and 20' of chain with 5/8" galvanized swivel - No trip line - Deployed in hurricane *Tia* in deep water approx. 25 miles off the Queensland coast near Bundaberg with winds sustained at 60 knots and seas of 30-40 ft. - Vessel's bow yawed 45° - Drift was estimated to be about 5 n.m. during three days at sea anchor.

Roger Olson is an experienced offshore sailor and a partner in the firm of *Sam L. Morse Co.*, builders of the Bristol Channel Cutter. Here are the transcripts of two files obtained from Roger:

> *Hurricane "Claudia" Near American Samoa (1980)*
>
> *I was lucky to only catch the edge. There were two hurricanes at the same time. On WWV I heard that a hurricane was approaching our location but there was too much interference to hear the exact coordinates. I used the ham radio to call New Zealand. A ham operator informed me that it was north of us and heading away. I wasn't aware that this was a different storm and that we were heading into the original one.*
>
> *As the weather deteriorated I ran off with storm jib and storm trysail. I considered dropping the trysail but wanted it up in just case I decided to heave-to. Deployed two "MINI" tires* [makeshift drogue] *off the stern for better control. Wind and seas not too bad (40 to 50 knots) and it was going in my direction. A huge wave broke next to us, depositing ample amounts of water on me and filling the cockpit. It doesn't take a genius to realize that if the wave had been over the stern I would have been rammed against the flat aft side of the cabin. Also, I could easily imagine this wave carrying me to the end of my harness tether. If the tether didn't break it would surely break my ribs. So I decided to come about and heave-to. I had to cut the drogue loose to come about. The boat set well for several hours but as the wind and seas increased it was apparent there was*

too much sail area up. So I dropped the storm jib onto the staysail stay and remained hove-to on storm trysail.

Never expected it to get this bad or I would have used the parachute anchor. It was in the lazarette and my rope was still shackled to the anchor chain and anchor, all lashed forward. There wasn't a snowball's chance in hell that I was going forward in those winds and seas to unlash it, undo the shackle, etc. I went below to get out of it. My hand-held wind indicator could only register 60 knots and it was at the maximum. During the night I knew my storm trysail was too much because the boat would heel severely on the crest of the wave. As the boat entered the trough she would change her set so when she got the full force of the wind on the crest the sail would flog and it seemed like it would rip the boat apart. Then it would fill and we would heel to the extreme.

There was only one knockdown, which was when everything came out of the lockers and drawers, burying me under cans and boxes. So much for the "slick!!" During the night it began to improve until I was able to sail by late the next afternoon.

Hurricane "Tia" Off Queensland, Australia (1981)

Australian radio stated that the Tropical Storm was strengthening to cyclone strength in the South Coral Sea and was heading south. This time I was better prepared. I had disconnected my anchor from my 5/8" nylon rope and pulled it all on deck. I tied the bitter end to the sampson post, leaving about 10 feet for freshening the nip. I had already run the rope through a fairlead on the bottom of the Cranse Iron (this is how I anchor anyway) and led the rest aft to the cockpit. Where the rope led through the fairlead I had sewn on a meter of leather for chafe. This was set so the leather just passed through the fairlead so I could let rope out to "freshen the nip" if necessary. (Later I never checked for chafe because I was too frightened to go forward).

I led the rope along the top of the life line and lashed it in place with fine nylon thread (dental floss would work) and to the cockpit where I coiled it and used stops to hold the coil in place. The parachute anchor was kept in the lazarette. I already had added about 25 feet of 5/16" chain to the end of the swivel attached to the parachute. I removed the parachute anchor, chain and swivel as a unit in a bag. Using a bowline with a double wrap, I attached the rope in the cockpit to the swivel. I deployed the parachute early while I was hove-to. From the cockpit I deployed the float (enough buoyancy to float the chain and anchor on 20 feet of rope attached to the center of the crown of the parachute) over the windward side. This was followed by the parachute anchor, chain and rope. The boat was making slow leeway so I was able to maintain complete control of the rope until all (300' + 20' chain) was out. As I let go of the rope it broke the thread along the life line until the boat was riding bow to the wind and seas. I dropped all sails and went below.

I remained below for the better part of three days. I still don't know the strength of the winds as my hand-held indicator wasn't working properly - it was stuck at 60 knots. The boat did tack in this position. In the trough there was little pull on the parachute anchor and the boat would set up to 50° from center. As she neared the crest more tension would be put on the rode, pulling the vessel straight. I had substantial water overboard because I was making little or no sternway. This was proven by feeling the pressure on the tiller, which I had lashed amidships. I was

concerned about damage to the rudder if I made too much sternway. I don't know the amount of drift in those three days, nor do I know the current.

After the worst was over I finally got permission to put into an illegal port of entry (Mooloolaba, Qld). I set my course based on my last known position and allowed about five miles for drift. I was sailing entirely on celestial navigation and didn't have GPS or SatNav. I used my RDF to take a rough bearing and set a course for Mooloolaba. As I approached land I found my DR wasn't far off.

Comments: *With the parachute anchor I never really felt in danger. Deploying it from cockpit worked great. I can't believe anyone would go forward in storm conditions to work* anything *on the foredeck. There was some chafe on the leather but it never wore through to the rope. I never adjusted it in the three days, but it was apparent that there was about one foot of stretch on the leather. I spent all my time inside during this and other storms. Only when conditions were not life-threatening would I go forward to inspect for chafe or damage. I had everything strongly lashed down, including my dinghy on the foredeck. The only things I lost were two 5-gallon fuel containers which were lashed with old 1/4" rope. Roller furling jib remained on the headstay - not recommended as it creates considerable windage. I had rolled it up tightly and pulled the sheets as tight as I could so the headstay wouldn't flog. It still shook the boat more than I thought it would. I don't know what I would have done had it unrolled.*

I should never have been sailing in those waters during the hurricane season. However, in both cases I was rushing to meet my girlfriend... wasn't worth it!

Xiphias of Los Angeles. This Bristol Channel Cutter rode out two hurricanes in the South Pacific, one to a sea anchor, "I remained below for the better part of three days... with the parachute anchor I never really felt in danger." (Roger Olson photo)

S/M-23 Tayana 42 Cutter

Tayana 42 Cutter

42' x 15 Tons, Full Keel & Cutaway Forefoot

18-Ft. Dia. Sea Anchor

Force 8-9 Conditions

File S/M-23, obtained from Captain Robert Proulx, Homer, Alaska - Vessel name *Even Star*, hailing port Homer, Tayana cutter designed by Bob Harris, LOA 42' x LWL 35' x Beam 12' x Draft 6' x 15 Tons - Full keel & cutaway forefoot - Sea anchor: 18-ft. Diameter *Para-Tech* on 400' x 5/8" nylon braid and 200' of chain with 5/8" custom-made bronze ball bearing swivel - Partial trip line - Deployed in a gale in deep water about 60 miles west of Humboldt Bay, California, with winds of 40-45 knots and seas of 15-20 feet - Vessel's bow yawed 20° - Drift was about 12 n.m. during 72 hours at sea anchor.

Captain Bob Proulx is a veteran of the Alaskan fisheries - the owner of a 105-ft. fishing vessel working the Bering Sea. He is also a marine safety instructor and an avid sailor. In this file he provides a sobering tale of what one might be getting oneself into when one asks the Coast Guard for assistance in marginal situations. Forewarned is forearmed!

> *My family and I decided to put commercial fishing "on hold" and go sailing. The early part of our voyage was great as we cruised the inland waters of the Pacific Northwest. Our story begins as we set sail southbound from Newport, Oregon on July 12. Winds were light, 10-15 NW, but began to build by evening, reaching sustained 30 from NW. By 2300 hrs. it didn't look like conditions would improve, so we shortened sail and decided to try out our new parachute sea anchor. Better try it out now, than have to sort out glitches when we absolutely have to use it. Deployed the sea anchor on 400' of rode, the bitter end secured to the 66 lb. Bruce anchor on the bow roller. It stabilized the boat and we were pretty comfortable, despite the 30+ winds and 15 foot seas. I lashed the helm, took the pendulum off the windvane and secured it to the rail.*
>
> *Overnight the weather worsened. The barometer hadn't dropped and the weatherfax wasn't showing anything, so I though it would all be over in a few hours. I had all the hatches dogged down and all the vents capped off, just in case. The seas and swell built to 18-20 ft. and the wind was on the increase.*
>
> *At first light I checked the rode and damn if it wasn't chafed at the thimble by the anchor on the bow roller. So I let out the anchor and 50 feet of chain. This eased the motion of the boat noticeably. The wind increased to 40 knots and higher. This was beginning to remind me of*

Bering Sea weather, having the earmarks of a good blow. But at least it was warm and everyone on board was in good spirits. The swells and the seas were getting farther apart and the boat more uncomfortable, so I let out more chain - now about 200 feet. The boat then began to yaw noticeably [too much chain out - review page 3.14].

We experienced some waves breaking forward of mid-ships, port and starboard, and on our stern quarter. Next, our rudder cable parted with a loud crack. I got the emergency tiller, put it on the shaft and lashed it secure. A wave broke over the starboard side at about a 30° angle and knocked the wind vane mast down. Before I could get a line on it another wave carried it away....

We had been on the sea anchor for better than 48 hours with not much to eat. My family wasn't sea sick, but my friend Joe was having a time of it. I decided to call the Coast guard and let them know our situation. I stressed that we had NO emergency, and requested the forecast for the next 48 hours. Due to worsening conditions, Humboldt Bay Coast Guard then decided to dispatch the 110-ft. cutter Edistow *to the scene. The cutter arrived around 1600 hours. After circling around us for a while they called us on the VHF, saying that it was too rough to do anything. They said they would standby the rest of the night, advised us to get in our survival suits and said they would call every hour, which they did....*

By morning the sea anchor was still holding well. I checked our drift. It was about half a knot. The wind had dropped to 30, but the seas and swell were now 20-30 feet. I have a great picture of the 110-ft. cutter with her bow and two thirds of her bottom out of the water. At this time the CG skipper decided that he would tow us to Humboldt Bay. I said NO. A little later he called back and said he would tow us south instead. This made a little more sense, though I was still not sure why I needed a tow. I thought, maybe he knew something about the weather or our situation that I didn't. Anyway, he asked if I had a drogue [to stabilize the tow]. *It took them two attempts to pass us a drogue. I then asked the skipper of the cutter to pick up our trip line on the sea anchor, to retrieve the sea anchor and its nylon rode - attached to our Bruce anchor - and attach his own tow line to that. This way the CG cutter's bow would be into the oncoming seas, so would ours, and this would be the safest for both boats. He said 'NO', he said that would be too dangerous for his crew. This started me worrying. I explained again how the sea anchor was laid out, and that there was no chance of him getting the rig in his props. He came back and suggested that I retrieve the sea anchor and rig - 400' of rode, 66-lb. Bruce and 250' of 3/8" chain, in 20-ft. seas, with a hand windlass!*

I have the greatest regard for the Coast Guard in Alaska. They have performed many amazing rescues and I have the greatest confidence in their ability to make the right decision at the right time. I assumed that all Coast Guard units along the coast would be the same. But now I was beginning to have my doubts.

Second mistake coming up: The cutter's skipper called me back, saying I should cut everything loose. I called him back saying I didn't like the idea of losing my last-ditch survival gear - meaning my sea anchor rig. And I told him I didn't like the idea of lying in the trough, sliding down the faces of 20-25 ft. seas. I asked him what the forecast for the next 48 hours was - he said "more of the same." I asked how he was going to approach us. I thought he said he would come in at our windward side, and then across our bow with the heaving line and 4" tow line.

Like an idiot I cut the chain loose from the boat. We swung around instantly in the trough and I knew in that moment that in all my years at sea I had never done anything so stupid. I told the CG skipper he would have ONE PASS, and ONE PASS only. My friend Joe and I crawled to the bow with our safety harness on, grabbing what we could to hang on. I was on the starboard bow, about two stanchions back, Joe being forward on the port side. I looked for the cutter and, Oh my God, it was downwind from us and coming at the wrong angle. And fast. I was hanging on for dear life, waving and screaming for him to abort. He rammed us about ten feet aft of the bow with his port stern quarter. I felt the cutter hit me, at the same time that it hit the boat, sending me flying forward through the air. The harness held - I felt a jolt at my shoulder. I had a death grip on the inner stay and looked up to see our bow pulpit and running lights hanging by the wires, the big double bow rollers twisted and mangled, the stanchions flattened on the deck. I yelled at Joe that we had to get below to see if she had holed us. Luck was with us: no hole.

The CG skipper called us to see if anyone was injured. We were all OK but I was furious! My wife Linda grabbed the mike before I could say what I was going to say. She told me to calm down. She said at least we were all OK. I unlashed the emergency tiller and brought our stern to the seas. The CG skipper then called back and said he KNEW he could heave us the tow line on the next pass! I said "no thanks!" I felt I had made enough mistakes in 72 hours to last a whole life. It was time for me to take command of the situation again. The CG asked what my intentions were. I said my intentions were to sail bare-poled out of there. He said that was not advisable and called Humboldt Bay CG to find out what to do next. Finally he came on the radio and told us that he would have to leave the area.

As the cutter pulled away I began to feel safe again. We were now running downwind, and our canoe stern was handling the 20-32 ft. seas superbly. The wind and seas let down in about six hours and we repaired the steering cables. The CG called us nearly every hour, wanting to know our ETA. The next day things calmed down and we motored into Bodega Bay.

The CG gave us a day to rest, before coming to take pictures of the damage the cutter had inflicted. They assured us it would all be taken care of. All we had to do was to fill out the claim report and find a yard to do the work - we needed to get two bids. A month after delivering the paperwork to the Alameda Coast Guard Station we have yet to hear anything about our claim.

Lessons Learned:

1. *Don't call the Coast Guard unless it is an absolute emergency, life or death situation. Call other vessels in the area first.*
2. *Evaluate carefully any advice given by anyone - Coast Guard or any other vessels - trying to help you.*
3. *If you accept a tow from the Coast Guard you have given them the command of your vessel - in our case our home.*
4. *Never forget that you are the one in command of your boat and the responsibility is your's.*

S/M-24 Roberts Motor Sailing Ketch

S/M-24

Roberts Motor Sailing Ketch

39' x 14 Tons, Full Keel

7-Ft. Dia. Conical Sea Anchor

Force 10+ Conditions

File S/M-24, obtained from Tim Kelly, Tralee, Ireland - Vessel name *Kerry Dancer*, hailing port Brisbane, Australia, motor sailing ketch, designed by Bruce Roberts, LOA 39' x LWL 33' x Beam 12' 6" x Draft 5' x 14 Tons - Full keel - Sea anchor: 7-ft. Diameter custom-made cone on 300' x 1" nylon three strand rode with 5/8" stainless steel swivel - Full trip line - Deployed in a storm in deep water about 1000 miles WSW of Cocos (Keeling) Islands with winds of 65-75 knots and breaking seas of undetermined size - Vessel's bow was kept at a slight angle to the seas by the sea anchor and mizzen.

Kerry Dancer was en route to Cape Town from Cocos-Keeling in September 1992 when she ran into a storm. Might it have been a cyclone? Although tropical cyclones are rare this time of year in the Indian Ocean, they are common in the Bay of Bengal fifteen hundred miles north of Cocos. At any rate, *Kerry Dancer*'s owner, Tim Kelly, had designed and made a sea anchor for just such an occasion. It was a large, heavy canvas cone, seven feet in diameter at the mouth, with a one-foot diameter opening at the other end. Kelly used a stainless steel wire hoop arrangement to keep the mouth of the cone open - similar to the arrangement found on the Galerider drogue. Kelly's hand-written note:

> *I kept the mizzen up whilst the sea anchor was in use. This kept the bow into the wind, (actually at a slight angle off it). But it worked well and I was able to sleep in peace whilst the storm blew itself out.*

S/M-25 Valiant 40 Cutter

S/M-25

Valiant 40 Cutter

40' x 14 Tons, Low Aspect Fin/Skeg

28-Ft. Dia. Parachute Sea Anchor

Force 10-11 Conditions

File S/M-25, obtained from Jim & Lyn Foley, San Lorenzo, CA. - Vessel name *Sanctuary*, hailing port Alameda, Valiant cutter, designed by Robert Perry, LOA 40' x LWL 34' x Beam 12' x Draft 6' x 14 Tons - Low aspect fin keel & skeg rudder- Sea anchor: 28-ft. Diameter C-9 military class parachute on 300' x 5/8" nylon three strand rode with 1/2" stainless steel swivel - No trip line - Deployed in a storm in deep water about 300 miles north of Bermuda with winds of 55-70 knots and seas of 24 feet - Vessel's bow yawed 20° - Due to the Gulf Stream drift was 15 miles *to windward* in 4 hours.

Sanctuary, a sea-kindly Perry-designed Valiant 40 was en route to the Azores from Florida when she ran into a northeasterly storm in the Gulf Stream. The stream was flowing exactly contrary to the wind at a current speed of five knots! One can only imagine the hell that *Sanctuary* must have gone through on the night of 28 May 1995. Transcript:

While crossing the Atlantic in May 1995 we encountered a Force 10 storm, an occurrence we will never forget nor care to repeat. Sailing east at approx. 38° 45' N, 63° 58' W, we enjoyed the fast moving east setting current and warm waters of the Gulf Stream. Dolphins played in our bow wake, tunas were jumping and the birds were fishing. With hardly a breath of wind, we attributed most of Sanctuary*'s forward progress of 6.5 knots to the Gulf Stream.*

The morning weather report from NMN (Norfolk, VA) included gale warnings for 40° north, 60° west, with forecast winds of 35-40 knots, seas 14-16 feet. The gale was indicated moving ENE at approx. 15 knots, and had a 200 miles semi-circle of influence to its southeast. In other words, we were some 75 nm behind the gale, and proceeding towards it at about 6 knots [while it was moving away at 15 knots]. *We plotted the parameters of the Gulf Stream as reported by NMN. The stream's main body was moving northeast above 40° N, and then curving back down to 39° N, creating a bend or bight in its eastward flow. While we realized that we were sailing into the lower semi-circle of the gale, we hated to give up the favorable current and thought we could ride the tail feathers of the forecasted gale as it moved forward of us. It did not occur to us that the gale would stall in the bight of the stream and build to storm force before the day was out.*

Early in the afternoon a northeast swell began to rise and fall with no wind to show for it. suddenly the blue sunny skies disappeared, winds picked up to 25, then 30 knots, increasing steadily. Seas had risen by that time to 10-12 feet. Accordingly, we kept busy reefing down our full

flying sails, until we carried our smallest storm sail plan - a triple-reefed main and a storm staysail.

As conditions worsened we hove-to using the two sails, thinking the "gale" would move eastward. We planned to sit tight until it passed - but the Gulf Stream current held us in the trough more than our sails could hold us into the steep, confused, falling and breaking seas. Then the northeast wind increased to a dramatic 55 or more knots. At the crest of waves Sanctuary *would round up, get knocked back and over. We had one very dangerous Chinese jibe - a wave broke on us, knocked our stern around and the cockpit filled with green water.*

We decided to lower the sails and set the parachute sea anchor. With 55 knots and more of wind, it was a challenge to get the sails down. As Jim struggled on the wheel, Lyn managed to douse the main and staysail, staying on the deck thanks to harness and tether. We then deployed the 28-ft. diameter C-9 military parachute - with 1/2" stainless steel swivel and 300' of 5/8" three strand nylon rode. The rode was led from the port side bulwarks hawsepipe, aft to the primary winch and cleat.

We deployed the parachute to windward, with no problem, but the line went taut so fast and so tight that we couldn't get the double-lined fire hose chafe gear in place. We tried motoring up on the anchor to relieve pressure - but with 55 knots of wind on the nose, and the parachute in 5 knots of opposing current pulling us INTO the wind and waves, we couldn't get the rode to slacken. We were unable to uncleat and unwind the rode from the winch, slip the chafe gear on, rewinch and recleat it. The rode was so taut instantly that we could see the 3-strand 5/8" nylon reducing in diameter. It was stretching down to 1/2" or less. We felt the rode wouldn't last long, and carefully stood clear of the line.

This line was brand new, never used before, dedicated to the para-anchor. We held 30 feet of the bitter end in the cockpit in reserve, and let out about a foot every 20-30 minutes to combat chafe. Meanwhile, as we worried about chafe, the para-anchor was working beautifully. The boat rode up the face of the waves, punching through their tops as the huge seas rolled under us. No more green water came on board, no more near knock-downs. For four hours we rested below, taking turns watching and letting out the rode to combat chafe. But in spite of our efforts the line parted after an especially strong gust, and the sea anchor was gone.

We fearfully lay a-hull until first light, then turned and ran before the waves, towing warps in an attempt to break up the curlers before they broke on us. We trailed 300 foot lines, with fenders and heavy gear in their bights. Lyn stood and looked aft, watching the waves and warning Jim as he steered down their faces. We were pooped several times in the next few hours. The seas were too strong for Lyn to steer, and we were both exhausted. Luckily, a few hours later we broke free of the Gulf Stream and the storm moved on.

We heard officially on that morning weather broadcast from NMN that the "gale" had been upgraded to a Force 10 storm, carrying winds up to 70 knots. We don't believe we experienced winds that high, however, using our stern-mounted radar arch as a measure, we know we had seas of 20 feet.

What we learned: *When we heard the gale forecast, we should have changed course to leave the Gulf Stream and its five-knot current. We believe the rode parted because: 1) The parachute was too big for our boat - that the current actually pulled us forward at more than 3 knots, instead of actually stopping the boat or truly "heaving-to." 2) No chafe protection on the rode. 3) Unusual circumstances of extreme current and opposing seas and winds.*

We will purchase a smaller diameter parachute. We will use 600 feet of 7/8" nylon line for the rode. Since the incident we have read Lin and Larry Pardey's Storm Tactics Handbook *and discussed what happened. Due to what we learned from them and our experience, we plan to add a bridle as they describe, with a snatch block over the rode and a turning block at the bow - and have heavy duty chafe gear in place before deployment.*

It is Victor Shane's considered opinion that if *Sanctuary* had deployed the given parachute on a much longer rode, with adequate chafe gear, this might have been one of the most remarkable files in the S/M section of the *Drag Device Data Base*. In some respects it still is.

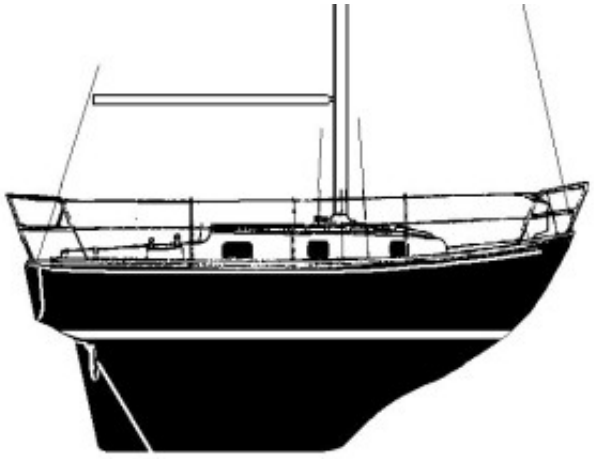
S/M-26 Bristol Sloop

Bristol Sloop

27' x 3.5 Tons, Full Keel

9-Ft. Dia. Sea Anchor

Force 8-9 Conditions



File S/M-26, obtained from Bud Clay, Pensacola, FL. - Vessel name *Miracle*, hailing port Pensacola, Bristol sloop designed by Carl Alberg, LOA 27' x LWL 22' x Beam 8' x Draft 4' x 3.5 Tons - Full keel - Sea anchor: 9-ft. Diameter *Para-Tech* on 80' x 1/2" nylon three strand rode with 1/2" stainless steel swivel - No trip line - Deployed in a low system in deep water in the Gulf of Mexico about 150 miles NW of Tampa with winds of 35-45 knots and seas of 9 feet - Vessel's bow yawed 30-45° during 14 hours at sea anchor.

Miracle, a full-keeled Bristol 27, was en route to Pensacola from Tarpon Springs (300 miles as the crow flies across the Gulf of Mexico) when she ran into a cold front in the month of June! Bud Clay told Victor Shane that a friend had loaned him the para-anchor, "just in case." At any rate, when the wind switched and started building right on the nose Clay beat into it for a couple of nights and a day.

Being shorthanded, tired and sleep-starved he deployed the para-anchor at three in the afternoon of the next day. He spent the night at sea anchor, managing to get some sleep in between trips forward to check for chafe. He felt somewhat rested up by next morning, at which time the wind and seas subsided and he was able to get underway again. Clay, who is now building a 31-ft. Farriar trimaran, told Shane that he would never go offshore without a sea anchor.

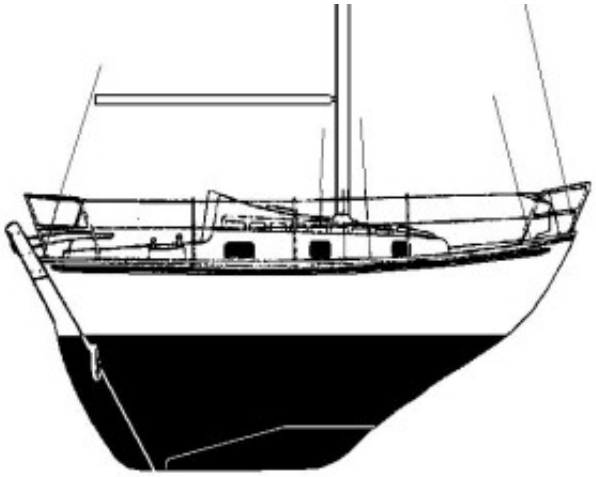
S/M-27 Contessa 26 Cutter

Contessa 26 Cutter

26' x 2.7 Tons, Full Keel

12-Ft. Dia. Sea Anchor

Force 9-10 Conditions



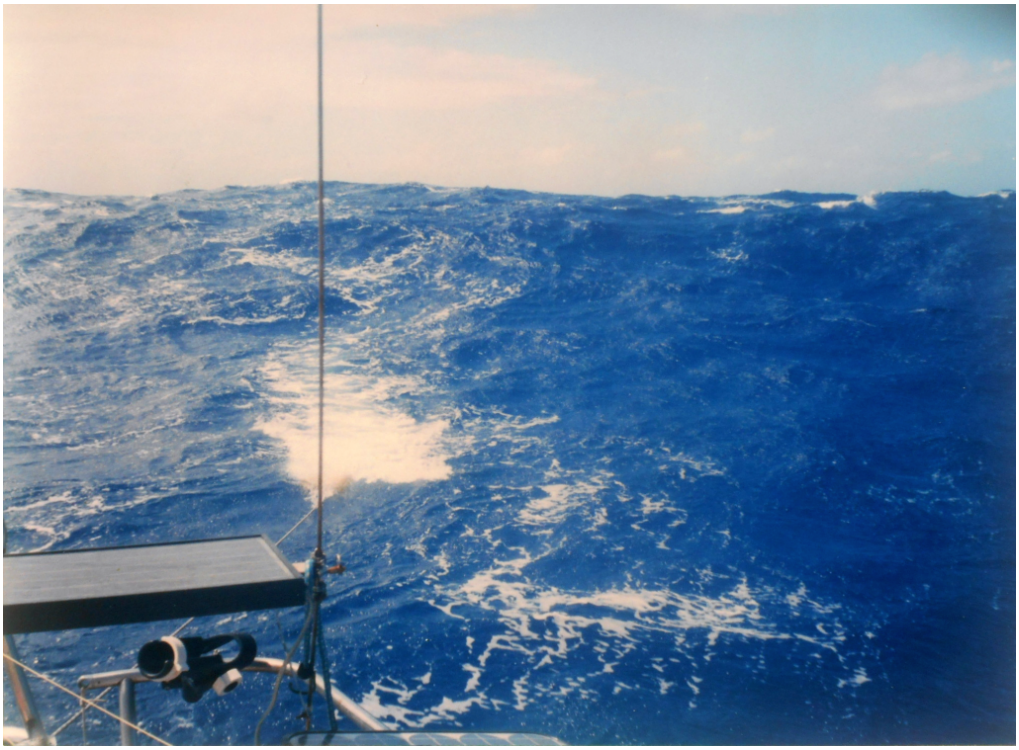
File S/M-28, obtained from Brian Caldwell, Jr., Honolulu, HI - Vessel name *Mai Miti Vavau*, hailing port Honolulu, Contessa cutter, designed and built by J.J. Taylor and Sons of Toronto, LOA 26' x LWL 21' x Beam 7' 6" x Draft 4' x 2.7 Tons - Full keel - Sea anchor: 12-ft. Diameter *Para-Tech* on 300' x 3/8" nylon braid rode with 1/2" stainless steel swivel - No trip line - Deployed in a gale about 12 miles east of Pt. St. Johns, South Africa, in shallow water (50 fathoms) with winds of 50 knots and seas of 12 feet - Vessel's bow yawed 30° - Drift was about 3 n.m. during 24 hours at sea anchor.

On 1 June 1995, amidst much fanfare, Brian - "BJ" - Caldwell cast off from the Hawaii Yacht Club aboard his Contessa 26 on the first of 13 planned legs, in an attempt to make it into the *Guinness Book of World Records* as the youngest person to circumnavigate the globe before his 21st birthday. On 28 September 1995 a flotilla of sailboats and other vessels welcomed BJ back to Honolulu with double the fanfare, as he accomplished his goal.

Mai Miti Vavau of Honolulu. Posing before, BJ Caldwell, was entered in the Guinness Book of Records as the youngest solo circumnavigator at that time. The yacht is a Contessa 26, designed and built by J.J. Taylor & Sons of Toronto. (BJ Caldwell photo).

Don Whilldin, president of Para-Tech Engineering, had sponsored the young man's effort with a sea anchor and a drogue. BJ Caldwell ended up using both drag devices on numerous occasions, declaring them to be the most important pieces of equipment on his boat. Here are some excerpts from the interview conducted by *Sailing* (December 1966, courtesy of *Sailing*):

> *I don't know how our family cruised for six years without this. There's no excuse for leaving on a long cruise without a sea anchor and a drogue.... The sea anchor I used for the first time in the Indian Ocean. Eight days out of Cocos winds were blowing 50 knots. The seas were mountains coming in from all directions. I also used it in hurricane-force winds while rounding the Cape. The blow lasted for an hour and then subsided to about 50 knots.*
>
> *The smaller drogue kept the mast above the water for about 10,000 punishing miles. I trailed it about 100 feet behind the boat whenever there was a risk of broaching. In the Indian Ocean I often had about 15 percent mainsail and 6 percent jib with the drogue out. I ended up using it for about a week during my 21-day passage from Cocos Island to Mauritius.*



Mai Miti Vavau in the Indian Ocean with Para-Tech Delta Drogue in tow (visible left of center). (BJ Caldwell photo).

Here are transcripts of two reports Victor Shane obtained from BJ Caldwell, one dealing with his use of the sea anchor and the other with his use of the drogue. The two categories have been combined into a single file for ease of comparison:

Para-Tech Sea Anchor (12-ft. diameter)

Unique situation - big seas in the Agulhas current [off lower east coast of Africa], *but much smaller inside the 100-fathom line. The axis of the current acted as a type of breakwater. Conditions in the current were utterly unpredictable. The seas very confused and powerful. It was much better inside the current line* [meaning the area bounded by the current and the coastline]. *Initially drogue was used outside of the continental shelf in Agulhas current and in 100 fathoms of water. As the wind increased I moved out of current and into shallow water for deployment of sea anchor. Both the drogue and sea anchor greatly enhanced safety.*

The hardest part in deploying the sea anchor was in handling the 300 feet of rode. Rope gets stiff from saltwater and use. I wouldn't say the ride [at sea anchor] *was comfortable. It was like a rodeo or a roadstead anchorage with no barrier to the fetch.*

The waves broke down the length of the boat and exploded over the cabin top. Main concern: Chafe was definitely a problem. Before I leave on my next trip, I'm going to put a couple of feet of chain into every hundred feet [of tether] *so chafe will be a non-issue. I was also concerned that the wind might switch from Nor'east to Sou'west, which would have created the 20-meter freak waves known for breaking ships in the Agulhas current. Fortunately this did not happen. I was able to sleep between switching chafe guards - let's say every couple of hours. The rudder was lashed to one side.*

Para-Tech Delta Drogue (36-inch diameter)

My average speed with drogue in tow was approximately four knots. Without the drogue I would have been hitting seven, while averaging 5½ knots. I used the device on and off for the whole trip. Instead of yawing and broaching, the drogue would keep the stern aligned with the seas and allow me to still make four knots - and boil water for coffee. I never had to steer manually. The drogue helped the windvane steer in large following seas.

I've said from day one that conditions in the south Indian Ocean are unique. Because there's no stationary high pressure cell in the Southern Ocean, the systems are continually racing eastward. So at any given time you've got swells coming together from a variety of directions - a washing machine, if you like.

It was blowing a sustained 40 knots the night I got rolled 180°. Because the reinforced trades weren't that strong I abstained from switching to sea anchor. With the wind just a few degrees

above a dead run with the drogue out, nothing but the staysail up and the boat sealed up, I heard a deafening roar approaching around midnight. Then everything hit the ceiling, including me. When I finally made it back to the cockpit and looked at my mast I couldn't believe it was still standing. I know it hit me broadside, so I think this is what happened: just before the freak wave broke over the boat the windvane lost the apparent wind in the trough and corrected for the loss of wind. As the boat veered upwind the monster erupted across the hull, rolling the boat through 180°.

Aside from the torn staysail, bent solar panels and a soaked single-sideband radio, the rollover caused no serious damage to the boat.

Mai Miti Vavau sailing out of Honolulu, with Diamond Head Crater in the background.

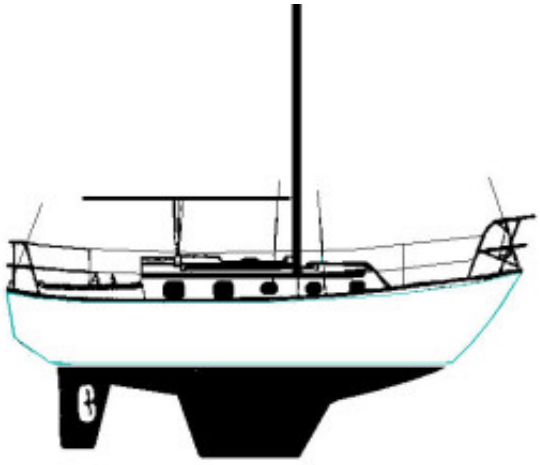
S/M-28 Camper Nicholson Sloop

Camper Nicholson Sloop

35' x 7.5 Tons, Low Aspect Fin/Skeg

15-Ft. Dia. Sea Anchor

Force 7-8 Conditions



File S/M-28, obtained from John G. Driscoll, Holywood, County Down, UK - Vessel name *Moonlight Of Down*, hailing port Southampton, Camper Nicholson sloop, designed by Raymond Wall, LOA 35' x LWL 24' x Beam 10' x Draft 5'6" x 7.5 Tons - Low aspect fin keel & skeg rudder - Sea anchor: 15-ft. Diameter *Para-Tech* on 380' x 5/8" nylon braid rode and 60' of chain, with 1/2" stainless steel swivel - Partial trip line - Deployed in a low system in deep water about 300 miles WNW of Bermuda with winds of 30-40 knots and seas of 12 feet - Vessel's bow yawed 30°.

UK sailor John Driscoll learned some lessons about the use of the Pardey bridling system when he crossed the Atlantic in November 1996. He offers the reader some valuable advice about having a game plan - and practice time:

> *Our vessel* Moonlight Of Down *was on a passage from Newport, Rhode Island to Bermuda, manned by myself and my wife. At 2200 hrs 1 Nov 96 the vessel was hove-to under triple reefed mains'l in a SW Force 7 wind with a rough sea, as it was not possible for the off-watch crew to sleep when underway. By 0000 hrs 2 Nov it was blowing SW Force 7-8 as a trough or local low center passed by. It was decided to deploy the Para-Tech sea anchor. This had not been attempted before, but practice runs of the deployment procedure had been carried out to the point of dropping the DSB* [deployable stowage bag] *overboard,*
>
> *The drill calls for the 5/8" octo-plait* [8-ply braid] *rode to be passed forward from the cockpit - outside everything - and shackled onto the shank of the 33 lb. Bruce, main bow anchor. 20 Meters of chain is then run out. A "Pardey Bridle" is rolling-hitched to the chain, and a further 10 m of chain run out. The parachute buoy, tripping line, primary float, float line, DSB and the main part of the 120 m nylon rode are then deployed from the safety of the cockpit.*
>
> *The drill went perfectly, no problems, and the vessel lay at 50° to the wind on the starboard tack with some tension on the bridle. The vessel then tacked and lay with the bridle under the boat. The vessel tacked every ten minutes or so. It was decided that the weight of the anchor and chain were too great for proper bridling (angles wrong), so some chain was reversed and the bridle re-attached. No improvement. At 0430 it was noted that the wind had dropped to Force 6 so it was*

decided to lay without a bridle, head to wind - so the crew could sleep.

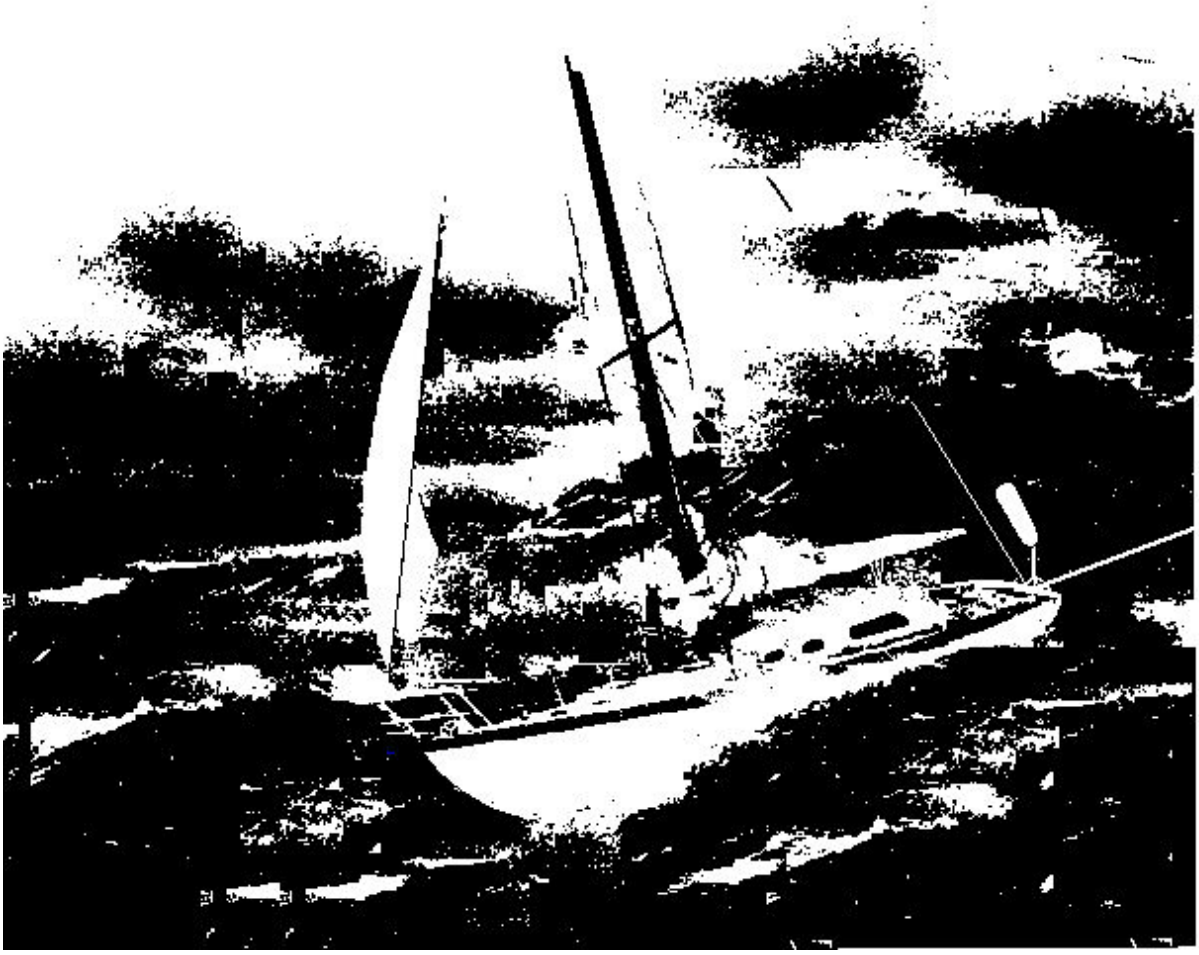
A rapid, severe roll developed with the vessel occasionally tacking about 30° each side of the wind. Sleep, or even rest were completely impossible, and it was decided to recover the sea anchor at first light, by which time the wind had dropped to Force 4.

The anchor was brought aboard with the windlass. The vessel was motored up the rode, which was recovered by hand to within 30 m of the sea anchor. The vessel was maneuvered to the parachute buoy, which was recovered and the sea anchor picked up by the partial trip line over the starboard bow. It came aboard so well-arranged it was immediately re-bagged for re-deployment if necessary.

In spite of the Hydrovane Self-Steering rudder being lashed amidships the vessel had at sometime backed down with sufficient force to free the rudder and stock hard over within the head clamp. No other damage or chafe occurred. Whereas the procedures for deployment and recovery were completely successful, the method of utilization was not considered successful and will have to be modified.

The following points are considered significant in the failure to achieve a satisfactory set: 1) Lying to a sea anchor off the bow head-to-wind is not considered practical due to the violent rolling induced. 2) Attaching the nylon rode to the sea anchor and dropping it over the bow, although improving the catenary and avoiding chafe, does not allow a Pardey Bridle to be used effectively on this vessel. 3) A sea anchor cannot be considered an effective asset unless practice runs have been carried out in suitable conditions to determine the exact method of utilization.

My next attempt (a practice run) will be to deploy the sea anchor as described in Storm Tactics *as shown in diagrams E & F (pages 38 & 39) and photos 3 & 4 (pages 79 & 80). I feel that the rode and bridle should be in the approximate plane of the vessel's gunwale to be effective. They should not lead steeply downward as occurs when chain is used off the bow. Should chain need to be incorporated into the rode it would probably be best at the sea anchor end. In conclusion we feel that the Para-Tech sea anchor is well constructed and its drag characteristic will enable it to achieve the desired performance, once we have developed the method of utilization appropriate to our own vessel.*



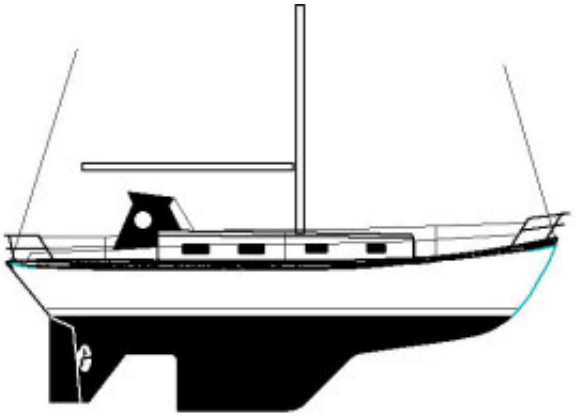
S/M-29 Morris Justine Sloop

Morris Justine Sloop

36' x 9 Tons, Low Aspect Fin/Skeg

15-Ft. Dia. Sea Anchor

Force 9 Conditions



File S/M-29, obtained from Robert K. Gwin, Jr., Orange Park, FL. - Vessel name *Osprey*, hailing port Jacksonville, Morris Justine sloop, designed by Chuck Paine, LOA 36' x LWL 30' x Beam 12' 6" x Draft 4' 9" x 9 Tons - Low aspect fin keel & skeg rudder -

Sea anchor: 15-ft. Diameter *Para-Tech* on 300' x 5/8" nylon three strand rode with 5/8" stainless steel swivel - No trip line - Deployed in a whole gale in shallow water (100 fathoms) about 300 miles ESE of Jacksonville, with winds of 45-50 knots and seas of 15-20 feet - Vessel's bow yawed 20°

Like so may other case histories the benefit that *Osprey* derived from her sea anchor was all too brief. The rode chafed through. Transcript:

> *We actually did not deploy our sea anchor until the storm had peaked and perhaps began dropping. The storm had been building the previous day and we had hove-to the previous evening under storm staysail and double-reefed main. The boat rode fairly well under this configuration, but there was a lot of movement and about 2:00 AM we took a 80-90° knockdown which carried away our deck-mounted life raft and did some other damage.*
>
> *We remained below until sunlight and decided to deploy the sea anchor to stabilize the boat. We lowered the stays'l and deployed it as instructed. It filled fairly quickly and appeared to have a quieting effect on the boat's motion. Unfortunately the rode was chafing on the bow roller next to the anchor due to the movement of the boat (¸ 20° yaw + more when the boat was hit by a cross sea). Attempts to re-route the rode resulted in the rode and the sea anchor being lost.*
>
> ***Comments:***
>
> *1) The primary anchor had not been stowed before going offshore, so the bow roller was not available for use, and the anchor caused chafing.*
>
> *2) A practice run had not been done.*

3) Insufficient chafe gear was available for use. We did notice that there was no jerkiness or surging with the anchor deployed. The tension on the rode was terrific.

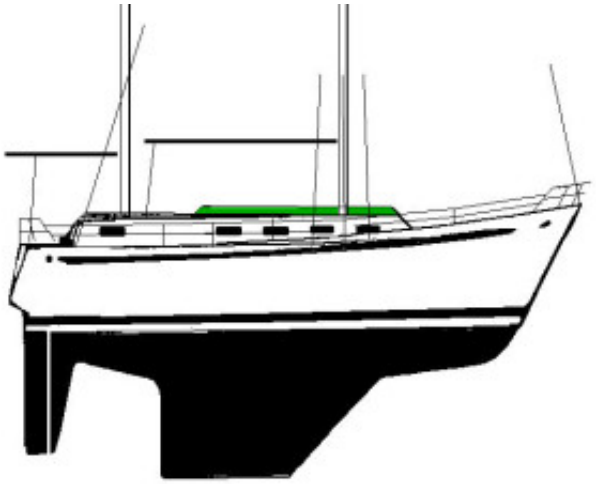
S/M-30 Venus 46 Ketch

Venus 46 Ketch

46' x 19 Tons, Low Aspect Fin/Skeg

24-Ft. Dia. Sea Anchor

Force 9 Conditions



File S/M-30, obtained from F. Bradford Smith, Newton PA. - Vessel name *Kindred Spirit III*, hailing port Baltimore, Venus Ketch, designed by Bob Salthouse, LOA 46' 6" x LWL 36' 6" x Beam 13' 6" x Draft 5' x 19 Tons - Low aspect fin keel & skeg rudder - Sea anchor: 24-ft. Diameter *Para-Tech* on 500' x 3/4" nylon double-braid rode with 3/4" stainless steel swivel - No trip line - Deployed in a gale in deep water about 600 miles east of Miami, with winds of 40-50 knots and seas of 20-25 feet - Vessel's bow yawed 10° with the mizzen up - Drift was minimal during 18 hours at sea anchor.

Kindred Spirit III was designed by Kiwi naval architect Bob Salthouse for New Zealand waters. She is a 46-ft. double headsail ketch displacing about 38,000 lbs. In late October 1985 she was being sailed from St. Croix USVI to Baltimore MD when she ran into foul weather. On board were the owner and skipper, age fifty four, himself an experienced sailor with moderate offshore experience, his wife, and a male crew member, age fifty six, an experienced coastal sailor. A 24-ft. diameter Para-Tech sea anchor was deployed on 500' of 3/4" nylon rode. This is the largest sea anchor Para-Tech makes for small craft and requires at least two crew members to deploy and retrieve. F. Bradforth Smith provides a compelling - step by step - account of the logistics that are involved in the deployment and retrieval of a large sea anchor on a large yacht:

> Kindred Spirit III *was newly purchased by her owners, who had spent the previous two months planning the delivery and preparing themselves and the boat for the trip. The preparations included the purchase of a parachute-type sea anchor system consisting of a 24' diameter Para-Tech model; 600' of 3/4" braided nylon rode made up in two 300' shots so that the rode was of manageable weight, each shot having heavy duty thimbles (one with thimbles at both ends, and one with a thimble at only one end); a 3/4" stainless swivel for connecting the rode to the anchor shackle; and a 7/8" galvanized shackle for connecting the two shots of rode to each another. Additionally, the owners installed heavy duty hawse holes in the forward bulwarks approximately three feet aft of the stem. These were specifically intended as the lead for the sea anchor rode, and were deemed necessary because* Kindred Spirit III*'s bow chocks were open top chocks and were located atop a 6-inch bulwark, resulting in an unfair lead to the bow cleats seated on deck. The presence of twin steel anchor roller and a large deck-mounted winch made a chafe-free lead directly over the bow problematic.*

Six days out of St. Croix Kindred Spirit *encountered a line squall which destroyed the leach of her 135% roller furling Kevlar tape drive genoa, rendering it useless and unrepairable with the materials and equipment on board. Proceeding under staysail, reefed main and mizzen,* Kindred Spirit *was faced with backing wind, and in late afternoon of 2 November was motorsailing into building wind and seas under staysail and mizzen only. Although the boat was moving comfortably and under full control, at 2000 the skipper decided to heave-to because the wind continued to be unfavorable, the seas were continuing to build, and he was concerned that the crew not become fatigued.*

Hove-to with staysail and unreefed mizzen, Kindred Spirit *rode out the night in comfort, and the skipper enjoyed a full night's sleep. At 0600 on 3 November the skipper decided to deploy the sea anchor because both wind and seas had continued to build during the night and, while the vessel continued to ride comfortably hove-to, the failure of the genoa caused the skipper to have concerns that the other heretofore undetected gear weakness could result in damage to the staysail, the mizzen, or the running rigging, any one of which could produce a dangerous situation.*

Additionally, the barometer was reading 1020 and above, indicating that what was being experienced was not a passing low pressure front or cell, and thus no reasonable estimation could be made of the current situation's expected duration. (It was later determined that what was experienced was probably a strong local enhancement of the NE trades, occasioned by a deep low pressure trough which had fallen off the US southeast coast the previous day, creating tightly-spaced isobars between it and the high pressure ridge around whose backside Kindred Spirit*'s route was planned).*

The sea anchor, rode and related hardware, all stowed in the V-berth forward, were brought to the center cockpit and assembled. Both the movement of the equipment and its assembly were difficult due both to weight (even at 300', the rodes weighed in with thimbles at almost 70 lbs. each) and to the motion of the boat as it rode 20+ foot waves. This process, which required managing 600' of 3/4" line in the center cockpit in a manner which permitted access to both ends of each of the 300' shots without creating any tangles, was slow, tedious work which took almost two hours to complete. In the skipper's opinion, attempting to accomplish this task hurriedly in an emergency situation is a recipe for disaster, and attempting it on an open foredeck in any kind of severe weather is unwise.

Once fully assembled and checked, including double mousing of the shackles, the bitter end of the rode was led forward outside all rigging and lifelines and was inserted through the hawse hole from the outside in and about 150' of rode was pulled through the hawse hole and made neat and fast on the foredeck. This rather awkward process was required because the heavy duty thimbles on the 3/4" line would not fit through the hawse holes, even though the hawse pipes installed were the largest available from boating catalogues. A six foot length of fire hose was slipped over the rode's bitter end using a boat hook as a needle, and was then run down the rode to the hawse hole, where it was made fast to the bow cleat. This was accomplished by cutting a "V" shaped notch in one edge of the flat fire hose, and then running a short piece of 3/8" line with a stopper knot through the hole and tying the fire hose to a cleat [so it could not migrate]. *This was the only trip to the foredeck required during the entire deployment operation. A 20" round fender buoy to*

serve both as a locator and as a trip line float was attached to the short nylon web tether provided with the sea anchor. No other trip line was used.

The sea anchor was then deployed from the relatively protected amidships weather deck adjacent to the center cockpit with the boat still hove-to. During deployment, the rode was snubbed about every 50' both to encourage the anchor to emerge from the storage/deployment bag and to help assure that the rode was running free. The boat did not respond to the sea anchor until almost all the rode was deployed and some substantial load was on the rode, at which point she came smartly round to windward and lay about 20° off the wind. The staysail was then doused and secured before it could drive the bow further off the wind and broadside to the waves.

The unreefed mizzen, of approx. 195 sq. ft., was left up as a riding sail the entire time at sea anchor, the intent being to get the boat to lie 40+ degrees off the wind in an attitude similar to that achieved when hove-to. While this did stabilize her motion somewhat, the sheeting angle needed to bring the bow down the desired amount was, in the skipper's opinion, such that too great risk of sail damage existed, so closer sheeting resulted in a stable wind angle of about 30 degrees.

Laying relatively quietly to the sea anchor, Kindred Spirit *received only spray on her deck for the 18 hours she lay-to, except for one boarding wave which was the second of two very steep and large waves so closely spaced that her bow was unable to rise from the back of the first to ride the face of the second. The sea anchor consistently "pulled" her bow through the face and crests of waves. Although the anchor rode was bar tight, no jerkiness was experienced, and the rode seemed, between stretch and catenary action, to exert a constant pressure on the deck cleat to which it was secured.*

The sight of the 20" round red float bobbing happily on the crest of the next wave in the train was a sight reassuring beyond description. On the other hand, the 3/4" rode, so massive in the cockpit, looked every bit like a string, from which it seemed Kindred Spirit *was hanging for dear life. On several occasions the skipper was grateful that he had gone up a size from the rode size recommended.*

Every two hours or so a foot or two of rode saved on deck for the purpose was released to even out any chafe. No chafe or even black marks from the inside surface of the fire hose was ever noted. Because the load on the rode was very high, the paying out of rode was a testy business. To avoid even the possibility of a runaway rode and possible loss of the sea anchor, an amidships cleat was used as a second securing point, and the rode was secured to this cleat with enough slack to permit both the paying out of the desired foot or two and the reattachment of the rode to the primary bow cleat. While this arrangement was never tested to its fullest, there were small mishaps which proved the value of the double attachment. Serious injury to hands and fingers is a real danger here, and must be taken seriously.

The skipper had intended to utilize a "Pardey bridle" to bring the bow 40-50° off the wind, primarily for comfort. The riding snatch block normally used in this setup was not attached to the rode before the rode was under load due to the risk of mishap during deployment. After deployment, it was discovered that the 6 foot chafing gear extended so far down the rode that it

was impossible safely to reach beyond it to attach the snatch block. The load on the rode was so great that the skipper decided to not risk mishap by attempting to bring the rode alongside to permit attachment of the snatch block, and the bridle idea was scrapped. While the boat's motion was not extreme, it was uncomfortable and enervating. The relative comfort of lying hove-to was significantly higher than the motion experienced lying to the sea anchor without the benefit of a twin attachment point scheme. During future deployments a shorter chafing gear rig will be used and the snatch block will be deployed as a high priority.

During the morning of 4 November the wind and sea began to abate, and by noon the sea anchor retrieval process began. The initial retrieval of the rode was relatively straightforward, as Kindred Spirit *was slowly motored toward the sea anchor guided by the orange float, which proved invaluable for this purpose. Due to the remaining wind and sea, constant attention was required to assure progress in the direction of the anchor, and prearranged hand signals from the foredeck to the helm were an absolute necessity. As the rode came aboard, the problem of a now wet 600 feet of 3/4" line on the foredeck became serious. As a practical matter, there was nothing to be done during the retrieval process except to assure that the rode was securely on board and not underfoot. As the float came to be retrieved a significant unexpected problem presented itself.*

Upon securing the float aboard, attention was given to the retrieval of the sea anchor itself. Buoyed (no pun intended) by the successful sea anchor experience, the foredeck crew failed to anticipate the extreme load still on the nylon web [float line] *tether due to the weight of the now deflated but wet 24 foot nylon parachute and to the strong motion of the boat as she bobbed in the sloppy leftover seas. The male crew member got his upper arm tangled in the webbing, and caught between the webbing and the upper lifeline. Before he was able to extract himself the loads badly bruised his upper arm. Had the tether been smaller in diameter, or had the crew member caught a wrist or finger, broken bones would have been distinct possibilities. It is strongly recommended that much greater consumer education emphasis be placed on the loads and resultant potential dangers associated with anchor retrieval. In the skipper's opinion, retrieval is at least as dangerous as deployment and is especially tricky due to the random load cycling resulting from the uneven motion of the boat as the anchor rode and tether become shorter at the late retrieval stage. Visions of plucking a deflated sea anchor from the water while hanging over the bow with a boat hook are not only fantasies for all but the very smallest equipment, but are also downright dangerous because they so grossly misrepresent the actual loads and associated dangers of sea anchor retrieval.*

Upon final retrieval, the anchor, rode and miscellaneous hardware was stowed on the large afterdeck. While this exposed the rode to sunlight, no practical alternative was found which did not involve dragging 600 feet of salt water soaked rode through the salon to the forward head. Minimum sea anchor equipage should include a tarp or other device with which the retrieved rode and sea anchor can be securely protected from the sun and still remain on deck. Future enhancements to Kindred Spirit*'s storm preparations will include two life raft canisters permanently attached to the aft cabin roof, customized with adequate drain holes and thus intended to permit both dry and wet storage of the sea anchor, rode, and miscellaneous hardware. An anticipated benefit of this arrangement is the ability to substantially make up the sea anchor assembly before departure, thus significantly reducing the time required to deploy.*

In summary, the parachute type sea anchor performed in a flawless manner during deployment in moderate gale wind and sea conditions. The ride while at sea anchor was uncomfortable but is expected to be substantially enhanced by use of a bridle off the side of the vessel, thus permitting the adjustment of the vessel's attitude to wind and seas. The 24' diameter sea anchor and its 3/4" rode are large, heavy pieces of equipment whose assembly, deployment and retrieval require very detailed planning and a realistic understanding of the conditions on a vessel in circumstances which make such deployment desirable. Finally, the notion that a 24' diameter sea anchor is a practical means of stopping for lunch is just not a realistic expectation. Heave-to for lunch, leave the sea anchor for when conditions make lunch an effort.

This skipper is grateful that his first deployment was in conditions which were relatively forgiving, and I encourage anyone purchasing a sea anchor to fully deploy, lie-to and retrieve it in moderate conditions. The education thus obtained cannot be described. And, don't leave home without one.

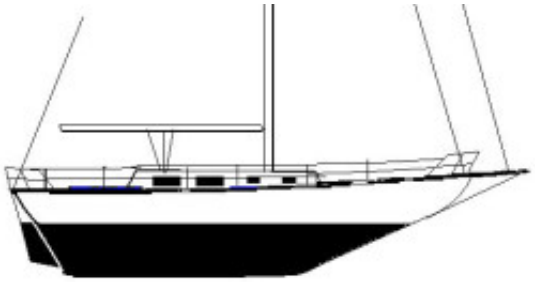
S/M-31 Gauntlet, Bermudan Sloop

Gauntlet, Bermudan Sloop

42' x 14 Tons, Full Keel

18-Ft. Dia. Sea Anchor

Force 8 Conditions



File S/M-31, obtained from R. Walton, North Gosforth, UK. - Vessel name *Lady Emma Hamilton*, hailing port Amble - Gauntlet, Bermudan Sloop, LOA 42' x LWL 33' x Beam 9' 6" x Draft 6' x 14 Tons - Full keel - Sea anchor: 18-ft. Diameter *Para-Tech* on 400' x 3/4" nylon braid rode with 5/8" stainless steel swivel - Partial trip line - Deployed in a gale in shallow water (45 fathoms) in the North Sea, about 125 miles east of Aberdeen, Scotland, with winds of 40-45 knots and seas of 28 feet - Vessel's bow yawed 20° at the peak of the gale in Force 8, increasing to 45° when the wind moderated to Force 6 - Drift was 7 n.m. *upwind* during 23 hours at sea anchor.

This file was forwarded to Victor Shane by Mike Seal, proprietor of *Cruising Home Ltd.* in the United Kingdom, to whom we are indebted.

Lady Emma Hamilton is a double-ended Bermudan Sloop, similar to Bernard Moitessier's *Joshua*, hailing from the Northumberland harbor of Amble (about 40 miles south of the Scottish border).

In June of '97 her owner, R. Walton, was sailing her back to Amble from Bergen, Norway, when she ran into a gale in the infamous North Sea, about 125 miles offshore, east of Aberdeen, Scotland. Walton describes the sea states as "cycloidal, steep, breaking/unstable" on the form he filled out, which is believable, given that the yacht was in only 45 fathoms of water, and that the northerly wind was blowing contrary to a northwesterly current. The average waves were about 28 feet high at the time, as measured by the crew on a nearby oil rig. Transcript:

> *Rode led over bow roller and tied to it. Rags were used to wrap around rode at bow fitting to stop chafe. In future I will use a leather "tube." Checked for chafe every two hours - rags wore through, but rode only very slightly scuffed. No bridle used. Once wind moderated the yaw increased, but at the peak of wind boat held almost dead into wind. We hove-to just next to an oil platform, "SANTAFE 135," which relayed a message to our destination advising our delay, etc.*
>
> *Hove-to at 0600 hrs. Wind moderated by 2300 hrs, but waited till first light to haul in the anchor as this was the first time I had ever used it. Made way at 0500 hrs 28 June in Force 6 still from North. Initially our drift was imperceptible (no noticeable slide or turbulence at all! Just stayed*

put). But by dawn it was obvious we had drifted upwind past the oil rig, so current was overcoming drift downwind.

Throughout, the tension on the rode seemed very great. Considerable windage from 60 foot mast and [roller] *furled genoa. No sail or other windage hoisted at stern. Boat motion was quite extreme, with gunnel to gunnel roll being set up, then dying down again every few minutes.*

The Para-Tech sea anchor and Delta Rode were supplied by Cruising Home Ltd. UK as a complete package, with deployment bags for both (rode in Rode Bag) - they worked perfectly. I just undid the straps and the Rode Bag toggles and tossed it overboard - it all sorted itself out and within five minutes we were riding head to wind. I am totally sold on the concept! We had been pooped twice before we hove-to and the seas increased in ferocity somewhat later.

S/M-32 Hunter 31 Sloop

Hunter 31 Sloop

31' x 5 Tons, Fin Keel

15-Ft. Dia. Sea Anchor

Force 8 Conditions

File S/M-32, obtained from Chris Brann, Sausalito, CA. - Vessel name *Snow Dragon*, hailing port Juneau, Hunter sloop, designed by Cortland Steck, LOA 31' x LWL 28' x Beam 11' x Draft 5' 10" x 5 Tons - Fin keel - Sea anchor: 15-ft. Diameter *Para-Tech* on 150' x 5/8" nylon double braid with 1/2" stainless steel swivel - Partial trip line - Deployed in a low system in deep water about 150 miles west of Noumea, with winds of 45 knots and seas of 15-20 feet - Vessel's bow yawed 30° - Drift was 8 n.m. (confirmed by GPS) during 5 hours at sea anchor.

Chris Brann was a participant in Compuserve's mammoth drag device and storm tactics debate. The debate has since been "packaged" and placed in the library of the SAILING FORUM. When in Compuserve click on the traffic icon, type GO SAILING and look for a file called *Thread on Drogues, Sea Anchors and Storms* in the "Seamanship and Safety" library.

Brann cruised Alaskan waters with *Snow Dragon*, a fin-keeled Hunter 31, before sailing her all the way to Brisbane, Australia. Aside from two incidents of rudder failure, the boat held up fairly well. The failures were caused by the rudder manufacturer's use of smaller shaft dimensions, a defect since corrected by Hunter Marine (owners of older Hunters should make certain that their boats are not affected). The second incident of rudder failure occurred on the Noumea leg of the journey, where Brann had to deploy a sea anchor for damage control and attitude stabilization purposes. Transcript:

> *0300 November 26, front passed, wind backed to southwest, over 30 knots. 0410 We suddenly lost steering. After mounting the emergency tiller, checking cables and movement of the rudder post we realized we'd lost our rudder again. The seas were over 12 feet and continuing to build. The wind was 40-50 knots. With no rudder we fell into the trough, lying parallel to the waves. 0510 We deployed a 15 foot diameter parachute sea anchor from the bow... to prevent capsizing, and to try and stabilize the vessel while we built an emergency rudder. This held the bow into the waves. By now the wave crests were breaking regularly. The anchor was attached to the bow, via 300 feet of 5/8 inch double braid nylon. This made things a bit more comfortable, and it was easier to drill holes and so forth. Unfortunately, the outer covering* [of the double braid] *chafed, so I pulled enough rode in to put sound line on the cleats. This resulted in about 150 feet between the sea anchor and the bow. This was not enough line to absorb the energy....*

At about 1000 a large wave broke over most of the vessel, filling the cockpit, even though it came from forward. The bow cleats are welded to a 1/4" stainless plate that is in turn bolted through the sides of the vessel. The strain [of the breaking wave] *curled this plate through more than 90 degrees, crushed the pipe forming the legs of the cleats, and then broke the 5/8" line (breaking strength 14,400 lbs.) I determined that the line had broken rather than chafed through by observing that the ends of the strands were all about the same length and were slightly fused. The strain also curled the main plate holding the forestay. Loss of this plate would have meant loss of the mast. The structure of the boat was also damaged, opening the joint between the hull and deck on the port side, and we started to take water in through the gap.*

1040 I rigged a trysail to try and stabilize the boat a bit, though it didn't really head it into the seas, and we were pretty much parallel to the waves for the rest of the day. We had crests break on the hull several times each hour, fortunately none of them were big enough to capsize us. I hung over the stern and dismounted the paddle from the wind vane (self-steering device) for use in building an emergency rudder, which occupied us for the rest of the day.

About 1600 the wind and seas had moderated, and we hoisted a storm staysail, streaming a 36" Galerider drogue from the stern. This got us moving towards Australia, though our course was still determined by the direction of the wave troughs. At 1900 wind was SSE 20-25 knots.... The next day we rigged the emergency rudder. It broke after a few hours, but we redesigned it and put it back on. We spent the next week improving the rudder and sailing to Australia.... Directional control was eventually established by a combination of jury rudder and a light drag towed behind the boat.... We tied to the customs wharf in Brisbane at 0720 local time on December 4.

Comments: *This was a normal low pressure system, with wind and seas that would present no danger to a well-found boat equipped with a rudder. Two other vessels were nearby and in radio contact with us. One was 32' long, and the other 43'. Neither of them suffered any damage from the weather, and in fact both were able to rendezvous with us to provide additional lumber for use in making another emergency rudder in case our first one failed. Our problems were solely a result of the rudder failure.*

What we'd do next time: *Shackle all 300 feet of nylon line to the* [steel] *anchor and let out the* [steel] *anchor and 100-150 feet of chain. This approach was used by some friends on a 42 ft. Lord Nelson with success in the Tasman sea. In our case, while it lasted the sea anchor stabilized the boat quite a bit, especially compared to our gyrations without a rudder.*

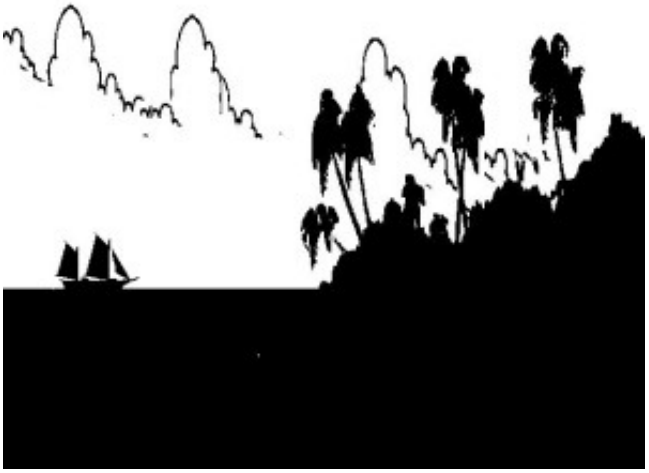
S/M-33 Gaff Rigged Ketch

Gaff Rigged Ketch

38' x 19 Tons, Full Keel

15-Ft. Dia. Sea Anchor

Force 5 Conditions



File S/M-33, obtained from Roger and Debi Brown, Port Townsend, WA. - Vessel name *Tropic Tramp*, hailing port Port Townsend - One-off gaff-rigged ketch, designed by Paul Snow, LOA 38' x LWL 35' x Beam 12' x Draft 6' x 19 Tons - Full keel - Sea anchor: 15-ft. Diameter *Para-Tech* on 400' x 3/4" nylon braid rode and 80' of chain, with 5/8" stainless steel swivel - Partial trip line - Deployed in a low system in deep water in the Tuamotus about 300 miles NE of Tahiti, with winds of 20 knots and seas of 15 feet - Vessel's bow yawed 10° - Drift was 16 n.m. during 44 hours at sea anchor.

On her passage to Tahiti, *Tropic Tramp* ran into a gale in the Tuamotus and hove-to for a night under sails. With 15-20 foot seas still running and the wind contrary, the sea anchor was then deployed to anchor this classic, gaff-rigged ketch to the misnamed Pacific and wait for better conditions. *Tropic Tramp* stayed "anchored" for two days and two nights. Transcript:

> *We deployed the sea anchor for several reasons.*
>
> *1) First time use and sea conditions were right.*
>
> *2) We hove-to* [with sails alone] *and found we drifted more than we felt comfortable with.*
>
> *3) Our jib needed a lot of restitching.*
>
> *4) We were gaff-rigged and headed west towards Tahiti, the winds were out of the west, and being a perfect gentleman beating into that didn't seem like a lot of fun.*
>
> *I felt this had all the qualifications for deploying our sea anchor. The storm had been at gale force during the night and our heading to get us past the atoll was not bad. We felt we had sea room by now, and no current. Plus, the worst of the storm had passed. Deployment went easy and as*

planned. We used 400' of rode and 80' of our 3/8" chain, and a 70 lb. anchor, which gave us a great rest. No jerking. The 50' [partial] *trip line let us retrieve effortlessly.*

After 44 hours, seas were flat, wind SE at 12 knots. A perfect sail into Tahiti, fully rested. Caught two 42" wahoos! A lot of other boats were very interested in all the "facts" of our experience at sea anchor.

S/M-34 Tahitian Ketch

Tahitian Ketch

55' x 40 Tons, Full Keel

24-Ft. Dia. Sea Anchor

Force 12 + Conditions

File S/M-34, obtained from Robin and Maggi Ansell, Campbell River, B.C. - Vessel name *ORCA*, hailing port George Town (Cayman Islands) - Tahitian Ketch, designed by R. Hartley, LOA 55' x LWL 47' x Beam 13' 6" x Draft 7' x 40 Tons - Full keel - Sea anchor: 24-ft. Diameter *Para-Tech* on 500' x 1" nylon braid rode with 5/8" stainless steel swivel - No trip line - Deployed in cyclone *Justin* in deep water about 200 miles off the coast of Queensland, with winds of 65-85 knots and seas of 33-40 feet - Vessel's bow yawed 25°- Drift was 80 n.m. during 53 hours at sea anchor.

ORCA was on the Pacific leg of her planned circumnavigation when she was caught in the web of cyclone *Justin* 200 miles off the Queensland coast. The largest cyclone in 20 years, *Justin* caused millions of dollars in damage, capsized barges, left two people dead, twenty three missing and many homeless. Scores of RAAF and US fighter aircraft and fifty warships had to be evacuated from Townsville as *Justin* tore into a massive joint military exercise - *Operation Tandem Thrust*.

ORCA might have emerged intact had the cyclone moved on, instead of stalling overhead. Finding themselves boxed in against the Great Barrier Reef, *ORCA*'s skipper and first mate decided to put down the sea anchor.

"Without the sea anchor, they would have found us on the reef," said owner Robin Ansell in a telephone conversation with Victor Shane.

Deployment of the large sea anchor and 500' of 1-inch line was difficult and further exacerbated by some sort of toxic, chemical mist emanating from the wet rope itself. All told *ORCA* remained tethered to the sea anchor for 53 hours, lying about 50° to the wind (no bridle).

One can only imagine what the conditions must have been like. In an interview with the *Townsville Bulletin,* Robin and Maggi said "It was like the water was boiling... it didn't have a pattern to the swell. It just hit us from all sides."

The yacht was eventually holed by a rogue wave. "We were hit by a wave which put a hole in the galley and a similar rogue wave tore two ventilator boxes off the deck. We tried to stuff them to stop the water

coming in but we realized we couldn't keep up with it."

The couple had to put out a Mayday. Senior Queensland Emergency Services helicopter pilot Peter Hope said it was the worst weather he had ever flown in. He said, "The majority of the swells were 10m but the mast of the yacht was 18m and there were times when you couldn't see it over the top of the waves." Here is a transcript of the DDDB file Shane obtained from Robin and Maggi Ansell:

> *We were already in very rough sea conditions when we deployed the para-anchor, because for as long as was viable, we motored across the seas to give us as much distance from the Great Barrier Reef as possible. We deployed it through our starboard side bow roller, and once the parachute had opened up, gradually let out the line by having it wound round the mooring bits. The scariest part of the whole thing was being temporarily blinded, which appeared to be caused by the acrid-tasting spray emanating from the rope, which was wet from the rain and salt spray, and squeezed out as a fine mist when it was pulled extremely tight as it was being run out round the mooring bits when we were struggling to let out the line with some control.... In any case, it is a potentially lethal situation, when one can only see vague shapes, and it is impossible to read instruments, etc. for 24-36 hours. (I couldn't even read the bright green of the radar screen). The absolute agony of the burning feeling under the eyelids, and the constant running of the eyes trying to rid themselves of the foreign matter was unbelievable, similar to a severe case of "arc eye." Fortunately we just stayed on the para-anchor, and vision started improving after 24 hours. There was absolutely no possibility in our weather conditions of being able to go forward each hour to check for chafe, also the load on the anchor line made the line like a steel rod, and one could never have got any slack to be able to replace a chafe guard. Realizing this from the start, Robin attached a ten foot length of half-inch section anchor chain to the eye of the line, which ran through the starboard bow roller. This took care of the chafe, as it was impossible to go forward again as far as the bow during the rest of the 53 hours at anchor before our rescue. The next day, only by peering through the window by the internal steering station, when the vessel was at the bottom or top of a trough, could we sometimes catch sight of the white line leading away from the boat. Then as vision improved we could watch the drift on the GPS, which seemed to average out at about 1.5 knots.*
>
> *We had deployed the whole 500 feet of line, which probably was not enough in those conditions, but once deployed, it was too dangerous to consider adding further line (of which we actually had another 800 feet). Also we did not employ chain for catenary, on this our first use of the anchor. We would guess that the wave length was probably about 150 feet. The rescue pilot said that the yacht was coming off the waves at 12 knots, since he had to reverse at 12 knots to maintain distance from the top of the mast as we rolled up the waves. He was probably hovering at about 100 feet from the water, and the top of our mast was 70 feet from the water.*
>
> *There were occasional maverick waves, which were double-crested. The result of which was that we rolled over the first crest straight into the advancing front of the second crest, instantly halting the vessel's roll. Roll rate was up to something like 60 degrees per second, so not only were tons of green water dumped over the vessel but the impact on the hull and superstructure was phenomenal. This is what lifted sealed and battened-down hatches pouring in gallons of water and later broke the galley portlight, and subsequently ripped off the starboard dorades and smashed the safety line stanchions. We probably had about 6* [rogue waves] *during the 53 hours*

before being rescued, each sounding and feeling as if one had been hit by an express train. Each increased in severity until the last two were responsible for the physical damage to the vessel.

Once we had issued the Mayday, we spoke via Townsville Radio and subsequently Sydney Radio to the rescue operations center at Canberra, and were informed that a rescue operation was being put in hand. Within an hour we heard that there was a US Hercules in the area to locate us, that a Rescue Helicopter had departed Townsville with an ETA at our position in 50 minutes, and that a Flying Doctor Service Beechcraft King Air with life rafts would be on station if the helicopter had to abort. We activated our Class 1, Type 406 Satellite EPIRB when instructed. Later we were told by our rescuers that without the EPIRB there was no way they could have located us in such atrocious conditions. We then followed their instructions to the letter, to enable the rescue to take place.

We were rescued on 9th March. We have subsequently heard that Townsville took a double hit from Cyclone Justin *on 22nd March and suffered significant damage. For a couple of days following our rescue, Townsville Radio issued the position of* ORCA *as a hazard to shipping. Then the bulletins stopped, and she is assumed sunk.*

ORCA of George Town. This Tahitian Ketch used a 24-ft. diameter sea anchor to stand off the Great Barrier Reef in cyclone Justin. "There was absolutely no possibility in our weather conditions of being able to go forward each hour to check for chafe.... Realizing this from the start, Robin attached a ten foot length of half-inch section anchor chain to the eye of the line, which ran through the starboard bow roller." (Maggi Ansell photo).

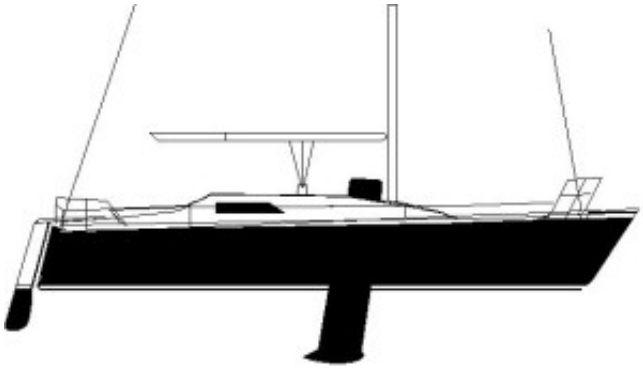
S/M-35 Fast 40 Sloop

Fast 40 Sloop

40' x 3 Tons, Lifting Keel

12-Ft. Dia. Sea Anchor

Force 7-8 Conditions



File S/M-35, obtained from Robert J. Bragan, Bethesda MD. - Vessel name *Javelin*, hailing port West River - Fast 40 sloop, designed by Alan Adler, LOA 40' x LWL 36' x Beam 8' x Draft 7.5' (with keel down) x 3 Tons - Lifting keel (fiberglass-encapsulated 2000 lb. lead bulb on end) - Sea anchor: 12-ft. Diameter *Para-Tech* on 300' x 5/8" nylon braid rode with 1/2" stainless steel swivel - No trip line - Deployed in a gale in deep water about 300 miles west of Bermuda, with winds of 30-40 knots and seas of 12-15 feet - Vessel's bow yawed 30° with riding sail on backstay - Drift was about 5 n.m. during 12 hours at sea anchor.

An ultralight ocean racer designed by Alan Adler, this yacht was one of fifteen Fast 40's built in the 1980's by North End Shipyards of Rockland, Maine. Given her narrow beam, slender profile, low displacement, and high-tech construction, she was aptly named *Javelin* by her owner.

En route to Bermuda in May 1996, *Javelin* ran into bad weather and hove to a sea anchor. After the weather moderated she got underway again. And that's when her 2000 lb. lifting keel fell off. The yacht rolled over and subsequently had to be abandoned. Rob Bragan's brief hand-written note on the back of the DDDB form reads, "the 12 ft. sea anchor performed beautifully once anchor riding sail set on backstay."

The following is a transcript of Rob Bragan's article about the incident, appearing in the September/October 1996 issue of *Ocean Navigator* (reproduced by permission of *Ocean Navigator* Magazine):

> *We sailed* Javelin *extensively on the* [Chesapeake] *bay in all sorts of weather, including winter gales. Experience caused us to add stand-up blocks on the cabin top for double-sheeting the trysail, as well as a 12-foot Para-Tech sea anchor, a wind vane self steering system, anchor riding sail, detachable furling system for the Yankee jib, and many other improvements. In two years I hauled the boat twice, initially for a survey that found no problems and later to fair and paint the keel and hull. The keel assembly* [2000 lb. fiberglass encapsulated lead bulb] *was inspected each time, but only after losing* Javelin *did I learn that the previous owner had found broken bolts among those that secure the Delrin blocks and had replaced all four bolts twice. (A good*

maintenance log might have saved the boat by recording such details for subsequent owners).

On Friday, May 24, 1996, after picking up a rented Viking life raft and an ACR Type B 121.5/243 MHz EPIRB (406 MHz units cannot be rented) from Outfitters/USA services in Annapolis, we left our mooring in Galesville, MD....

Transitioning from Chesapeake Bay sailing to ocean sailing as night fell, we left the coast behind. Our course of 150° magnetic led to a waypoint NE of Cape Hatteras where the [Gulf] *stream was only 80 nautical miles wide.... A pod of 30 to 50 spotted dolphins greeted us as we entered the stream, and they stayed until a tail slapped to starboard calling them off to the south. Were they moving away from impending bad weather?*

The wind strengthened from the NNE on May 30, reaching a sustained 28 to 32 knots (Force 7) at the masthead anemometer by afternoon. The sea state increased from a few feet in the morning to 10 to 15 feet with occasionally larger, breaking waves, by evening. The 65° water temperature, knotmeter, and GPS readings all suggested we were in the wrong quadrant of a cold eddy which was aggravating the sea state. We put the second drop boards in place, secured the sliding hatch and hand-steered a beam reach, turning up and over bigger waves. The back sides of some waves were as steep as the fronts, requiring another turn at the wave top to set a good angle down the back and avoid slamming the boat....

After battling the waves for hours, the prospects of further exhausting ourselves with hand steering or deploying a drogue and losing miles by running off to the SSW were unacceptable. Lying ahull or heaving to were out of the question since Javelin *had been too lively in past attempts and since the steep, breaking waves could roll the boat if she were caught broadside. Our position was approximately 400 miles from Bermuda, 10 to 20 nm south of the rhumb line. It was the right time to deploy the sea anchor. I had made up a dual-purpose sea anchor/drogue bridle of 3/4 inch three strand nylon line a few weeks before that would be strong and resist chafe. The bridle, shackled to stainless steel lifting plates on the aft end of the keel case, ran forward and through the rubber bow anchor rollers, terminating in a heavy thimble clamped in place. Three hundred feet of 5/8-inch braided nylon anchor rode was now shackled between the bridle thimble and the sea anchor. Strong attachment points on the boat, chafe protection, and a long, braided elastic rode are necessary components of a sea anchor system.*

Deployment involved Tim's steering us through a 150° turn to point up into the wind, at which time I fed out the sea anchor float, trip line, deployment bag, and rode from the bow. The boat immediately fell off onto port tack before Tim could drag the trysail down. I fed rode and Tim wrestled sail until finally the rode came taught and we were pulled around.... A few minutes after the messy set, we were riding to the sea anchor and Javelin *began her anchor dance. She was sailing through a 90° arc, so that breaking waves threatened to throw her sideways.... Setting the 15- to 20 square-foot anchor riding sail on the backstay with double sheets led forward to the toerails reduced the boat's arc to less than 60°.... With the cockpit secured, we closed ourselves up inside the boat to rest. Both the boat and we had taken a pounding during the last 12 hours. We needed food and sleep....*

The next day and a half brought NE winds at 18 to 25 knots and six-to 10-foot seas, so we

recovered the sea anchor and set sail that day, continuing on through the night making good speed and staying on course. We lay to the sea anchor on the night of June 1 as the wind clocked to east and strengthened. On June 2 we again set sail, but 20 to 30 knots of wind out of the ESE nearly halted our progress, and we made only 40 nm to the south. Early that evening we again set the sea anchor to hold our position while awaiting a better wind direction. Sounds from the keel that were louder than usual caused Tim to raise it into its case for support....

We awoke on the morning of June 3 to the first beautiful day of the trip. The wind had rounded to the SW at last and moderated to 10 knots. The sky was clear for the first time, the waves were running three to five feet and we only had a couple of hundred miles to go.... We lowered the keel and put the aluminum brace back in place.... Upon recovering the sea anchor, we raised the mainsail. As it filled, the boat heeled a little... a lot... and continued to lay over until flat on her side. It happened so gently.... After pausing for a few seconds, Javelin *finished turning turtle, leaving us alongside trying to comprehend what had happened in less than a minute. We climbed onto the hull and peered into the empty keel case. The four bolts that had secured the keel to the Delrin blocks on either side were sheared off, leaving the heads on one side, tails on the other, and nothing but air in between....*

After getting over the initial shock, Rob Bragan and son Tim inflated the life raft and quickly resigned themselves to the serious business of survival, diving and retrieving 20 gallons of water, food, blankets etc. from *Javelin*'s upturned hull. The EPIRB was then turned on and the raft allowed to drift free of the mothership.

A short while later they spotted a passing ship and fired off parachute flares, but it did not see them. Just before sunset however, a Coast Guard C-130 roared overhead. Crew members on the aircraft reportedly saw *Javelin*'s upturned hull first, and Bragan reckons that they should have remained tethered to the hull for as long as possible to be easier to see. Later the Italian bulk carrier *Ursa Major* was diverted to the scene and plucked the waterlogged sailors out of the Atlantic.

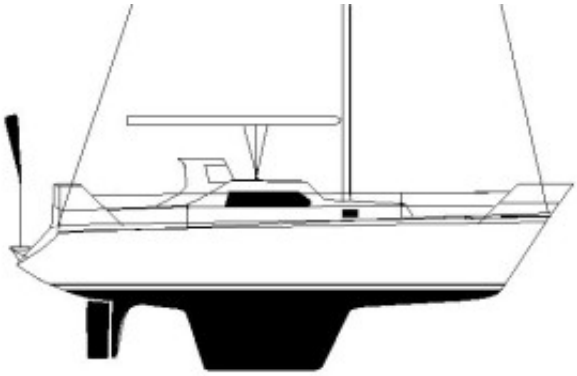
S/M-36 Arpège 29 Sloop

Arpège 29 Sloop

29' x 3.6 Tons, Low Aspect Fin/Skeg

12-Ft. Dia. Sea Anchor

Force 8-9 Conditions



File S/M-36, obtained from Eleanor Tims, West Hagbourne, England - Vessel name *Moon River*, hailing port Southampton - Arpège sloop, designed by Dufour, LOA 29' x LWL 22' x Beam 10' x Draft 5' x 3.6 Tons - Low aspect fin keel & skeg rudder - Sea anchor: 12-ft. Diameter *Para-Tech* on 300' x 5/8" nylon braid rode with 1/2" stainless steel swivel - Partial trip line - Deployed in a gale in deep water about 50 miles north of Casablanca, with winds of 35-45 knots and confused seas - Vessel lay broadsides to the seas due to fouled sea anchor - Drift was about 80 n.m. in 32 hours.

Eleanor Tims has been a die-hard sailor for twenty years and has her own sailing school in the UK, offering practical boat handling and confidence-building courses. She has cruised her Dufour Arpège 30 out of Hythe Marina in England, sailing nearly 5,000 miles a year, now and then shaking a white-knuckled fist at Fastnet Rock on a passage to the fair harbors of Ireland, or waving a hasty goodbye to Ushant Island on a wind-driven - compulsive - jaunt to Santander harbor on the northern coast of Spain.

Eleanor is *addicted* to sailing. She has written many articles describing some of her hair-raising experiences at sea, the most infamous of which took place in the Bay of Biscay in 1994 - Force 9 and 25-foot seas, the mast about to come down, crew seasick, the diesel and the VHF dead, a roller furling genoa in ribbons and turned into screaming banshee, rocky islands and shoals looming close in the night, etc. etc.

Somehow the indefatigable, indomitable Eleanor Tims manages to emerge from such ordeals with a wave, a nod, a wink and a wicked sense of humor. Where would we all be without our sense of humor at sea?

In November 1996 Eleanor and friend Tom were sailing *Moon River* to the Canaries from the Moroccan harbor of Mohammedia when they ran into a gale and tried to deploy a sea anchor. What follows is a hard-won lesson that the lady would like to pass on to others:

> *We left Portugal for the Canaries with a favorable NE wind and decided to divert to Casablanca, Morocco, in order to break the long 600 mile leg into two stages and also to visit an "exotic" country. After leaving the harbor of Mohammedia our tack lay to the SW, but the wind, which had*

been from the NE for a long period, did a complete volte-face and came from the SW. I decided, nevertheless, to leave, as the forecast was for Force 5/6 and I thought that I could lay in a long tack to the NW and then to the South and perhaps the front would pass over in that time. However, things did not work out according to plan, as firstly there were very big seas running and secondly the wind increased past Force 6, to 7 and then 8. We were already becoming very tired and it was obvious that the time had come - indeed was past, as it was now dark - to put out the para-anchor.

Because it was dark, I took a long time in carefully preparing everything to ensure that is would run smoothly when launched, perhaps an hour. When I went up onto the foredeck, it was found that the deck-light was not functioning, so I had only the fitful light of a flashlight shone from the cockpit towards me. First of all I launched the pickup buoy and line, followed by the float buoy, but these were torn from my hands by the wind (nearly 40 knots) and by waves sweeping over the deck and over me. I then realized that the genoa furling line made things complicated and that I ought to have launched all this gear beneath the furling line instead of above it, so I pulled it in and tried to stuff it back into the sea under the line instead of over. Trying to do this caused a tremendous snarl-up, so I was forced into spending a long time lying sprawled on the deck in the almost continuous dark, with waves washing over me, trying to sort it all out. Eventually I decided I had it just about right and once more launched it all, following it finally with the para-anchor and 100 metres of rode. This done we turned in. However, things didn't seem right somehow. The bow was clearly not pointing into the waves, as every wave swept us over sideways, sometimes very nearly beam on, is how it felt. We were quite clearly lying ahull, and an inspection of the wind instrument confirmed that wind and waves were beam on. We passed an entirely wretched night, and were so tired the following day, with the wind steady at about 40 knots, that we were too tired to do anything much about remedying the situation. I did realize that the para-anchor hadn't opened, and as I could see both buoys close together, I also realized that the whole lot had snarled up together. We attached the rode to the [steel] *anchor and let out a few metres of chain, so that it now ran out of the boat through the bow roller instead of through a deck fair-lead. This didn't improve things at all, in fact it probably worsened them, as I suffered some damage to the bow roller as a result. We had another perfectly horrible day, drifting backwards for the Strait of Gibraltar, far beyond our original starting point* [more than 60 miles].

Day 3 saw me in more positive mood. "We have to get this thing in," I told Tom, so he did the muscle work. The wind was still 30+ knots and it took us about 50 minutes to bring the bundle in, and then the sad story could be seen. What had happened was that the tripping line had twisted round and round itself until it was as stiff and unwielding as a metal spring and that this metal-like mess had ensnarled with it some of the shroud lines of the para-anchor. (The latter had not opened - had just lain in the water like a lump of cloth). Later, on arriving at a harbor near Cadiz when I was able to put it all out onto a dock and try to disentangle it, I found I had to cut away the tripping line - it had practically fused into a couple of "springs." These had abraded 11 of the 12 shroud lines and had indeed broken three of them. I knew I should return it to the factory [for repairs] *but I did not dare let it out of my hands. I knew I would need it again and I intended to use it again. So I took it to a local sailmaker, spread it out on his floor and we agreed as to how to repair it. He sewed some very strong sailmaker's tape into the shroud lines, restoring them all to a good state and ensuring that they were all the original length.*

On Christmas day we left again for the Canaries. Same story. Weather got bad, decided to put out

the para-anchor and this time to do so before dark. I had bought a new tripping line, 50 metres of floating line. This went out OK, then the float buoy.... Got the float out and the parachute. Absolutely brilliant! The bow came right round into the waves and yawed from side to side, but I could see the parachute had opened. Good, so far, I thought. I then uncleated the pickup buoy, stood up and tossed it into the sea over the pulpit. I had cleated off the anchor rode at about 20/30 metres, and was going to let more out in progressive lengths. However, I never got as far as that because in a twinkling the parachute had opened, the rode-tightened to steel-bar tautness, and, horror of horrors, not only was it leading OVER the pulpit, which folded down as if made of butter, but it was also once round the forestay and my precious furling gear. How that happened I have next to no idea because I thought I had been very careful... I think this story illustrates the dangerous effect of being tired and maybe also of being short-handed.

OK, still enough daylight, probably, to winch it in and start again. However, we were hampered by the weather conditions from doing anything at a reasonable sort of speed. Rain, like a dense monsoon, fell like rods of iron, flattening the sea, doing a sort of white-out and flattening me too! Eventually got the chute back on deck. Exhausted. And dark now. OK, why didn't I motor up to the pickup buoy and pick it up? Because as I hadn't stitched the damned knot up, just tied it to the [float-line] *swivel, it had come undone and is now floating happily around the north Atlantic, trailing its new rope!*

Well, it was dark, I was soaked and exhausted, and felt unable to sort out the mess of lines, so bungeed it all away and off we went into the night and Force 7/8 - increasing - big seas, 4-6 metres. Later the night turned into a nightmare. I was making very poor progress with small sails, only about 2 knots, and a ship (whose Officer on Watch was clearly not on watch as I even fired a flare) collided with us! In order to prevent the mast from falling (an upper shroud was torn away) I decided to go back - 200 miles - to Cadiz. I think I am lucky to be alive, as after that the wind increased to 40+ kn steadily, gusting up to 55, and we had to hand-steer under the most minute sails, in waves that must have been 8-10 metres high....

Somehow - by hook or by crook - Eleanor managed to outdo Neptune and bring her ship back into safe harbor at Cadiz, whence she contacted Victor Shane. Shane then passed her feedback on to Don Whilldin of Para-Tech Engineering in Colorado.

Although it would appear that in this case the para-anchor and float line assembly may have been fouled even as they hit the water, Whilldin nevertheless went to work on the design of the Deployment Bag, to see if there was any way in which he could somehow further reduce the chances of float line foul-ups. The simplest solution, of course, would have been to forego the float-line altogether. Unfortunately the float line and float are necessary to keep larger para-anchors from sinking straight down when the wind dies.

So Whilldin made a modification to the deployment bag instead. The thirty feet or so of colored float line, previously coiled outside the Deployment Bag, is now tucked into a "kangaroo pouch" under it. With this minor design change there is less chance of float line foul-ups. Whilldin reasons that once the parachute

has opened up and is under stable tension the chances of float line foul-ups are greatly reduced. Likely most of those foul-ups occur in the pre-inflation stage, when the parachute is a shapeless mess of loose cloth and shrouds.

Don Whilldin sent the English lady stranded in Spain a brand new sea anchor, in appreciation of her contribution to design improvement. The redoubtable Eleanor Tims has since crossed the Atlantic.

S/M-37 Monohull, Pearson 424C

Monohull, Pearson 424C

42' x 11 Tons, Low Aspect Fin Keel

18-Ft. Dia. Sea Anchor

Force 8-9 Conditions

File S/M-37, obtained from William T. Dwyer, Jr., Chicago, IL. - Vessel name *Overdraft*, hailing port Chicago, Pearson 424C cutter, designed by William Shaw, LOA 42.4' x LWL 33' 8" x Beam 13' x Draft 5' 6" x 11 Tons - Low aspect fin & skeg rudder - Sea anchor: 18-ft. Diameter *Para-Tech* on 300' x 5/8" nylon braid rode with 5/8" stainless steel swivel - Partial trip line - Deployed in a gale in deep water about 350 miles NW of Bermuda, with winds of 35-45 knots and seas of 12-20 feet - Vessel's bow yawed 20° - Drift was undetermined due to the proximity of the Gulf Stream.

The Gulf Stream is a 60-mile wide, swift (up to 5-knot) eastward flowing current. Past Cape Hatteras the stream is known to meander from side to side like a river. These meanders may change periodically, peeling off from the main body of the stream to form intense eddies. The eddies are sometimes called "rings." As the Stream moves eastward, warm rings are formed to its north and cold rings to its south. These discrete rings often migrate and meet back up with the main body of the Stream after months, or sometimes years.

Since the Gulf Stream transports warm water from southern latitudes one can usually tell whether one is entering or exiting it by the abrupt change in water temperature. At its edges, and deeper down, the Stream consists of a distinct, temperature gradient. This thermal gradient may extend deeper than 6000 ft. beneath the Stream.

Since cold water tends to dive beneath warm water, theoretically it may take a large sea anchor down with it - if it is deployed at an exact boundary zone. This is something that one has to be cautious of if one has to use a sea anchor in the Gulf Stream, especially in the fringes of a cold eddy. If this is the case one should rig a full trip line, one that allows the canopy to be readily tripped and retrieved without having to power up to the secondary float of a partial trip line. Otherwise the anchor may have to be cut away. There may be a possibility that this is what may have happened in the case of the S/V *Overdraft*. Transcript:

> *We departed Newport, RI on the afternoon of June 1, 1997 bound for the Mediterranean via the Azores. NOAA and a private weather forecaster called for NE winds 20-30 kts and recurring low pressure systems along a frontal boundary lying east to west along the 40th parallel, dropping to*

the southeast. Our plan was to sail SSE to approximately 38° N where we would cross the Gulf Stream and then sail SE until we encountered the westerlies. The going was rough, with winds from the NE higher than predicted.

Some time in the early morning of June 3, we entered the Gulf Stream heading south. Winds over the prior 24 hours had been NE at Force 6 to 7. Throughout the morning, winds increased to Force 8 to 9 with one observed gust of 55 kts apparent. We were sailing downwind in a following sea doing 8+ kts by the speedo. The waves became tall (10-12' with frequently higher waves of approximately 20'), and steep, as the seas ran counter to the Gulf Stream. Graybeards covered the sea as the tops of the waves broke against the current. We were sailing almost due south with the wind against the current, and although our knotmeter was registering hull speed, we were making approximately 4 kts over the bottom according to the GPS. I determined that we could not exit the Stream before nightfall on our current course, and decided to attempt to head ESE to escape these dangerous conditions before dark.

We proceeded ESE under staysail, deeply reefed main and engine to maintain as much directional control as possible. We took the non-breaking waves just aft of the beam and fell off to take the large breakers on our port quarter, or headed quickly up to take them at a 60° angle off the port bow. On three occasions when attempting to run off we were caught by a breaker and broached to starboard with the spreaders in the water and the wave breaking over the port side, filling the cockpit with 2½ feet of green water. By dusk we had reached the edge of the Gulf Stream, which we determined by a significant drop in water temperature. The waves became more trochoidal [rounded] *in shape with fewer breakers. I decided at this point to set the sea anchor for the night as the crew had experienced miserable weather for three days and had no food or sleep for almost 24 hours.*

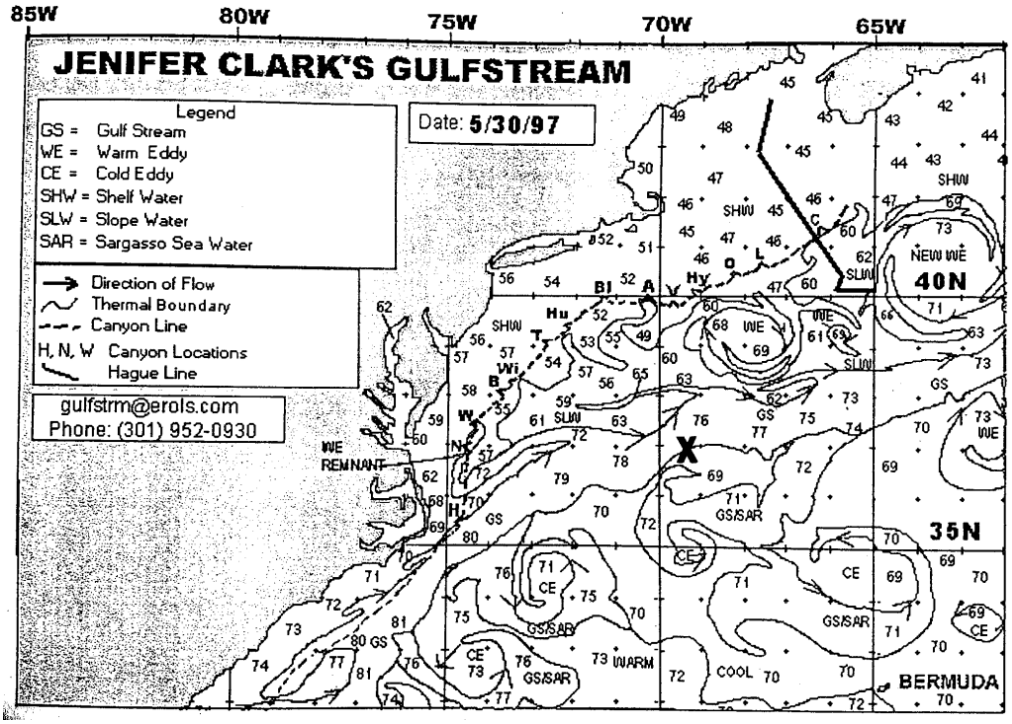
An 18 foot Para-Tech sea anchor was deployed off the bow on 300' of 5/8" nylon braid line with 5/8" stainless swivel and no chain. The para-anchor had the standard float line with a 12" diameter plastic float buoy securely attached. After deployment the boat lay bow to the wind and did not yaw significantly from side to side, although Overdraft *continued to pitch sharply, as the seas, while improved, were still quite steep. The boat lay to the sea anchor all night in winds of Force 7 decreasing to Force 6. Seas remained at about 8 feet.*

At first light, we found that the rode was pointed downward at an angle of 35-45° off the port bow. Overnight the rode had chafed through the teak cap rail below the chock in an arc, cutting downward 3/4" to 1" into the wood. It was apparent that the boat was being pulled by the para-anchor in a northeasterly direction against the wind and sea. A comparison to the position check at the time the anchor was set showed we had move NE more than 3 nm overnight. The strain on the anchor rode was significant.

We attempted to retrieve the sea anchor by motoring in the direction of the anchor and pulling on the line - without success. The anchor seemed to dive deeper as we motored towards it, and we were only able to recover line as the boat rode down into a trough. As Overdraft *rode back up the next crest, the rode was cleated and came under extreme tension with the anchor pulling downward on the bow. The wind was beginning to increase again and I feared that the crew attempting to retrieve the anchor by uncleating and cleating the line between waves could suffer*

serious hand injury, given the tension on the rode and the sea states. At this point I cut the anchor away. We had only recovered about 10 feet of line.

My supposition is that we had not sailed completely out of the Gulf Stream, and that the sea anchor was pulled downward by the northeasterly flowing current which may have been stronger at depth because of the counter-acting surface conditions caused by wind and waves. I do not believe the float became detached as it was securely tied and floating free upon deployment. Clearly, we were still in the influence of the Stream or we could not have moved northeast overnight against the wind and sea. An attempt to plot our position on a May 30th Gulf Stream analysis weather fax is enclosed, and it shows us at approximately the edge of the Stream on 0700 June 4. I find our overnight drift the more compelling evidence that we were still in the Stream because the potential plotting error of both the boat's position and the Gulf Stream location on this large scale fax is very large. For what it is worth, I don't believe setting the para-anchor in full current of the Gulf Stream in the conditions we experienced would have been a successful strategy. Because of the steepness of the seas and their frequent breaking, the boat would have taken a terrible pounding. The current would have pulled us NE into the seas, and because the anchor "dove," the bow would have been held down, further impeding the boat's ability to ride over the breaking seas. This experience has convinced me that (not even considering the loss of the gear) a sea anchor should not be set in a strong current running counter to the wind and seas except in a case of absolute last resort.



NOAA chart of the Gulf Stream for 30 May 1997. X marks the location of Overdraft. (Courtesy of JENIFER CLARK'S

GULFSTREAM).

CAUTION: Do not deploy a large sea anchor in the axis of a major current unless it is absolutely necessary. Use a full trip line if you do, else stand ready to cut away the rode if you are *absolutely certain* that a cold eddy is taking the parachute down into the depths. You will be able to tell that this is so when the main float begins submerging and then finally disappears, by the significant increase in the angle at which the rode is leading downward, and by an unmistakable downward pull on the bow of the vessel.

If you are in the vicinity of a major current and there is a gale on the way, the best strategy is to try to traverse the current at right angles and *get well clear* before deploying the sea anchor. By and large ocean currents are a mixed blessing. The free ride that they may provide can be very costly at times. Some experienced sailors prefer to stay out of them altogether. The Pardeys have this to say about major currents in *Storm Tactics*: "Another thing we've learned the hard way is to avoid the axis of major currents. Even though it is tempting to grab the free lift offered by the Gulf Stream, you increase your chances of meeting unusual weather patterns and rougher seas."

S/M-38 Tayana Surprise

Tayana Surprise

46' x 13 Tons, Fin Keel

18-Ft. Dia. Para-Anchor

Force 12 Conditions

File S/M-39, obtained from Stephen Edwards & Deborah Schutz, Henley Beach, South Australia - Vessel name *Prisana II*, hailing port Adelaide, Tayana Surprise ketch, designed by Pieter Beeldsnidser, LOA 46' x LWL 40' x Beam 13' 4" x Draft 6' 10" x 13 Tons - Fin keel - Sea anchor: 18-ft. Diameter para-anchor (Para-Anchors Australia) on 410' x 3/4" nylon three strand rode with 3/4" stainless steel swivel - Partial trip-line - Deployed in a storm in deep water about 75 miles west of Cape Bouvard (Western Australia), with winds of 65-80 knots and seas of 40-60 feet, with microbursts evident - Vessel's bow yawed 20-30° during 59 hours at sea anchor. Drift was affected by a southerly current.

This important file was initially forwarded by Alby McCracken of *Para-Anchors Australia*, to whom we are indebted. The sea anchor used was 18 feet in diameter, manufactured by *Para-Anchors Australia*. Stephen Edwards and Deborah Schutz are quite certain that it saved the boat. The winter storm that they ran into may have been reinforced by microbursts, judging by the thunderstorm activity, and by the tornado that left a 2-mile long swath of destruction through South Perth.

Deborah Schutz was kind enough to send a clipping from the July 17, 1996 edition of *The West Australian*. The headline reads "South Perth Hit by Rare Tornado." Accompanying photographs show the twister's fury as it rampaged through South Perth, taking roofs off of houses and uprooting trees. The Australian Weather Bureau's severe weather meteorologist, Tony Bannister, said the tornado probably originated west of Rottnest Island, traveling at about 80 km/h at sea, increasing in intensity and sporting 200 km/h winds when touching down at Perth.

Prisana II is heavy, with a lot of windage - two equal height masts, both with in-mast furling. She was en route to Dampier, Western Australia, from her home port of Adelaide, South Australia, when she ran into this freak storm.

Perhaps we have a recurrence of the same sort of freak events that *Gold Eagle* ran into in File S/T-15, where we find Dr. Andrew Cserny writing, "Sometime during the night we were hit by an immensely strong burst of wind which I presumed must have been a twister, because the pressure inside the pilot house fluctuated rapidly, the windows rattled, the doors to the pilot house rattled, and the sliding hatches tried to come off the top of the boat.... The wind shrieked horribly with pitch and intensity I have never

heard before." *Gold Eagle* was later struck by a rogue wave. So was *Prisana II*, leading your authors to believe that these may have been microburst-generated ESWs - *extreme storm waves*. Transcript:

> *Sunday July 14th, 1996: By nightfall we were almost abeam Cape Naturaliste. Our weather fax showed a complex low was fast approaching. Due to our position, the unfamiliar coastline and the wind direction (40 knots NNE) there were no safe anchorage along the coast here in these conditions. Our motor was playing up and the option of using our sea anchor already considered, but due to the number of ships in the vicinity, we decided to keep going. We reduced sails, expecting the winds to swing SW with the approaching front, which we'd use to get us to Fremantle. We were wrong! Throughout the night Mother Nature unleashed a storm of unrelenting fury, NNE to 50 knots with large seas - our only choice to head out to sea* [starboard tack].
>
> *Monday July 15th: At first light we came about* [port tack]. *Perth Radio issued another gale force warning. The barometer read 996 and was rapidly falling. By evening strong west winds were in force, the barometer now at 990, though seas had moderated. As the night progressed, squalls reached 60 knots and lightning could be seen behind us as we traveled in a northerly direction* [parallel to the coast of Western Australia]. *The ferocity of the storm was intensifying. The needle on our wind indicator went beyond the last notch (65 knots) and the seas were dramatically increasing in height. At approximately 0500 hrs a huge wall of water knocked us down. The helmsman stood chest-high in water (thankfully harnessed) and our masts leaned to starboard, touching the surface of the ocean. We deployed the sea anchor, then all crew below and hatches battened. At this point we were 30 nautical miles off Rottnest Island.*
>
> *Tuesday July 16th: During the morning I ventured above to the cockpit and was immediately awestruck. The seas were incredibly huge. I soon retreated below. I later found out the seas were reported to be 11 meters on top of a 9 meter swell - the faces of the waves around 60 feet. We currently had plenty of sea room and were drifting in a southerly direction at 1 knot. The parachute anchor held us steady, as the winds, sounding cyclonic, whirled over 70 knots. Waves drenched the deck as we rolled from side to side. For 24 hours we drifted in this direction, towards Naturaliste Reef.*

"Tuesday July 16th: During the morning I ventured above to the cockpit and was immediately awestruck. The seas were incredibly huge. I soon retreated below.... The parachute anchor held us steady, as the winds, sounding cyclonic, whirled over 70 knots." (Photo credit: Deborah Schutz).

Wednesday July 17th: We were drifting east and we now know that we were in the Leeuwin Current. The Leeuwin Current runs southward down the continental shelf from Indonesia, bringing masses of warm water. It begins flowing around April each year, through October, seldom moving faster than 1 knot in a band approximately 50 kilometers wide. The weather remained unchanged. All day long the winds continued to blow over 70 knots and we were now down almost as far as Bunbury, having crossed over, above the Naturaliste Reef. A large cargo ship had just lost 30 containers off Cape Leeuwin. The Adelaide media reported that a cyclone had hit Perth.

Thursday July 18th: Conditions were moderating, winds now down to 50 knots and the barometer slowly began to rise - seas still large but easing. Late in the afternoon we retrieved the para-anchor (which wasn't easy), and she came up with a hole in her. Our 130 meters of rope had stretched an extra 20 meters. The wind now blowing 30-40 knots - felt like a mere breeze as we set course for Rottnest Island. Friday July 19th, around 1030 hrs we motored into the Fremantle Sailing Club, grateful that we had decided to purchase a parachute anchor. With it we were able to ride out and survive the conditions - our bow held into the seas. The Weather Bureau in Perth described the freak weather as a rare winter tornado. It struck the coast with 200 km/h winds.

Southwest corner of Australia. "X" marks the approximate place where Prisana II first deployed the sea anchor

In the face of this important file, Victor Shane contacted Deborah Schutz & Stephen Edwards regarding a few more questions, and received additional answers as follows:

> *Was the deployment fairly easy? We preformed a "Flying Set" and deployment was relatively easy. The anchor rode was fixed to a strong point at our bow, led aft and held in position by plastic cable ties at 6-inch intervals along the port side toe rail to a deployment bag containing 125 meters of 18mm 3-strand nylon anchor rode. This was set up prior to our departure from Adelaide to cross the Great Australian Bight. Deployment simply involved reaching from the safety of the cockpit to the rode deployment bag, unlacing the top - removing the end of the rode and shackling it to the parachute anchor. Trip line floats were then fed overboard, followed by para-anchor in deployment bag. Within approximately 30 seconds, we had taken up all the rode*

and the vessel was gently pulled into the wind, allowing us to lower the sails.

How did the boat behave at sea anchor? *Generally it appeared to be falling off 20 to 30 degrees, though it's difficult to be precise as we were below deck for nearly the whole duration of the storm. Occasionally we fell back on the rode and fell away to somewhere near 45°, approx. once every half hour, maybe due to rogue waves coming in on a different angle - hard to tell from down below.*

What about the disposition of the rudder? *The rudder was lashed to center at the quadrant, which broke twice - 6mm pre-stretched cord broke first, then 16mm nylon braid also didn't hold. We managed to make it hold on 18mm nylon anchor rode. Small twist, 10-15° in 2-inch 316 stainless steel rudder shaft at the point where quadrant is fixed.*

What about chafe? *Due to the set up of 1 meter of chain at the bow we had no chafing.*

Any green water come on deck? *Yes, Steve said there was a small amount, compared to the 2-3 foot of white water that washed over the deck.*

General impressions of strains involved? *We've realized the attachment point on bow needs to be extremely strong. Parachute anchor was shackled to 1/2 inch chain link welded to ship's anchor. Our ship's anchor was stored below deck level via custom bow fitting* [as with large ships, the forward part of the anchor left protruding out of the bow, and the para-anchor rode shackled directly to the ship's anchor by a 1 meter length of chain]*, then secured aft by 3/8 inch Ronstan rigging screws, secured to a 10mm stainless steel plate, bolted under the anchor winch. Winch and plate fastened by 6 x 3/8 inch stainless steel studs. Both the fixing point to the ship's anchor and to the plate were backed up by secondary systems. Ronstan rigging screw had 10mm chain back-up. Fixing to anchor was backed up by 5/8 inch stainless steel bolt, through anchor cheeks. Both systems failed! Ronstan rigging screw had 8 turns of thread removed. Back-up held, but ship's anchor smashed around, causing damage to our stainless steel bow fitting. Chain-link welded to ship's anchor was torn off and secondary chain from nylon rode took up the weight on 5/8 inch stainless steel bolt through anchor cheeks.*

Did you use a full trip line? *No, partial trip line - 2 floats and 2 x 15 meter lines with swivels.*

Was retrieval easy? *Not really. Wind was still strong (40-45 knots) and seas were still huge and getting steeper due to the shallowing depths as we got close to the coast - running out of sea room. Due to the noise from the wind and seas it was difficult to hear skipper's instructions from the bow to the helm and we fouled the rode on the propeller.*

How big was the tear in the para-anchor? *Two large, well frayed holes in two separate panels, between the venthole and the skirt.*

Did the para-anchor save the boat? *Absolutely!!! In the conditions we were caught in, we believe having our para-anchor set up, ready for deployment prior to leaving port, was crucial in the safe and easy deployment. Seas were huge - by far the biggest we had ever seen. Parachute rode was spanning one swell, being ripped out of the troughs and pulled taut. There was much white water*

being swept from the swell tops - large rolling loads of white water. Prisana II took many loads of white water across the deck, (maybe 2-3 feet of white water coming over the bow). The conditions were so bad that it was impossible to be anywhere on deck. We used a harness just to visit the cockpit - almost all of our time was spent below deck. The noise of the wind whirling outside was incredible.

We had a close encounter with a container ship slowly jogging into the storm, headed our way on the dawn of day two. Our radio contact was first answered by another ship, Australian, six miles away, and they informed us that this container ship was a foreign vessel, also mentioning that they didn't envy us one bit. After ten long minutes the container ship finally answered our call and his broken English caused us a minor panic - he didn't seem eager to alter his course! He told us he had no ballast and that he couldn't even see us! After persuading him to alter course by 10-15 degrees he passed us by only 0.4 nautical miles away - confirmed by our radar. The seas were so big that we were totally losing sight of this container ship (approx 400 foot long with an extensive bridge structure) behind the swells.

S/M-39 Lotus 9.2 Cutter

S/M-39

Lotus 9.2 Cutter

30' x 4 Tons, Low Aspect Fin/Skeg

12-Ft. Dia. Sea Anchor

Force 10 Conditions

File S/M-39, obtained from Ann and Jim Wilson, Christchurch, New Zealand - Vessel name *Karoro*, hailing port Moncks Bay, NZ, Lotus 9.2 sloop, designed by Alan Wright, LOA 30' 2" x LWL 26' 3" x Beam 11' x Draft 5' 6" x 4 Tons - Low aspect fin keel & skeg rudder - Sea anchor: 12-ft. Diameter *Para-Tech* on 2 lengths of 220' x 5/8" nylon three-strand rode plus 120' of chain and a 35 lb. plow anchor, with 1/2" stainless steel swivel - Partial trip-line - Deployed in a storm in deep water about 400 miles ENE of the North Cape of New Zealand, with sustained winds of 50 knots and seas of 20 feet and greater - Vessel's bow yawed 20° - Drift was about 10 n.m. during 15 hours at sea anchor.

In March 1966, New Zealander Jim Wilson used a 12-ft. Para-Tech sea anchor on *Karoro* in a gale during a coastal passage from Dunedin to Christchurch. Four months later, en route to Tonga, he used it again in a much heavier storm.

The sea anchor - deployed on two lengths of 220' x 5/8" rope, knotted together with bowlines - held the bow into the waves for a period of fifteen hours, the vessel yawing through a total arc of about 30-45° (about 20° off to each side). The sea anchor was then lost when the rode failed at one of the knots.

Sometime after losing the sea anchor, *Karoro* was rolled while lying a-hull. This incident confirms the opinion rendered by Peter Blake in File D/T-1: "I don't think lying a-hull is a mode of survival that one should contemplate if conditions are really severe. In moderate conditions, if you're not too worried about the sea state, maybe it's OK. But lying a-hull in a storm is a recipe for being rolled, or having the deck or the cabin top stove in and heavy water come inside. I think that the other approaches are better. Even

though lying a-hull is natural and sort of easy, I definitely don't think it's a tactic that people should use, unless they haven't got another option." Most safety experts concur that lying a-hull in a storm is a recipe for disaster.

Here is a transcript of the feedback obtained from Ann and Jim Wilson:

> *After three good days of sailing to the northeast, out of Gisborne, making over 120 miles a day, we began to feel anxious about warnings of storm-force winds heading our way. The wind increased gradually in intensity and it became clear we would soon be in the storm. Jim went out and put both storm sails up. The mainsail had to be completely removed from the mast to make room for the small orange trysail. The storm jib was hanked onto the* [removable] *inner forestay, and the furling headsail rolled up completely and lashed. This took some time and Jim finally staggered below, wet and weary. The sails felt comfortable* [with the vessel hove-to]*, but the wind kept gaining in intensity and the forecast was frightening - a band of storm-force winds, 50 knots, 400 miles wide. Soon the waves had become mountainous. I was too scared to look at them.*
>
> *About 1500 hrs Jim decided to take the storm sails down and put out the sea anchor. He collected three lots of chain, one from under the floor boards, and quietly deliberated on which to use. Then the slow ritual of dressing up and harnessing and emerging into the wild, wet cockpit to sort out sea anchor, buoys and buckets of rope, tying everything up. The sails had to be removed and stowed below, and he finally moved all the gear to the bow. It was starting to get dark. He said he had to get it right the first time or we'd have had it. That put me into a mild state of panic. I followed his movements like a hawk, terrified he'd be washed overboard by a crashing wave and left dangling by his harness. He was wedged in the bow trying to untangle a maze of rope. The wind and waves crashing over were making it worse and his life line kept getting tangled as well. I suddenly felt he'd never sort it out on his own. I began to knock on the hatch window and yell over the sound of the storm, asking if I should come and help. He finally beckoned me out, so I took the headlamp and clipped onto the safety line. Once outside, the force of the wind was terrifying. I was so scared of getting washed off I practically crawled up to the bow and between us we went about untangling the mess of rope.*
>
> *I found the free end he was looking for, tied the first buoy on and threw it over on Jim's instructions. I hurriedly played out the line which floated backwards. "Bring it in again," shouted Jim, "it's gone under the boat!" I suddenly saw the futility of it all. "It's hopeless," I shouted. At that he said, "OK, OK, throw out the other buoy." Over it went and then finally over went the sea anchor at last. Jim played out the warp and then the chain, and slowly we swung around into the waves. I found it hard to believe it was so much trouble. The whole performance had taken over three hours. (We have since devised a much easier system of deploying it from the cockpit, with chain already through the bow anchor roller fitting, with restraining pin in place, and the chain led back along the toerail, lashed in easy-release fashion, to the cockpit. We should, of course, have devised and tried this system before setting off.)*
>
> *I crawled back inside. The gentle hove-to movement had changed to a jerky sideways rock, but now we were parting the waves with the bow and not taking them every which way. Jim finally came below and after a cup of hot chocolate we crashed into bed. I discovered that the high pitched whine of the wind, and the way it ascended the scale as it increased in volume, was what*

depressed me most. That, and the way it stayed at a high pitch for long periods without dropping, and all the frantic rattles and quivering in the rigging and the sudden loud bang as a wave hit us and the water pouring over the decking. I suddenly remembered the wax ear plugs I'd brought along for diving. I jammed a couple in my ears and blissfully all sound disappeared. Only the motion remained. It got me through the night. I think we all had a reasonably good sleep.

Saturday morning, June 22, suddenly Guy said "We're going backwards." Jim saw the loose chain out of the front hatch and said, "My God I think we've lost the sea anchor." My hand flew to my mouth in horror as Jim raced about. "It's OK," said Guy, "it's a much nicer motion now" [the vessel now lying a-hull]. *I thought of the sea anchor floating away behind us. Poor Jim was struggling away at the bow, winding in the chain. He'd put so much effort into researching, buying and setting up the sea anchor, and phutt! Just like that, it was gone. He came in and said that the sea anchor warp had broken. He could hardly believe it. It was the same one he'd been towed by, off Akaroa, when the skeg and rudder went. Though he had been towed on these warps, under wild conditions, and therefore thought them tried and true, they were getting old; worse, we only had thimbles spliced in one end of each of the two, the other ends being bowline-knotted, which although tested before under tow (and afterwards, amazingly, the bowlines were undone quite easily) we should have known that a knot is a weak point; and it was at one of the knots that the rope broke.*

Jim lashed the tiller to one side and we lay a-hull with no sails. The motion was certainly more comfortable. We put the wooden washboards in the lower half of the companionway and the clear, perspex panel in the top, and slid the hatch cover shut as usual. Sheer stupidity - had we had all the washboards in, instead of this flexible clear upper panel, we would have taken in very little water later.

It was mid-afternoon when we were knocked down. There was no warning. No roar as the rogue wave approached us. It was deceptively quiet and I had momentarily undone my car seat belt that Jim had rigged up in my bunk. I'm not sure why, but I certainly paid for that folly. It seemed like slow motion as I rolled out and hit the table, breaking it off the wall. Then the sound of rushing water. I looked up and saw a waterfall pouring through the gap in the companionway. The clear perspex panel had popped out like a cork. Then Jim was hauling me under the armpits. He said, "We've just been knocked down - we'll come up again." I don't remember coming back up. I was too busy making horrible groaning noises as I struggled to get air into my lungs. My legs were caught in a swirling tangle of quilt, twisting like seaweed in the water. Then I was tossed onto my bed. I seem to remember Jim and Guy baling with buckets.

There was a sharp pain in my ribs and I was straining to breathe, but only getting a small amount of air in. I hoped my lungs weren't perforated. Jim left off baling and raced to the radio. He got through to T.M. [Taupo Maritime] *Radio and told them what had happened. "I think I've broken my ribs," I chattered through my teeth, while shivering. A doctor came on the radio and said to take my pulse and respiration, and to keep me as dry as possible. The storm was still raging. We had all the wooden washboards in but there was no guarantee that it wouldn't happen again. Jim and Guy were now as scared as me that we might have another knock down. Jim had strung me in my bunk even more firmly, but every time there was a loud bang on the side of* Karoro *I'd grab the rail and give a terrified shout.*

By Sunday morning, June 23, the storm was over, but we were a depressing sight. I was immobile and on pain killers. The inside was a mess. The radar was out. The new spray dodger had ripped out its attachments, the frame and stainless steel grab rails bent. The VHF aerial was ripped off, and the wind arrow and lights on top of the mast were gone. Blessedly the sun came out. Jim wanted to carry on to Tonga, saying at least we'd be in warm waters then. I couldn't envisage another week at sea. Jim unhappily agreed to go back to New Zealand, although later he realized we'd done the sensible thing. He started the motor, checked out the chart, and found our closest option to be Great Barrier Island. We felt so lucky to have dry batteries, engine and GPS, and the SSB still working. Apart from me getting thrown out of my bunk, we had gotten knocked down on the best side, leaving the batteries high and dry. We turned and headed back. By evening there was some semblance of order.

The next few days are pretty much blurred in my mind. I remember constantly asking "what day is it?" Time seemed to go so slowly. Nights were quicker with escape into sleep. We ran into strong northwesterlies. By Monday we were beating into 40-knot winds.... On Tuesday night we were closing in, but Taupo Maritime Radio had for some time been broadcasting navigational warnings of the New Zealand Navy's target practice along the Coromandel Coast... we were right in their firing line! Jim contacted T.M.R. and told them we'd been knocked down, on our way back, and in the line of fire. It was comic. Racing into stormy winds and big waves, saved from the depths of the sea, only to be fired on by our own navy. Guy and I were cracking up - me painfully....

On the quiet, still, cloudy morning of Thursday June 27, 1996 we motored into Tauranga. I had dropped into a deep sleep. I finally came to with the sound of voices. Jim was talking to a man who was helping us tie up alongside the marine. We'd made it!

Did the Wilsons sell the boat and buy a cozy little sheep farm inland? No! Ann & Jim recently returned from *another* long trip! Jim Wilson's hand-written note on the filled out DDDB form that Victor Shane had been anxiously waiting for reads thus: "Just returned from 6 months on *Karoro*, to Tonga and back. No need for sea anchor this time - no knockdowns! But very glad we had a replacement on board. Wouldn't now go to sea without one."

S/M-40 Monohull, Alden Ketch

S/M-40

Monohull, Alden Ketch

50' x 15 Tons, Full Keel & Cutaway Forefoot

18-Ft. Dia. Sea Anchor

Force 9-10 Conditions

File S/M-40, obtained from Steven McAbee, Lihue, Hawaii - Vessel name *Celtic*, hailing port Dutch Harbor (Alaska), monohull, cruising ketch designed by John Alden, LOA 50' x LWL 33' x Beam 12' 6' x Draft 5' 6" x 15 Tons - Full keel & cutaway forefoot - Sea anchor: 18' Diameter *Para-Tech* on 400' x 3/4" nylon three strand rode and 150' chain, with 5/8" stainless steel swivel - Deployed in a whole gale in deep water about 500 miles south of Dutch Harbor with winds of 45-50 knots and seas of 20-25 ft. - Vessel's bow yawed 10° with reefed mizzen flying - Drift was about 22 n.m. during 5 days at sea anchor.

Celtic is a 45-ft. center cockpit ketch built by Fuji Shipyards in 1975. In June 1996 she left Dutch Harbor, Alaska, headed for Hawaii and the South Pacific. On board were owner Steven McAbee, wife Pamela and son Zach. A few days out they ran into a succession of gales in the Gulf of Alaska. McAbee was well-prepared and deployed an 18-ft. diameter Para-Tech sea anchor. *Celtic* spent the next five days at sea anchor, her heavy, reefed mizzen keeping her bow nicely snubbed into the seas. The following is a transcript of Steven McAbee's article *Crossing Gale Alley*, appearing in the November/December 1997 issue of *Ocean Navigator* Magazine (reproduced by permission):

> *We had fully expected gales and had made preparations for them. Up on the bow, ready to deploy, was a Para-Tech sea anchor complete with trip line, buoys, 3/4-inch rode, and chain catenary. In the lazarette we had stowed a Seabrake Drogue with its own dedicated rode/catenary and bridle. We had Mustang exposure suits for foul weather on deck, harnesses and snap lines for each of us, immersion suits for abandon ship, flares, handheld VHF and GPS, survival supplies, and a 406 EPIRB. We also had* Celtic, *a proven storm survivor.*
>
> *Nevertheless, as the low continued to deepen and it became apparent that we would have to deal with it, an old familiar dread began to live in my guts. How bad would it get? Would the sea anchor and drogue work? Although we had practiced deploying them, it had been in relatively calm conditions. We were 500 miles from the nearest land and out of the shipping lanes on a big and lonely ocean. There would be no help coming. Whatever happened, we would have to deal with it ourselves. At night we listened on the SSB to other vessels, some in distress. A 49-foot ketch 400 miles south of Adak lost her rudder and was pummeled by 25-ft. seas.* Kamishak Queen, *a vessel we were familiar with, sank in Nuka Bay. A tripped EPIRB had been detected in Bristol*

Bay. The weather forecast called for 45-knot winds and 25-ft. seas. If the low stayed on track we would be in the worst possible place: south of the center and on the backside, the zone of highest wind and seas.

Throughout the day the winds and seas increased. As the wind shifted around from northwest to west to southwest and then south, our progress slowed until we found ourselves beating into 30-knot winds and eight-foot seas. The time had come to make a major strategy decision: Should we bear off to the west or east and try to make a few miles of southing in the worsening conditions? Or would it be better to deploy the sea anchor and sit out the gale?

After due consideration, we decided to use the sea anchor. The Para-Tech was connected to 400 feet of 3/4-inch nylon rode with a stainless steel swivel. All rode ends had spliced eyes with steel thimbles, and in the middle of the rode we had spliced in 20 feet of 1/2-inch galvanized chain to act as a catenary. After a practice deployment before the trip, we had decided to connect the bitter end of the rode to the chain anchor rode and deploy 150 of that. Additionally, we lashed the anchor chain to the bow roller to prevent it from jumping out as Celtic *rode the waves into the trough.*

We had packed the sea anchor, trip line, and rode into a large canvas bag and lashed it to the bow rail with the bitter end hanging out a hole cut in the bottom. All we had to do was unlash the bag, shackle the bitter end to the anchor chain (the [steel] *anchor had been disconnected and stored below for the open ocean), attach the buoys to the trip line, and let her go. Everything went smoothly, and soon we were securely moored to the Para-Tech. We hoisted a reefed mizzen, secured everything on deck, and went below. As night fell we began to feel the full fury of the storm. The rising wind was blowing a steady 40 knots, gusting to more than 50, while the seas built.*

I was really pleased with the performance of the sea anchor and the way Celtic *rode. During the five days of gale winds at 40 to 50 knots and seas of 18 to 25 feet, I never felt we were in any immediate danger. As the storm worsened and seas began to break over* Celtic, *I began to wish I had some way to attach all that chain and rode to the bobstay eye on* Celtic's *stem so her bow would ride higher, but there was no changing anything once it was set. As each monster wave approached,* Celtic *would back up, much like a retreating Muhammed Ali against a charging Joe Frazier, and let the impact roll under her. Huge waves would break on us, darkening the cabin as green water rolled over the ports.*

We were alone. We thought about all the stories we'd heard about vessels slowly breaking up under similar onslaughts: seams opening, through-hulls loosening, cockpit drains plugging. We had made all the preparations we could; all we could do was remain alert and deal with whatever happened.

We set up a radio schedule with the Kodiak Coast Guard Communication Base, better known as CommSta Kodiak, and every four hours we gave them our position, weather conditions, and vessel status. It was a comfort to speak with someone, and the sound of the radio operator's voice and the obvious concern of everyone at the station about our safety was really comforting.... By the time the storm abated, we'd had our fill of granola bars, crackers, and pop. We'd also had our fill

of gales. For the last week it had been hard sleep, except for Zach, who was unflappable and able to sleep while weightless and bouncing off the ceiling. We were exhausted.

Unfortunately, the weatherfax showed another developing low headed in our direction, and we decided to make a run for it. The wind had switched around to the west but had dropped to near calm. I proposed that we fire up the engine and run south for 48 hours. That would get us about 300 miles farther and hopefully get us out of what we had come to refer to as "gale alley." Pamela and Zach both agreed, and in short order we were underway.

Forty-eight hours later, on July 8, 13 days after leaving Unalaska, we shut down the engine for the last time. We estimated that we had about 10 gallons of fuel left, and we had consumed much of our perishable food supplies. Counting four days in English Bay and the five days hove to during the gale, we had spent a total of nine days going nowhere. We still had a long way to sail, so after considering everything, we decided to head for Hawaii, where we could re-supply and recuperate before going on to the Marshall Islands. With the wind out of the west and Hawaii just 1,200 miles due south of us, we suddenly felt eager and optimistic....

Twenty-seven days after casting off from Dutch Harbor, Celtic *entered Nawiliwili Bay on the southeast corner of the island of Kauai.*

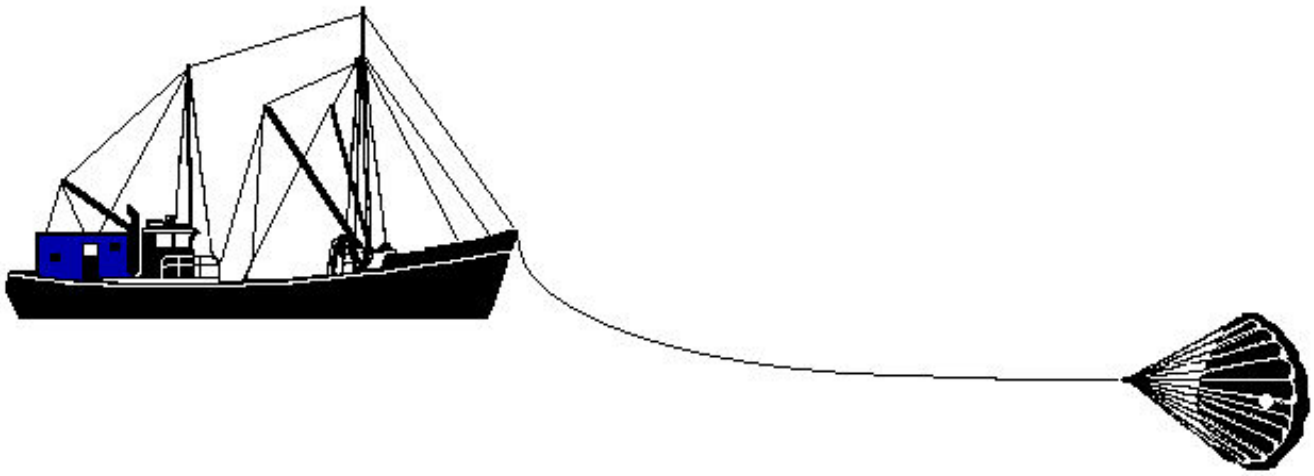
Sea Anchors on Power Vessels

S/P

S/P

Files Relating to Sea Anchors

Used by Fishing and Power Vessels off the Bow



"When my brother and I started in the fishing business in Iceland we went into handlining with auto jig, on 8-meter high-speed, high-tech boats, especially built for these waters. We found out shortly that there was no way to fish with auto jig or handlining in weather over 4 on Beaufort, but tried every means of jury-rigging sea anchors to slow the drift down to be able to fish. In June 1992 I was introduced to a parachute-like sea anchor from Para-Tech and I purchased one. It made a world of difference. Now, most of us in my home village have them. Our cod catch has gone up from 30 tons a year to over 100 tons.

"Though we handliners don't ordinarily use the sea anchor as a safety device, it has probably saved my life and my boat. In May 1994 I was coming home from 64° 12' N, 24° 20' W, after fishing in a northeasterly Force 5. I had a full load and the wind was building to Force 8 while I was entering the reefs in Breidhafjördhur, about six miles from my home port of Stykkisholm. Suddenly the engine started to overheat, in the worst spot around Iceland - near 65° 05' N and 23° 01' W. I felt the engine could not last any longer so I deployed my sea anchor. I was able to get some water into the cooling system and get going again. I tell you that was a close one. In that weather it would have taken 30 minutes to regain two miles."

Simon Sturluson, Icelandic Fisherman
(Translated by Valdimar Samuelsson)

S/P-1 Commercial F/V

Commercial F/V

50' x 22 Tons

28-Ft. Dia. Parachute Sea Anchor

Force 10 Conditions

File S/P-1, obtained from Captain Arthur Davey, Yarmouth Port, MA. - Vessel name *Sea Roamer*, hailing port Hyannis, MA, commercial F/V, designed by Gallagher, LOA 50' x LWL 48' x Beam 16' x Draft 6' x 22 Tons - Sea anchor: 28-ft. Diameter C-9 military class parachute on 150' x 3/4" Poly-Dacron rode with 5/8" galvanized swivel - No trip line - Deployed in a storm in shallow water (60 fathoms) 75 miles east of Chatham, Massachusetts, with winds of 50 knots and seas 20-30 ft. - Vessel's bow yawed 10° - Parachute disintegrated after 20 hours (probably due to short, low-stretch rode).

This file was derived from numerous telephone conversations with Captain Arthur Davey, along with an article called *The Wreck Of The Sea Roamer* by William P. Coughlin of the *Boston Globe* (courtesy *Boston Globe*).

At the time, Captain Arthur Davey was a 30-year veteran of the commercial fisheries. He has been through more storms than he can remember. This one was different, however.

On the night of Tuesday 15 December 1981, *Sea Roamer*, a steel-hulled gillnetter out of Hyannis, was about 75 miles offshore, riding to her 28-ft. diameter parachute in 30-knot winds. The rode consisted of about 150 feet of 3/4" low-stretch Poly-Dacron. The barometer was dropping. There were warnings of two weather fronts, with an interval of 12-18 hours forecast between them. A faster moving upper altitude TROUGH was about to overtake and reinforce a surface LOW (classic "bomb" type storm development, similar to Fastnet '79.)

By 8 a.m. the next morning it was blowing 45 knots as *Sea Roamer*'s bow, snubbed to her parachute, lifted in what now were 30 ft. combined seas. One and a half hours later it was blowing 50 knots - with 90-knot gusts recorded at Chatham Weather Station.

The 150 feet of Poly-Dacron rode was not long enough, nor did it have sufficient elasticity to absorb the dynamic loads imposed by the wind and the seas on the 22-ton commercial F/V. Those loads were being transmitted directly to the lightweight surplus parachute in the water, and it began to fail - panels began to blow out.

Sea Roamer's bow began to swing off the wind in an increasing arc. The parachute finally disintegrated and Captain Davey had to cut away its remains. *Sea Roamer* came beam to the seas and began rolling heavily, rails buried. The skipper fired up the engine and put her on a westerly course, the 300 horsepower Caterpillar Diesel chugging at 1200 RPM. That was when the two weather fronts came

together. They fell into synch, "Right on top of us," Captain Davey said. No 12-18 hour interval. No window of escape for *Sea Roamer*. The forecast had been wrong.

The seas rapidly built until some of them started to curl over and break. Arthur Davey was at the helm, trying to call them. He had to steer carefully, using *Searoamer*'s bow as a shield. When he saw one coming he would head into it by putting down the wheel and easing off on the throttle. The wave would slam against the bow, making the hull pivot on its CLR. The skipper would then apply throttle again, inching westward, rounding up north to parry off another wave, then inching westward....

Captain Davey: "Once in a while, one would break over the bow, but I wasn't concerned. I had been caught in it before. And, if worse came to worse, I figured we could go further to south'ard and go in the deep water route by Great Round Shoal Channel."

An hour later the wind was screeching at hurricane force - 75 miles per hour sustained. The sea had become white with foam and was now delivering hammer blows at *Sea Roamer*'s steel hull.

Already the Coast Guard had its hands full. For that was the dreadful night in which the 94-ft. F/V *Pioneer* went down and all hands had to be rescued. Meanwhile, Marjorie and Arthur Davey Sr., the skipper's parents, had been calling *Sea Roamer* over the base station from their home at South Yarmouth - to no avail. Their concern mounted until finally a call was put through to the Coast Guard. Soon they were listening on Channel 16 as the Coast Guard station at Chatham put out its own calls: "Come in Sea Roamer. Come in Sea Roamer." There was no answer.

Sea Roamer, apparently out of range, continued to inch her way through streaked, white mountains of water until 3:40 in the afternoon. That was when the hands on the ship's clock stopped - a watery giant, coming from a different direction, curled and exploded right on top of her.

"It was a rogue. A rogue wave of good proportions," Captain Davey said later, "I was at the wheel. I was on watch. That's all I remember to this day. How it hit, I don't know. I can vaguely remember the chopper, then the brain scan machine at the hospital. That's about it."

The wave ripped open and devastated *Sea Roamer*'s heavily built oak and plywood wheelhouse. It also knocked the skipper unconscious. According to Roy McKenzie, mate for two years, "Everything was blown out in the wheelhouse. The captain was on the floor... the doorway was gone. Blood was pouring out of both his ears, his forehead and mouth. His eyes were open, rolled back."

Somehow McKenzie and deckhand Jack La France managed to get the unconscious Arthur Davey into a survival suit, and then put their own suits on. *Sea Roamer* lay dead in the water, with three of her five watertight compartments flooded forward. "The sea had gone to just foam. It was all white. Terrifying. You could hear the wind. That shrieking noise. That roaring," said McKenzie.

They deployed the life raft and struggled with it, but had to cut it loose, unable to put the unconscious captain in. The seas were now breaking regularly and *Sea Roamer* was lying a-hull, rolling heavily - up to 60°. Twilight descended. A tanker passed by, but didn't see the lights that they flashed at it - it was having troubles of its own. Exhausted, the men lay down on the steel deck next to their unconscious captain. Both recall having lifelike visions of their past lives.

By dawn the next day, the Coast Guard had a helicopter and a fixed wing Albatross out of Otis Field searching for *Sea Roamer*. On board the boat, Captain Davey suddenly groaned, opened his eyes, and looked around. "What happened?" he asked. "Get on the radio. Call the Coast Guard. And, Jack, Jeeze, will ya close the door. It's cold in here." There was no door to speak of - it had been blown away. The radio had been damaged - and the EPIRB lost - when the rogue wave hit. But McKenzie and La France bailed and managed to reconnect the battery line to the engine. They found the starter switch in the jumble of wires and hit it. The big diesel turned, stopped, turned again, caught and started to chug.

Sea Roamer was under way again, but her captain lapsed back into unconsciousness. The men steered for the west and kept bailing with buckets. At 12:39 p.m. on Thursday Dec. 17th, Lt. Steve Hilfery and co-pilot Lt. Ted Ohr, flying an Albatross seaplane out of Otis Field, spotted the little white hull of *Sea Roamer* in the rough sea below and a message quickly crackled back to the air station: "Located F/V Sea Roamer. Position, 41-dash-31 North latitude, 68-dash-50 West longitude, proceeding 330 degrees at five knots. Appears disoriented. There is damage to the pilot house."

The twin engined plane banked, turned and made a low-level pass over the boat. When the men heard the aircraft roar overhead they began sobbing uncontrollably. They came out and waved their hands.

At 2:55 p.m. a Coast Guard helicopter lifted the unconscious Captain Arthur Davey to safety, the seventh human life it had plucked from the ocean on that day.

The ordeal ended the next morning when the cutter *Point Bonita* eased into her berth at Woods Hole, having put three Coast Guard seamen on board *Sea Roamer* for the slow tow to Hyannis, and having taken La France and McKenzie on board the cutter for initial treatment for "harsh exposure." Roy McKenzie's wife Melody and his son, Roy Jr., were standing at the dock as lines were heaved to the *Point Bonita*. Jack La France stepped onto the concrete dock and made a vow never to go to sea again, a vow that he has yet to break.

But Captain Arthur Davey? Well, no sooner did he get released from the hospital than he was right back offshore, staring down another winter gale on the Georges Bank. For cryin' out loud Arthur.

How would *Sea Roamer* have fared at sea anchor if she had used 600 feet of elastic nylon rode instead of only 150 ft. of low-stretch Poly-Dacron? Would she have been able to ride out the storm without damage? We will never know, but Arthur Davey told Victor Shane that he was never too old to learn. He still uses parachutes at sea. But now with a long NYLON rode.

S/P-2 Commercial F/V

Commercial F/V

65' x 43 Tons

28-Ft. Dia. Parachute Sea Anchor

Force 9-10 Conditions

File S/P-2, obtained from Captain Marc Palombo, Sandwich, MA. - Vessel name *Holly & Michael*, hailing port Sandwich, commercial F/V, designed by Washburn and Doughty, LOA 65' x LWL 60' x Beam 16' x Draft 6' x 43 Tons - Sea anchor: 28-ft. Diameter C-9 military class parachute on 450' x 3/4" nylon three strand rode, with 5/8" galvanized swivel - Full trip line - Deployed in a whole gale in shallow water (45 fathoms) about 75 miles SE of Nantucket with winds of 45-55 knots and seas of 18 ft. - Vessel's bow yawed 10° - Drift was estimated to be 15 n.m. during 24 hours at sea anchor.

Captain Marc Palombo is president of Calico Lobster, Inc.. He has a number of commercial F/V's that work out of Sandwich, Massachusetts. These lobster boats, designed by naval architect Bruce Washburn, have proven to be extremely stable platforms at sea. Because of their hard chines they don't roll very much. Their low profile allows them to fish in high winds, and their wide open after decks can accommodate hundreds of lobster traps. Palombo called Victor Shane's company a number of years ago about C-9 parachutes for the boats. It seems that a member of his crew, Arthur Davey by name (see previous file), kept insisting that they should have one on board.

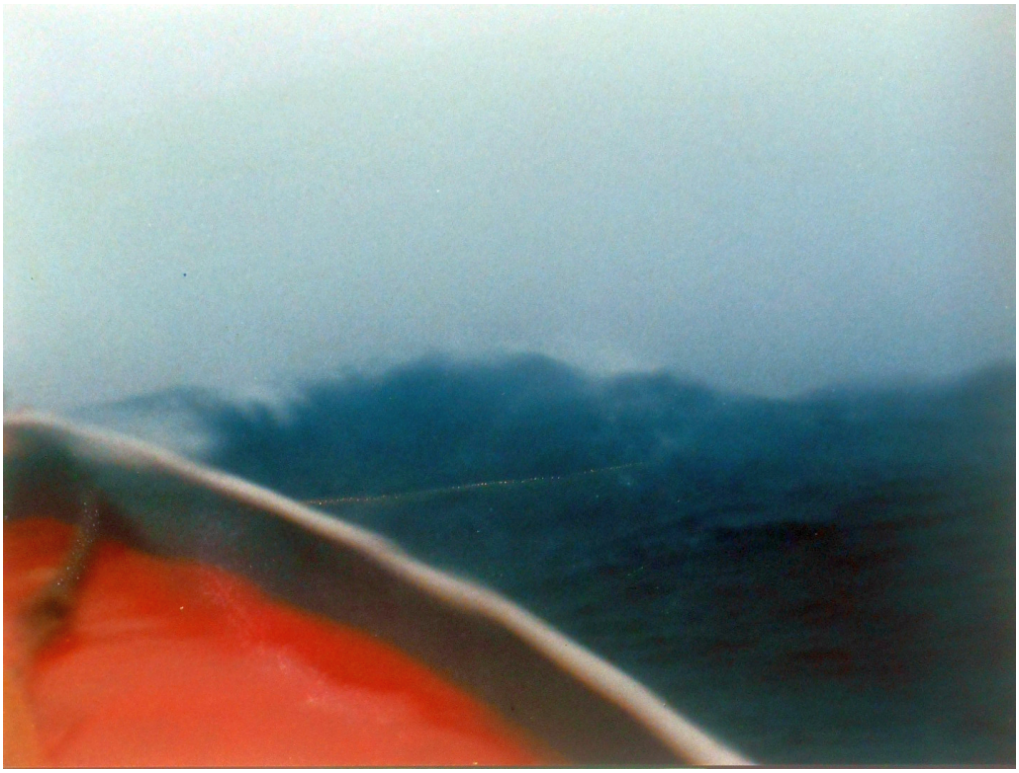
Shane explained to Captain Palombo that he had a few C-9's in stock, but that in his opinion they were not suitable for a big, 40-ton commercial F/V. He reminded Palombo that they were parachutes, designed for one man jumping out of an airplane. Captain Palombo insisted that he wanted three of them. He said Arthur Davey had told him they should be adequate.

Shane said "O.K", but went to great lengths to explain the importance of the long rode, "Remember, the long rode acts as a load buffer. THE LONGER THE RODE, THE LESS THE STRAIN ON EVERYTHING!"

Those C-9 parachutes were subsequently used by the Calico fleet in heavy weather, in conjunction with 400-500 feet of nylon rode. They didn't tear, and some were still in use years later. In 1986, for instance, the *Holly & Michael* used one in a November gale on the Georges Bank - 45 fathoms. Transcript:

> *I am writing to compliment you on the usefulness of the PARA-28* [28-ft. C-9]. *As an offshore Lobster Fisherman I have deployed the parachute many times. I am completely satisfied with its operation. In one instance, we deployed the chute in a November 1986 gale, 75 miles south-east of Nantucket. The weather conditions deteriorated rapidly and we found ourselves sitting in 45 knot*

winds with about twelve foot seas....



Holly tethered to a 28-ft. diameter C-9 parachute in 18-ft. seas during a November gale about 75 miles SE of Nantucket. Note the breaking crest to the left, and the rode leading to the sea anchor. "Through the toughest twenty hours of the storm we lay to the parachute.... The PARA-28 kept our bow into the seas as we drifted. We did not pound into the seas, nor did we lie beam-to. It was a soft, comfortable manner to ride out the storm." (Photo courtesy of Captain Marc Palombo, Calico Lobster, Inc.)

For about twelve hours the National Weather Service out of Boston had storm warnings up. Through the toughest twenty hours of the storm we lay to the parachute. We were as comfortable as could be expected under these conditions. The PARA-28 kept our bow into the seas as we drifted. We did not pound into the seas, nor did we lie beam-to. It was a soft, comfortable manner to ride out the storm. The parachute enabled us to stay and ride out the storm. Some of the other vessels went into port with broken trips. We stayed and were able to complete our trip. In this respect the anchor paid for itself tenfold. I must stress that there is no substitute for good common sense in some of the decisions to either go home or stay out. But if I were to decide to stay and ride out a storm, I would definitely want a parachute sea anchor out.

Holly & Michael of Sandwich, Massachusetts. This commercial F/V uses parachute sea anchors to stay on top of the fishing grounds offshore. (Photo courtesy of Captain Marc Palombo, Calico Lobster, Inc.)

S/P-3 Commercial F/V

Commercial F/V

66' x 120 Tons

32-Ft. Dia. Sea Anchor

Force 9-10 Conditions

File S/P-3, obtained from Captain Michael Monteforte, Kenyon, RI. - Vessel name *First Light*, hailing port Point Judith, RI, commercial F/V, designed by Walter Bechman, LOA 66' x LWL 62' x Beam 21' x Draft 12' x 120 Tons - Sea anchor: 32-ft. Diameter *Para-Tech* on 150' x 1¼" nylon three strand rode, with 3/4" stainless steel swivel - Full trip line - Deployed in a whole gale in shallow water (60 fathoms) about 150 files from Boston with winds of 55 knots and seas of 20 ft. - Vessel's bow yawed 10°.

According to the Bureau of Labor Statistics, commercial fishing ranks as one of the most hazardous occupations in the United States.

Those of us who sail offshore for pleasure can pick our season and our route, and change both if necessary. But the skipper of a commercial F/V is up against an economic imperative. "Breaking up a trip" can be an expensive proposition. He has spent hundreds of dollars in fuel, ice and provisions, and the crew has to get paid whether they catch fish or not. So what happens when the Weather Service issues an untimely bulletin? Given today's shaky economic picture, the skipper has to make a difficult decision as to whether to go ahead with the trip, or to abort and head back for port with the holds empty.

In the course of interviewing scores of offshore fishermen, Victor Shane discovered that, as a general rule, most will stay on the fishing grounds and ride out the average gale, especially if the trip is still young. The majority will steam back for port in the event that the forecast is upgraded from "gale" (34-40 knots sustained) to "storm" (48-55 knots sustained). Sometimes they get caught out there in between.

Now when a commercial F/V runs into an offshore gale it is standard procedure to "jog into it" - an expression used by commercial fishermen themselves. The engine is placed in slow forward and the F/V makes just enough way to enable the helmsman to keep the bow pointed as high into the teeth of the gale as possible. Fuel is spent in jogging into the seas; the hull may pound some; there is the wear and tear on

everything and everyone. And if the vessel loses power, if she springs a bad leak, or if something major - like a pump - breaks down, she may end up needing the assistance of the Coast Guard.

This is why commercial fishermen were among the first to use parachutes at sea. With the parachute set they can shut down all engines and stay on top of the fishing grounds, anchored to the surface of the ocean in relative comfort. Transcript of Captain Monteforte's testimonial:

> *I used sea anchors for four years on my last boat, the* Dyrsten*. She was 60' long by 20' wide, made of yellow pine planks with oak ribs. Her gross weight was 38 tons. We used surplus parachutes then, but suffered with the problem of the chutes blowing out, so we always carried a spare. I thought about a chute for my new boat,* First Light*, but because she is at least three times heavier than* Dyrsten*, I didn't follow up on the idea, until last January, when I called Para-Tech, after seeing their ad in* National Fisherman*. I purchased a 32' diameter chute... a well-made, extremely rugged looking sea anchor.*
>
> *We started using it on the very next trip. We would fish all day, and lay to the chute during the night. What we experienced at sea anchor was a very peaceful motion, as the bow of the boat tracked its way into the oncoming swells. The ride was different than if you were to jog into it. I suppose there was just less pitch, allowing for a good night's sleep. On one particular trip in March '88 we were fishing at least 150 miles offshore when, on the second or third day of the trip, the barometer started to fall rapidly. Now, ordinarily, we are left with two choices if the weather deteriorates: steam home, or lay to. Unless the forecast is really bad, we invariably lay to. At any rate, we set the chute before dark and when I got up at dawn the wind had already shifted to the northeast and was blowing 30 knots. Having noticed that the barometer was still low, I decided to remain at sea anchor a while longer. As it turned out we remained at sea anchor for another day and night. The wind increased to fifty five, sixty knots, with higher gusts.*
>
> *The whole time that we were hove to the sea anchor we were comfortable and relaxed. When it was over, we were rested, in good shape, and anxious to get back to work. In my opinion, a sea anchor, used with good judgment, is an invaluable tool.*

S/P-4 Commercial F/V

Commercial F/V

70' x 30 Tons

24-Ft. Dia. Sea Anchor

Force 9-10 Conditions

File S/P-4, obtained from Captain Bobby Lucas, Youngstown, FL. - Vessel name *Captain Gorman III*, hailing port Panama City, FL, commercial F/V, designed by Davis, LOA 70' x LWL 66' x Beam 20' x Draft 7' x 30 Tons - Sea anchor: 24-ft. Diameter *Para-Tech* on 600' x 7/8" nylon braid rode, with 5/8" galvanized swivel - Full trip line - Deployed in a whole gale in deep water about 150 miles SE of Morgan City, Louisiana, with winds of 45-60 knots and seas of 15-20 ft. - Vessel's bow yawed 10° - Drift was 8-10 n.m. during 48 hours at sea anchor.

Captain Gorman III is one of numerous commercial F/Vs that work the Gulf of Mexico out of Panama City, Florida. Many are equipped with sea anchor. Some carry 1000 feet of nylon rode on a hydraulically operated reel. *Captain Gorman III* routinely uses her 24-ft. diameter Para-Tech sea anchor for sea layovers and station-keeping offshore. In March 1988 her skipper, Bobby Lucas, deployed it about 150 miles south of the Louisiana coast in a gale. Transcript:

> *I am a longliner fisherman for tuna and swordfish, and I fish anywhere from 100 to 200 miles offshore. During the winter I am in a lot of rough weather. I used to idle into the sea or idle with the sea to keep from lying dead in the water and getting hit broadside by big waves. It is very dangerous not to have any way of anchoring. Now I always carry my 24-ft. sea anchor so that I can get my bow around into the sea and keep from lying in the trough in rough weather. I have been anchored in 50 knot winds, gusting 70, and seas of 12-20 ft. for as long as 48 hours. Without the sea anchor it would have been a very uncomfortable ride and possibly I would have had to steam in to port. Offshore, it is necessary to have a sea anchor.*

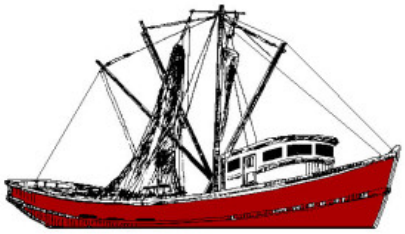
S/P-5 Commercial F/V

Commercial F/V

55' x 60 Tons

24-Ft. Dia. Sea Anchor

Force 8-9 Conditions



File S/P-5, obtained from Captain Dennis Crosby, Youngstown, FL. - Vessel name *Ashly G*, hailing port Panama City, FL, Thompson trawler, LOA 55' x LWL 50' x Beam 18' x Draft 10' x 60 Tons - Sea anchor: 24-ft. Diameter *Para-Tech* on 400' x 3/4" nylon three strand rode, with 3/4" galvanized swivel - Partial trip line - Deployed in low system in deep water about 150 miles south of Mobile, Alabama, with winds of 35-45 knots and seas of 15 ft. - Vessel's bow yawed 10° - Drift was estimated to be 4-5 n.m. during 24 hours at sea anchor.

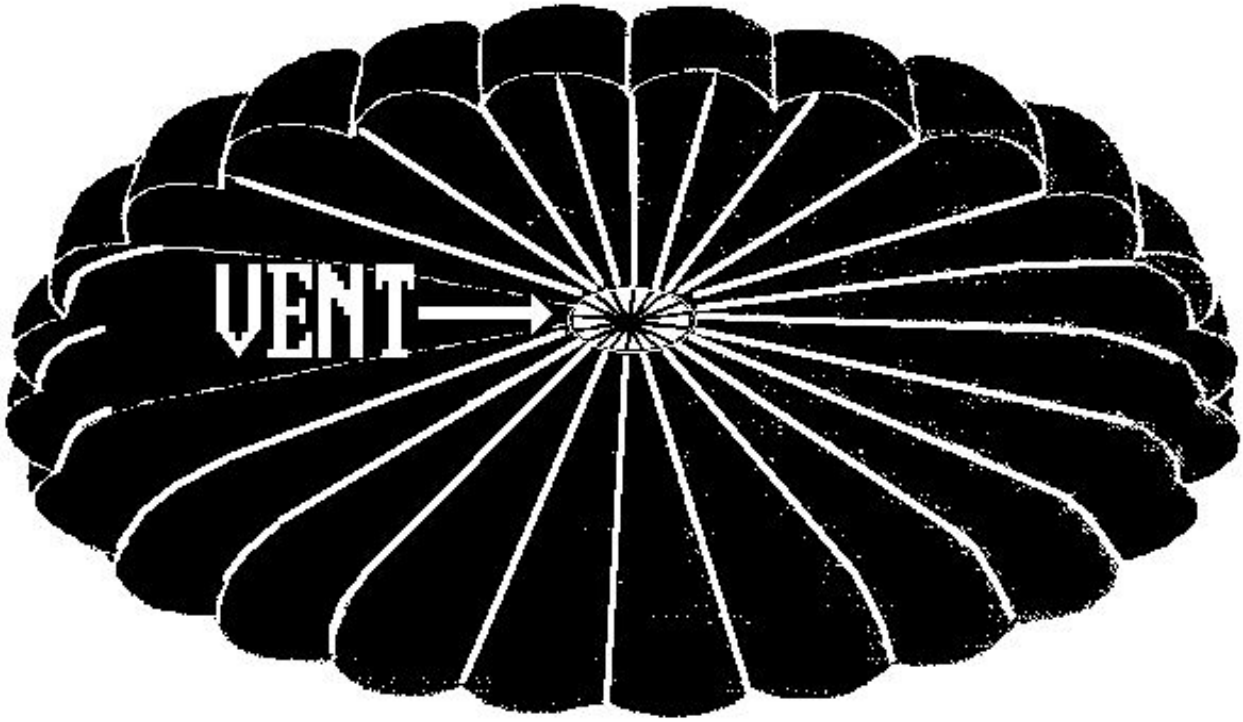
Ashly G's partially torn sea anchor came back for repairs a number of years ago. Upon inspection the first thing Victor Shane noticed was that the canopy was inside out! The skipper of the boat could not recall how this came about. Most sea anchors and parachutes have a heavier, skeletal, web framework that cradles and reinforce the lighter canopy material. If the parachute is used inside out high loads may tear the canopy away from the radial basket, which is probably what had happened here.

Upon further inspection Shane also noticed heavy damage in the vent-hole area.

The vent-hole is the discharge orifice incorporated into the top of the canopy to afford stability and shock absorption. This is a very critical area where there is tremendous water pressure trying to squeeze through a small hole. The nylon cloth of the parachute is not strong enough to withstand the pressure, so the vent-hole has to be heavily reinforced with webbing - it is the strong webbing that takes up the strain, and not the lighter canopy material. And indeed, in this case it had been redundantly reinforced.

So what could have happened?

Further investigation revealed the culprit: CHAFE! The trip line has to be tied off to something. Usually that something is the webbing that reinforces the vent-hole. In daily use the trip line rubs and pulls against the webbing. Chafe does the rest. Once the reinforcing webbing has chafed through the high loads have to be born by the lighter canopy itself, usually resulting in failure of major proportions.



SHOWING CRITICAL VENT-HOLE AREA

Shane was quick to bring the matter to the attention of Para-Tech's Don Whilldin. A master parachute rigger and veteran skydiver (more than 1000 jumps), Whilldin went to work and redesigned the critical vent-hole area.

All Para-Tech sea anchors now have a separate recovery bridle, to which the trip line may be attached independently of the critical webbing that reinforces the vent-hole.

S/P-6 Commercial F/V

Commercial F/V

65' x 33 Tons

24-Ft. Dia. Sea Anchor

Force 9-10 Conditions

File S/P-6, obtained from Captain Paul Clampitt, Everett, WA - Vessel name *Majestic*, hailing port Seattle, converted 1923 wood schooner, LOA 65' x LWL 58' x Beam 16' x Draft 13' x 33 Tons - Sea anchor: 24-ft. Diameter *Para-Tech* on 600' x 3/4" nylon braid rode, with 3/4" bronze ball-bearing swivel - Full trip line - Deployed in a southeasterly gale in 300 fathoms of water about 40 miles south of Yakutat Bay, Alaska, with winds of 40-50 knots and seas of 20-30 ft. - Vessel's bow yawed 20°

Washington fisherman Paul Clampitt is the owner of the 65-ft. schooner *Majestic*. While longlining, he routinely uses a 24-ft. diameter Para-Tech sea anchor for station keeping, allowing the crew to get a good night's sleep offshore. On the occasion of this file the same 24-ft. sea anchor was used in a southeasterly gale in the Gulf of Alaska. The para-anchor did a good job of holding the bow of the boat into the seas - bearing in mind that this is a converted 1923 wood schooner with a full keel and stern draft of 13 feet. Transcript:

> *The parachute sea anchor requires some skill to learn how to properly deploy. We deploy it using a "flying set," by setting the chute off the stern and allowing it to open, then turning the helm upwind with the engine in neutral. The main advantage in using the anchor is in getting a good night's sleep without having to man the helm through a gale. We have yet to use the chute in true storm conditions, because in life-threatening situations I don't want to experiment, and prefer to have a man on constant watch - so we might as well maintain steerage way by jogging up into the seas. But it is a comfort to know the chute is available for deployment in case of loss of power.*
>
> *In our case the chute doesn't really help that much in stopping the boat from drifting, however, because most of our drift occurs from strong tides in our areas of operation and the vessel and chute drift at the same rate in these situations.*

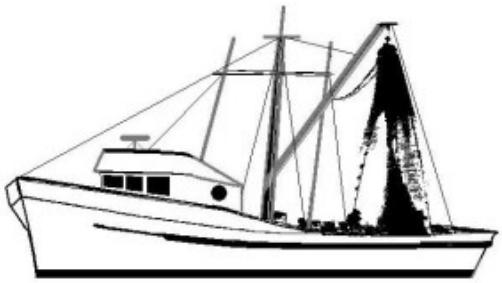
S/P-7 Commercial F/V

Commercial F/V

50' x 35 Tons

28-Ft. Dia. Parachute Sea Anchor

Force 7-8 Conditions



File S/P-7, obtained from Captain George W. Newson, Comox, B.C. - Vessel name *Kella Lee*, hailing port Comox, commercial F/V, designed by Monk, LOA 50' x LWL 47' x Beam 15' x Draft 9' x 35 Tons - Sea anchor: 28-ft. Diameter C-9 military class parachute on 500' x 1/2" nylon braid rode, with 5/8" bronze ball bearing swivel - Full trip line - Deployed in a gale in shallow water (70 fathoms) about 40 miles west of lower Vancouver Island with winds of 30-35 knots and seas of 12-15 ft. - Vessel's bow yawed 10° - Drift was estimated to be 13 n.m. during 13 hours at sea anchor.

Captain George Newson is the president of Newson Fisheries and a veteran of many gales in the Pacific Northwest. Whether longlining for halibut, trolling for salmon, or gillnetting for herring, the sea anchor has always played an important part in enhancing the safety, comfort and efficiency of his crew. Even as a young man he was accustomed to using government surplus parachutes while fishing Cape Flattery's stormy waters.

On the occasion of this file he used a 28-ft. diameter military surplus (C-9) parachute on the west coast of Vancouver Island.

He has since obtained - and used - a much heavier 24-ft. diameter Para-Tech sea anchor.

Newson was using a dedicated tether consisting of 500 feet of 1/2" nylon braid! *Kella Lee* is a 50-ft. Monk trawler with a dry weight of 35 tons, yet her skipper - with many years of experience - initially chose 1/2" line for the tether, a size that one would ordinarily associate with the ground tackle of a 26-ft. sailboat weighing three tons! This says something about the importance of incorporating elasticity into parachute anchoring system. Transcript:

> *I used a regular 28 ft. chute years ago while trolling salmon off the Washington coast. It was common practice for most of the West Coast troll fleet. We worked the area above Gray's Harbor, known as the Prairie. Most of the area was too deep for anchoring and too far away to run in, so we used parachutes for sea anchors. We rode out many NW gales in relative comfort, averaging 1 nautical mile of drift per hour to leeward in gale force winds. The boat always rode bow to the sea.*
>
> *The Para-Tech 24' diameter chute, being somewhat smaller and considerably heavier, tends to set easier than the government surplus 28-footers.... We pay out 500 ft. of 1/2" Samson double braid nylon rode, which is shackled to the bow.... The drift is reduced by two thirds. The ride is*

reasonable because of the elasticity of the long, thin rode.

Update: Two years later Shane received another letter from Captain Newson, indicating that the 1/2" nylon braid had in fact broken in a gale. The break occurred right at the thimble area of the splice. Newson was able recover the parachute by powering up to the float. He now uses 5/8" nylon braid.

S/P-8 Commercial F/V

Commercial F/V

65' x 49 Tons

24-Ft. Dia. Sea Anchor

Force 12 Conditions

File S/P-8, obtained from Captain Clark B. Fay, Pelican, Alaska - Vessel name *Arch Angel*, hailing port Alaska, commercial fishing schooner, LOA 65' x LWL 56' x Beam 16' x Draft 11' x 49 Tons - Sea anchor: 24-ft. Diameter *Para-Tech* on 600' x 1" nylon three strand rode, with 3/4" bronze ball bearing swivel - Full trip line - Deployed in a storm in deep water in the Gulf of Alaska with winds of 75 knots and seas of 30 ft. - Vessel's bow yawed 10° - Drift was uncertain due to 3-4 knot westerly current.

Captain Clark B. Fay is also a veteran of the Alaskan fisheries. He has been through many a gale and not too few storms. *Arch Angel* weighs in at 49 tons, has a draft of 11 feet and, according to Fay, has been tethered to her 24-ft. diameter Para-Tech sea anchor hundreds of times.

On the occasion of this file, winds were hurricane strength with occasional gusts to 90 knots. Seas were as great as 30 ft. Shock absorption was provided by a full spool - 600'- of one inch nylon three strand. Transcript:

> *I use the sea anchor almost daily during the spring when I am offshore, and occasionally during bad weather in the summer and fall. Only an idiot fishes up here in the winter. A good swivel is an absolute must. I use a commercial fishing swivel that salmon purse seign vessels use on their purse lines, rated at 32,000 lbs. It has three races of stainless steel ball bearings, and the body is made from bronze. Cost is about $200.00, available from Redden Net Co., Bellingham, Washington.*
>
> *With enough line payed out I've never found a catenary (chain) system at all necessary and I wouldn't want to have to haul back the extra weight. I use a Poly-Pro trip line and run it all the way back to the boat, using a power winch to haul the rig back.*

S/P-9 Commercial F/V

Commercial F/V

79' x 87 Tons

24-Ft. Dia. Sea Anchor

Force 10 Conditions

File S/P-9, obtained from Captain G.T. Bodiford, Jr., Panama City, FL. - Vessel name *Arizona*, hailing port Galveston, TX, Tuna longliner designed by Master Marine, LOA 79' x LWL 70' x Beam 24' x Draft 8' 9" x 87 Tons - Sea anchor: 24-ft. Diameter *Para-Tech* on 300' x 7/8" nylon three strand rode, with 5/8" galvanized swivel - Full trip line - Deployed in storm in deep water about 400 miles SSE of New Orleans with winds of 50 knots and seas of 20 ft. - Vessel's bow yawed 10° - Drift was estimated to be 18 n.m. during 40 hours at sea anchor.

Two generations of Bodifords have been fishing the Gulf of Mexico for tuna, using parachutes for station keeping and sea layovers. On the occasion of this file the F/V *Arizona* was approximately 400 nautical miles south-south-east of New Orleans when she was overtaken by a Tropical Depression. She was too far offshore to duck back into port so Captain Bodiford decided ride it out on the 24-ft. diameter Para-Tech sea anchor.

At the height of the storm the wind was sustained at 55 knots out of the NE, occasionally gusting to 80. Seas were about 17-20 feet. *Arizona* is a large, heavy boat, weighing in at almost 90 tons. She was hove to the para-anchor for a total of 40 hours without any problems. She drifted about 18 miles in that time.

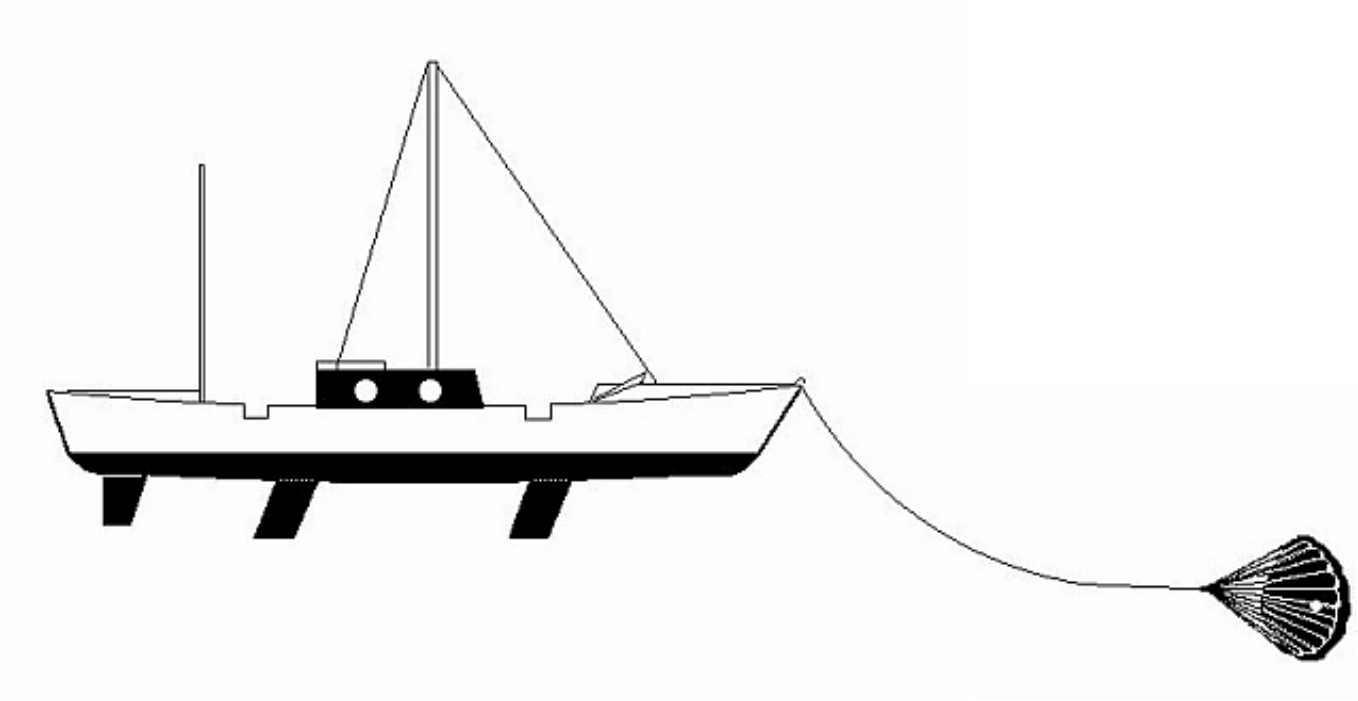
Sea Anchors on Rowing Boats

S/R

S/R

Files Relating to Sea Anchors

Used by Rowing Boats off the Bow



"*On the seventh day [of our row to Antarctica], around midnight, a frontal system passed over us and the wind shifted from WNW eventually to settle on SW with overcast and rain. The conditions were not rough; however, the wind was contrary to our purpose and, in order to hold the southing and westing that we had gained, we once again deployed the sea anchor.*"

Mark Eichenberger
Long-time sailoer and adventurer

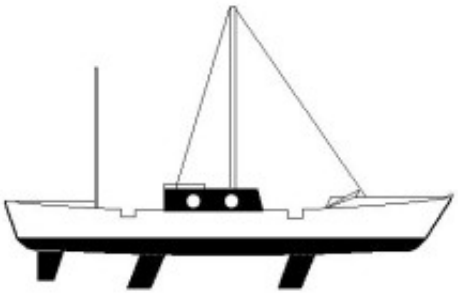
S/R-1 Aluminum Dory

Aluminum Dory

28' x 2.5 Tons, Dagger Boards

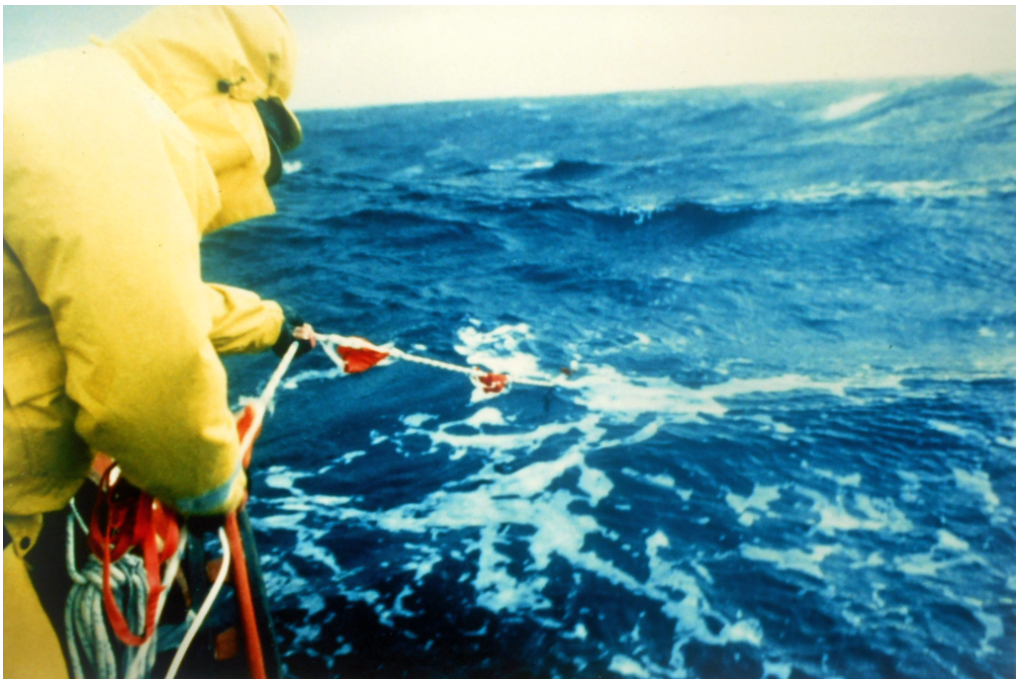
12-Ft. Dia. Sea Anchor

Force 5 Conditions



File S/M-14, obtained from Ned Gillette and Mark Eichenberger - Vessel name *Sea Tomato*, aluminum rowing dory designed & built by Ned Gillette, LOA 28' x LWL 24' x Beam 7' x Draft 18" x 2.5 Tons - Dagger boards - Sea anchor: 12-ft. diameter *Para-Tech* on 300' x 1/2" nylon three strand rode with 1/2" stainless steel swivel - Full trip line - Deployed during passage of frontal troughs in deep water in the Drake Passage and off the coast of Antarctica with blizzard & winds of 25 knots - Drift was estimated to be 10 n.m. during 21 hours at sea anchor.

Victor Shane's company sponsored the team of Ned Gillette and Mark Eichenberger in their successful attempt to row a specially designed dory, *Sea Tomato*, from Cape Horn to the Antarctic, a distance of 1000 miles across the treacherous Drake Passage. They supplied the expedition with a small speed-limiting drogue, a Jordan series drogue (88 cones on 300 ft. of line), a 12-ft. diameter Para-Tech (main sea anchor) and a 9-ft. diameter BUORD (backup sea anchor).



Taken in the waters off Punta Arenas, Chile. Mark Eichenberger test-deploying the Jordan series drogue supplied by Victor Shane of Ned Gillete's Antarctic row - see File S/R-1 (Ned Gillete photo)

Shane saw in this expedition an opportunity to put several drag devices to the test. As it turned out, however, the crew never did get into a storm, other than the one that blasted them off in the beginning, which was driving them exactly where they wanted to go.

They did derive benefit from the 12-ft. diameter Para-Tech sea anchor in terms of drift control, however. When Mark Eichenberger afterwards visited Shane in Santa Barbara he said that no sooner had they sighted the coast of Antarctica than the weather turned sour and a Force-5 blizzard started pushing them back out to sea. They then deployed the sea anchor, which kept them more or less in place for 21 hours. He said icebergs, driven along by the wind, were drifting by the boat during that period.

Ned Gillette is both mountaineer and sailor, having conquered Everest and now Cape Horn. Author of the book *Everest Grand Circle*, he is also a free-lancer for the National Geographic Society. His article, *Rowing Antarctica's Most Mad Seas*, appeared in the January 1989 issue of *National Geographic Magazine*. Mark Eichenberger was a long time sailor and adventurer. The following is a transcript of the feedback obtained from Mark:

> *The sea anchors were key to our strategy on our expedition to row from Cape Horn to Antarctica, and the 12' diameter `FORCE 10' worked remarkably well. It was easy to deploy and retrieve, and it was effective in practically eliminating our wind drift. The only reason we did not use them more than we did is that we were blessed with very fortunate weather, the winds being mostly favorable and moderate.*
>
> *During the third day out, 24 Feb. 1988, the winds from the gale which had blasted us off from the coast diminished gradually until in the evening they were W to WNW about Force 5. We had begun rowing at 0900 that morning and continued throughout the day until midnight whereupon it became too dark to row effectively. So we put out the sea anchor and lay to it until 0940 the following morning, about 10 hours during which our average drift was 0.9 knots. We most likely would have had a current of .5 knot or more in this part of the Drake Passage. On the seventh day, around midnight, a frontal system passed over us and the wind shifted from WNW eventually to settle on SW with overcast and rain. The conditions were not rough; however, the wind was contrary to our purpose and, in order to hold the southing and westing that we had gained, we once again deployed the sea anchor. From 0230 until mid-afternoon we lay to the sea anchor, nearly 13 hours. Our average drift had been 0.6 knots. Interestingly, in the morning we had a pair of Southern Bottlenose Whales, about 30 feet long, come by to investigate this enormous orange jelly fish - the sea anchor. They swam between us and the sea anchor, but fortunately decided it was inedible and left.*
>
> *The third and final use of the sea anchor came on our approach to the Antarctic coast on the 13th day out. A light westerly wind gave way to a fresh breeze (Force 5) out of the southeast, so at 1930 hrs. we deployed the sea anchor to hold what ground we had gained, and lay to it from late on the 4th of March, throughout the night and following day until 1630, a total of 21 hours. We*

kept an "anchor watch" throughout the period as there were icebergs scattered around and occasionally growlers and bergy bits would drift down past us.

EPILOGUE: In December 1991 Mark Eichenberger was working on the ice breaker *Erebus* in the Strait of Magellan when a devastating storm blew into Punta Arenas. Two great waves washed over *Erebus*' decks in rapid succession. Mark was swept overboard and lost at sea. He was a good friend of Shane's and an accomplished seaman. We are all diminished by the passing of a comrade. We bid defiance to the sea, in honor of his memory.

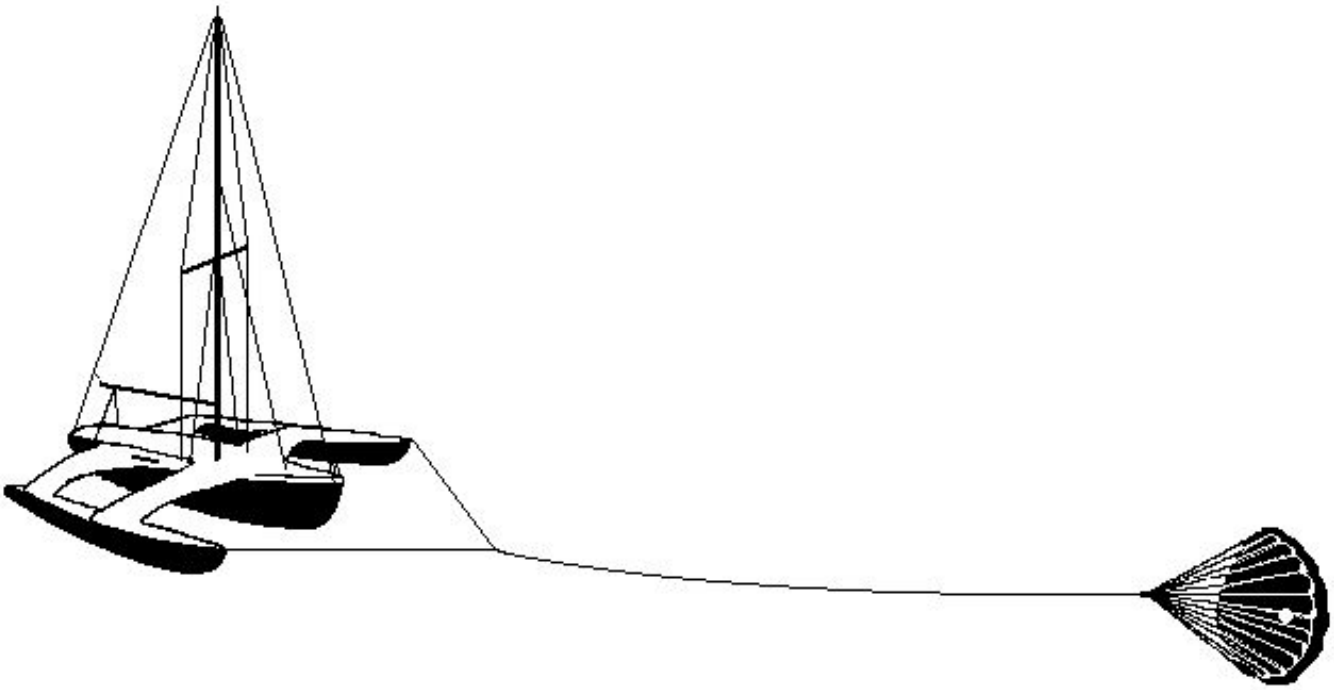
Sea Anchors on Trimarans

S/T

S/T

Files Relating to Sea Anchors

Used by Trimaran Sailboats off the Bow



"Although we are skeptical about uncapsizeable multihulls, we do believe that many mishaps could have been averted by prudent seamanship, alertness, and the conviction that multihulls are all capsizeable."

Charles K. Chiodi

S/T-1 Trimaran, Horstman Tristar Ketch

S/T-1

Trimaran, Horstman Tristar Ketch

39' x 22' x 8 Tons

28-Ft. Dia. Parachute Sea Anchor

Force 12 Conditions

File S/T-1, obtained from Joan Casanova, Oregon City, OR. - Vessel name *Tortuga Too*, hailing port Seattle, Trimaran, Tristar ketch, designed by Ed Horstman, LOA 39' x Beam 22' x Draft 44" x 8 Tons - Sea anchor: 28-ft. Diameter C-9 military class parachute on 400' x 3/4" nylon three strand tether and bridle arms of 60' each, with 1/2" galvanized swivel - Full trip line - Deployed in numerous storms during 18-year cruise from Seattle to African coast, the Southern Ocean and back to Texas - Severest use case was over the Burwood Bank, between Cape Horn and Falkland Islands, with winds of 85-100 knots and seas in excess of 30' - Vessel's bow yawed about 20° - Drift was estimated to be 16 n.m. during three days at sea anchor.

By and large this is probably the most important file in the *Drag Device Data Base*. Other than a handful of known but poorly-documented cases of commercial fishermen and some sailboats using parachutes, our knowledge about the general behavior of boats at sea anchor was sketchy until the Casanovas came alone. We didn't know if a boat would "rise to the seas," or be pulled through green water. We didn't know if the boat would roll with the punches and "yield to the seas," or stand up against them and break up. We didn't know if the boat would get "slingshotted" off the crests as the elastic rode stretched. We

didn't know if the boat would "back down" on her rudder, so as to cause it to break off. We didn't know if the hardware and fittings on boats could withstand the forces involved. Well, thanks to the pioneering work of Joan and John Casanova, now we know.

The parachute anchoring system never failed on *Tortuga Too*, not once in eighteen years and some 200,000 blue water miles. Off the coast of New Zealand where cyclone winds were recorded at 90 mph, in a hurricane off Fiji where several other boats were lost, in 40-ft. seas in the Indian Ocean, and in a truly devastating storm off the Falklands, time and again *Tortuga Too* survived without damage by the correct use of the parachute sea anchor. While Lady Luck might have played a significant role in some of the other files in this database, it is clear that her role was minimal in this one. Indeed, the number of times that the parachute was used, and the broad range of life-threatening storms and heavy weather situations in which it was deployed, seem to tell us that luck had very little to do with anything here - though it goes without saying that luck always favors the wise and the well-prepared.

Despite her relatively lightweight - plywood - construction, and despite her 22-ft. beam, *Tortuga Too* was never in any danger of breaking up. Not once did she get slingshotted off the huge storm crests; she never went crashing through green water; the galvanized swivel did not fail; the deck fittings did not pull out. The 28-ft. diameter military parachute held and the system worked, time and time again.

Tortuga Too's worst-case scenario occurred over the shallow Burwood Bank, between Cape Horn and the Falklands. This was a "bomb" type storm development, to use the expression coined by professor Fred Sanders of the Massachusetts Institute of Technology. The term "bomb" is generally used to describe the rapid development of a secondary storm, which overtakes - and reinforces - its predecessor. In particular it describes the pressure gradient amplifications that result from the overtaking of a surface LOW by a faster moving upper altitude TROUGH, resulting in barometric pressure decreases of 24 millibars or more in a 24-hour period, as well as abruptly angled surface wind fields. This type of storm development - usually identified by high-altitude comma-shaped clouds on satellites pictures - was associated with Fastnet '79.

In the book *The Parachute Anchoring System* Joan Casanova describes *Tortuga Too*'s encounter with a genuine ESW - extreme storm wave. *Tortuga Too* was tethered to a 28-ft. diameter C-9 parachute when an enormous mountain of curling, roaring water rose before her bows, something akin to the terrifying photographs in Coles's *Heavy Weather Sailing*. This sobering account should be a source of comfort to multihull sailors in particular. It is reproduced by permission of Chiodi Advertising & Publishing, publisher of *Multihulls Magazine*:

It was the type of a wave which pitchpoles yachts in these oceans, the type which every voyager sailing in the high latitudes of the Southern Ocean fears. While we watched, horrified, this monster welled up for a second time, curling over as if breaking on a beach, then roaring in foamy masses on top of Tortuga Too, *covering deck and wheel house before running off into the sea once more. We were so shaken by this experience that it seemed an eternity before we regained our composure to check the boat's condition, but she was all right. In fact,* Tortuga Too *recovered faster than we. There was no structural damage. She had returned to her original position of facing the storm and was already climbing the next wave....*

We want to stress here that no vessel, multihull, monohull or freighter, could have survived such a sea unless tethered with a long line from a sea anchor... we share this story with you only to prove how this technique can protect a craft in extraordinary circumstances. Although Tortuga Too *survived this mammoth wave crashing on her deck, there was no backing down on her rudder, nor any structural damage to the hulls.*

The experiences of the Casanovas with parachute sea anchors is so broad-based, so extensive that it has entered into the legend and nomenclature of multihull sailing. In the multihull community the name "Casanova" is synonymous with parachute anchoring, to the extent that the names "Voss" and "Pardey" are synonymous with heaving-to in the monohull community. In the course of logging all those blue water miles, Joan and "Cass" tried every conceivable heavy weather tactic known to man, including the use of makeshift drogues off the stern, but they always found themselves coming back to the bow-deployed parachute sea anchor. Multihull sailors owe a debt of deep gratitude to Joan Casanova in particular, for having the vision to see in her valuable storm experiences a *responsibility* to inform others. (See also her early articles in the Spring 1976, July/August 1979 and August 1980 issues of *Multihulls Magazine*).

S/T-2 Trimaran, Kismet

Trimaran, Kismet

31' x 18' x 2.5 Tons

20-Ft. Dia. Parachute Sea Anchor

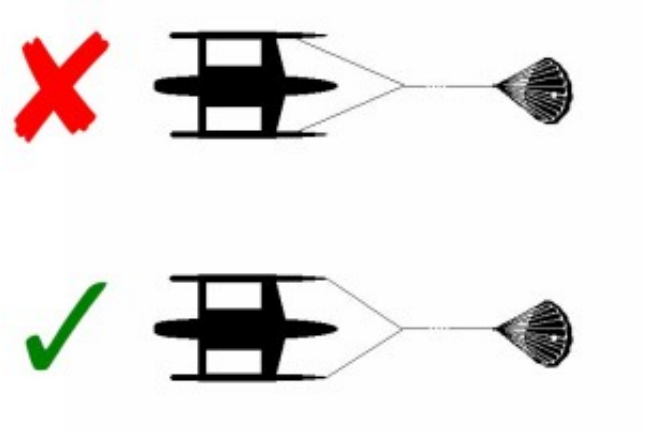
Force 10+ Conditions

File S/T-2, condensed from the writings of Randy Thomas - Vessel name *Celerity II*, hailing port Victoria BC, "Kismet" trimaran designed by Bill Kristofferson, LOA 31' x LWL 29' x Beam 18' 6" x Draft 30" x 2.5 Tons - Sea anchor: 20-ft. Diameter cargo parachute on 300' x 7/16" nylon three strand tether and bridle arms of 100' each, with 1/2" galvanized swivel - No trip line - Deployed in hurricane *Freida* in deep water in the South Pacific, with winds of 50-60 knots and seas of 30 ft. - Vessel's bow yawed 20°.

This file was condensed from articles by Randy Thomas and additional information provided by others, among them Bob Wilson of the British Columbia Multihull Association, to whom the author is indebted.

Celerity II, a Kristofferson-designed, light displacement Kismet 31 was en route to Kosrae from Rabaul (Solomon Islands) when she had an encounter with hurricane *Freida* in February 1982. As the wind and seas continued to build, Randy Thomas found options narrowing. Running off was out of the question. It would take *Celerity II* into a screen of low-lying atolls, and toward the eye of the storm. And Randy had once tried lying a-hull in a blow off Point Conception, California. It had been a bad experience.

With her reefed main set as a riding sail and the tiller lashed amidships, *Celerity II* lay quietly hove-to for a while. But the wind was building in 5-knot increments and soon it became clear to Randy that the mains'l would have to come off altogether - taken off the boom. It was time to set the parachute sea anchor. Randy had never set the chute before. With safety harnesses snapped on, he and his companion Thea carried the 20-ft. diameter parachute on deck. Crests broke over the boat as Randy crawled onto the narrow floats to shackle each end of the bridle to the heavy duty U-bolts which he had installed three feet inboard. "`Next time rig the bow bridle before you leave port,' ran my mental memo." (Writing in the article that appeared in *SAIL Magazine*). They dunked the chute and watched, as the boat's drift payed out the 400' of tether and bridle. But *Celerity II* continued to lie-ahull!



Bridle should be attached to the extreme outboard ends of the floats to obtain maximum leverage possible.

Overcome with dismay, Randy wanted to get the knife and cut the whole rig away, but Thea shouted above the noise of the wind that he should try leading the bridles off the extreme outboard tips of the floats before doing so. Randy was skeptical at first, but then decided to give it a try. He would have to unclip the two snatchblocks from the U-bolts (three feet inboard), wriggle out to the ends of the narrow floats and re-attach them to pad-eyes forward. It was a formidable struggle, but it did the trick. *Celerity II* immediately rounded up and began facing the seas. In his article appearing in the June 1982 issue of SAIL, Randy describes *Celerity II*'s behavior (reproduced by permission of *SAIL* Magazine):

> *She bobbed easily over the upwelling crests, first backing swiftly, then popping upward like a suddenly released balloon. I was certain we would be buried under each seemingly perpendicular wall. No water came on deck. The bridle led perfectly, never coming into contact with either the hulls or the deck. There was no jerking at the blocks - only a gradual tension and relaxation as the nylon "springs" dissipated the heavy loads. We were anchored in mid-Pacific. We might have been anchored in a monsoon-torn harbor, except for the longer periods between each extraordinary rise and fall.*

With the situation in hand they went down below and prepared a meal. Radio reception faded in and out, but they were able to piece the fragments together: tropical storm *Freida* had been upgraded to a hurricane, and her eye was 150 miles to the north! Just before dark Randy estimated the wind speed at about 50 knots sustained, with seas of 30 feet from trough to crest. Many of the waves were observed to be breaking heavily along their full lengths, but *Celerity II* had settled down into predictable cycles and seemed to be doing OK.

The night was a lonely vigil for the two. Randy writes that lying in the dark cabin they were mentally overwhelmed by the noise of the combers, rising in pitch as they approached the boat and then falling in pitch as they receded - like approaching and receding freight cars. The wind was shrieking through the rigging and the radar reflector up on the mast, creating an incessant racket that tore at their nerves. It was

impossible to sleep. At dawn they were able to prepare a breakfast, and the radio informed them that the eye of the storm - packing 100 knot winds - had re-curved and was passing to the north for the second time! Thea put her head into the plastic observation bubble in the coach roof and surveyed the white seas around them. Suddenly she exclaimed she could see the parachute in the distance. As the boat climbed the next wave, Randy saw it too, "a shimmering disc, suspended like a huge jellyfish in the face of the bottle-green sea. The shroud lines reached out like tentacles, holding us safely in their grasp. We knew we were safe as long as our chute held." Well, the chute did hold, and, other than some minor damage to the trim-tab on her self-steering rudder, *Celerity II* emerged from her encounter with the lady *Freida* intact. In the same article Randy Thomas sums up his opinions:

> *Cruising safety depends on having options. And the parachute sea anchor can offer you a crucial alternative when the chips are down. Lying a-hull in heavy seas can result in damage, capsize, or worse aboard a light-displacement boat that is easily "tripped" by a fin keel or a submersible float. A parachute will hold such craft safely head-to-the-seas, minimizing drift and the danger of breaking crests.*

S/T-3 Trimaran, Cross

S/T-3

Trimaran, Cross

50' x 27' x 16 Tons

28-Ft. Dia. Parachute Sea Anchor

Force 10 Conditions

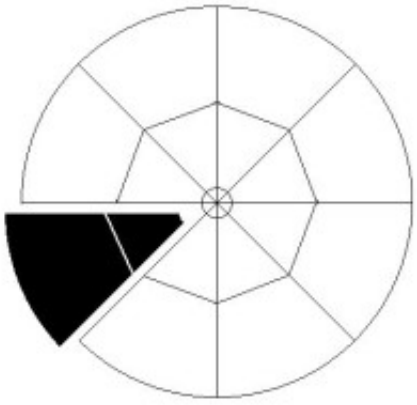
File S/T-3, obtained from the owner of the boat, residing in Durban, South Africa - Vessel name withheld by request, hailing port Yarmouth, England, trimaran ketch, designed by Norman Cross, LOA 50' x Beam 27' x Draft 6' x 16 Tons - Sea anchor: 28-ft. Diameter C-9 military class parachute on 500' x 3/4" nylon braid tether and bridle arms of 80' each, with 5/8" galvanized swivel - Full trip line - Deployed in an Atlantic storm in deep water south of Tristan Da Cunha with sustained winds of 50 knots and seas of 30 ft. - Vessel's bow yawed 20° - Drift was estimated to be 12 n.m. during 36 hours at sea anchor.

South African safety expert, yachtmaster, instructor and Intec Maritime Academy principal Henton Jaaback had heard about the Casanovas' pioneering work. He acquired a military parachute, which he ended up loaning to the owner of this passage-bound trimaran. On her way to Rio from Cape Town the trimaran ran into a horrendous storm south of the island of Tristan da Cunha. Exhausted, the owner and his wife deployed the parachute according to the Casanovas' guidelines. It pulled the three bows into the huge seas and kept them there for 36 hours - through the worst part of the storm. After the 36 hours there was a jerk, the bows fell off the wind, and the big multihull lay beam to the seas, drifting downwind. It is the owner's opinion that the galvanized swivel in the system seized - failed to rotate, though the 3-strand rope used for the bridle arms is suspect as well (3-strand will torque under load). At any rate when he pulled the lines back on board, all that remained were the two bridle arms of about 60 ft. each, twisted

around each other and their ends unraveled. The full trip line had snapped at the same time, so they lost everything, hardware, swivel, tether, parachute and all.

Galvanized swivels have always been a source of concern to your author, though one looks at the Casanovas' file and sees that they never had a problem with theirs in eighteen years of cruising and storm use. The problem with these swivels lies in the galvanic process, which results in an acid-etched coarse surface, liable to stick or "gall" under load. Even so, the swivel - if of good American or Japanese make - usually gets a chance to rotate during slack cycles, as born out by many other files in this database. Moreover there are excellent stainless steel swivels on the market today.

Why do parachutes rotate under load? They may do so because of inconsistencies in fabrication, or shroud lines that are not precisely equal in length. But mostly they rotate because of the *ratchet effect* produced by the overlapping of the panels. These panels, shaped like pie wedges, have to be sewn together to form the circular shape of the canopy. The edge of the first panel is laid *over* the edge of the second and sewn, the edge of the second panel is laid *over* the edge of the third, etc., the radial seams being *over, over, over,* and this is where the *ratchet effect* crops up. To do away with this built-in cause of rotation one has to stagger the fit of the seams. The edge of the first panel is laid *over* the second and sewn, but the edge of the second panel is laid *under* the third, etc. *Over, under, over, under.* The parachutes that are used to slow down supersonic aircraft on the runway are of staggered fabrication. You won't see them spin.



Canopy panels

The panels on Para-Tech sea anchors are now sewn in such a way as to be spin-neutral, although swivels are still a good idea. Here is a transcript of the DDDB feedback provided by the owner and his wife:

> *Swivel on bridle galvanized iron 16 mm - swivel on parachute 16 mm also. The bridle was attached to the swivel of the main line with two shackles. Main line 20 mm "multiplait." Bridle was 25 mm nylon 3-strand rope. After recovering the remains of the bridle we saw we had lost the*

two shackles and the swivel. The remains of the arms of the bridle were unraveled & twisted around each other - everything else was lost. We have been informed that galvanized swivels apparently lock under strain....

The trip line also snapped when we lost the para-anchor. This was at about 3 pm (we felt a jerk). We rushed into foul weather gear and on deck.... When we started up the engine and tried to find the "rig," the wind was so strong the boat could make no headway - also the seas were white, so the [white] *buoy was impossible to see! A red buoy would perhaps show up better, even though we could not have motored to get it....*

Some hours after we lost the para-anchor, after broaching dangerously south of Tristan da Cunha, we decided to use a drogue to slow the boat and eliminate broaching. We were bare-pole doing 5-6 knots and descending the slope of waves at 12-13 knots. The drogue consisted of 150 ft. of "multiplat" 20 mm. rope plus 33 ft. of 1/2" chain with 4 knots to make more vortex [turbulence]. *All the above was attached to a bridle of 30 ft.* [each arm].... *We used the engine* [in conjunction with the drogue] *at the minimum, about 1000 revs, that gave us a speed of approx 4-5 knots and maximum speed in descending wave slope of 7-8 knots and no more broaching.*

We needed the engine to keep enough steering power. We had a 3-blade fixed prop that spoiled the efficiency of the rudder; I think we lost about 50% efficiency! But we used the autopilot without any problem and we really appreciated the work of the drogue in straightening the boat each time at the beginning of a broach. The bridle was fixed to two sampson posts of 4" square oak, fixed to the keel of each float. The wind was then about 40 knots, with big breaking seas for about 24 hours.

We were very surprised by the efforts [loads] *imposed by the drogue and also by the parachute anchor and we don't think that normal cleat-type fitting would have lasted under the strain....*

We now have two para-anchors.... We honestly feel we would not sail without one now. Our experience around Tristan, and the knowledge that we were safe and could ride out a storm, has made this indispensable.

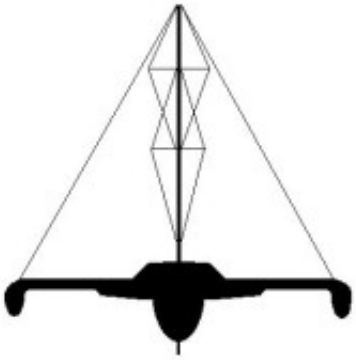
S/T-4 Trimaran, Condor

Trimaran, Condor

40' x 28' x 3 Tons

18-Ft. Dia. Sea Anchor

Force 7-8 Conditions



File S/T-4, obtained from Jack Hunt, Apollo Beach, FL. - Vessel name *Crystal Catfish IV*, hailing port Apollo Beach - Trimaran, designed by Condor Ltd., LOA 40' x Beam 28' x Draft 8' (20" board up) x 3 Tons - Sea anchor: 18-ft. Diameter *Para-Tech* on 400' x 1/2" nylon three strand tether and bridle arms of 80' each, with 5/8" galvanized swivel - No trip line - Deployed during passage of low system in deep water in the Gulf of Mexico about 125 miles WNW of Tampa with winds of 30-40 knots and seas of 15 ft. - Vessel's bow yawed 10° - Drift was estimated to be about 2 n.m. during 12 hours at sea anchor.

Jack Hunt is a veteran of the 1980 and 1984 OSTARs (*Observer Singlehanded Trans-Atlantic Race*) in which he sailed a 31-ft. monohull named *Crystal Catfish III*. After making the switch to a lightweight, fast multihull, Jack ended up using a Para-Tech sea anchor during the 500-mile single-handed qualifying run, in preparation for the 1988 OSTAR. In a related article which appeared in the January/February issue of *Multihulls*, Jack describes conditions in the Gulf of Mexico in the winter as "a battleground of warm and cold fronts, locked in fifteen-round bare-knuckled battles for supremacy, much like the English Channel in June, except the waves in the Channel have the decency to come from the same direction as the wind." Here is a transcript of the DDDB feedback your author obtained from Jack:

> *Two things caught me by surprise in the twelve hour winter ride* [at sea anchor] *in the Gulf. First, how much stretch there is in nylon rode. Chafe protection is a must. Second, the "G-forces" which result from the boat being lifted up on a wave top (increased G-force) and then let down into a trough (reduced G-force), much as one would feel on a roller coaster. These forces are a characteristic, I suspect, of the lightweight multihull configuration, having nothing to do with the para-anchor and not at all a problem, just surprise. Because I am alone I do not use a trip line; not enough hands. Instead, I winch the rode in until the para-anchor is within reach with a boat hook and then pick up a shroud line. All of which nets me quite a mess hurriedly stuffed into a bag*

on a trampoline, so I can get back to tending the suddenly underway boat. Re-folding the chute for its next use presents me with the "one-legged sailor at an ass-kicking contest" scenario. Consequently I have acquired a parachute for use in between the time I haul out the para-anchor and can get it re-folded, if something should develop. The [aerial] *parachute is not nearly as rugged as the para-anchor, however, so I remain motivated to work out a more reliable re-folding routine.*

The only question remaining for me is, "why didn't I use a para-anchor all those years I had a monohull?" Probably had to do with the false heroism of getting the hell kicked out of me and my boat while hove-to. I should have had this para-anchor years ago.

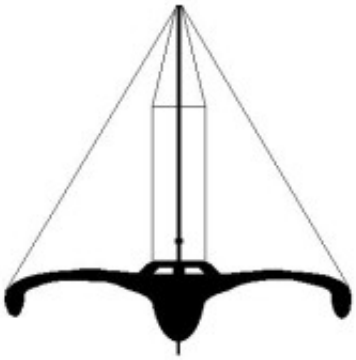
S/T-5 Trimaran, Newick Derivative

Trimaran, Newick Derivative

30' x 25' x 2 Tons

5-Ft. Dia. Sea Anchor

Force 9 Conditions



File S/T-5, obtained from the owner of the boat, residing in Falmouth, MA. - Vessel name withheld by request, hailing port Falmouth, design derived from the Newick Val 31 concept (lightweight, open wing ocean racing trimaran), LOA 30' x Beam 25' x Draft 8' x 6" (2' 3" board up) x 2 Tons - Sea anchor: 5-ft. Diameter *Shewmon* on 200' x 5/8" nylon three strand tether and bridle arms of 50' each, with 1/2" galvanized swivel - No trip line - Deployed in a gale in deep water within the Gulf Stream with winds of 45-50 knots and seas of 12 ft. - Vessel's bow yawed 10° - True drift was undetermined due to the Gulf Stream.

This lightweight Val-class racing trimaran was sailing back from Bermuda to her home port of Falmouth when she ran into a gale within the Gulf Stream. The skipper deployed a 5-ft. diameter Shewmon sea anchor, which pulled the three knife-like bows into 12-ft. confused seas, and kept them safely there for a period of 18 hours. Several snatch blocks were used to bring the bridle ends to cockpit winches. This enabled the skipper to work the bridle from the safety of the cockpit. He found it necessary to *freshen the nip* once every hour or so - two turns on the winches to shift the wear points and reduce localized chafe. The large daggerboard - drawing 8' 6" when fully lowered - was raised about two thirds of the way up, leaving about three feet of board sticking out of the bottom to keep the hull's center of lateral resistance sufficiently forward. The tiller was lashed amidships.

The bridle was led off the main hull and the tip of the port float only. The beam of the yacht being 25 ft., this "half-bridle," extending from a 12½ ft. base, was evidently enough to provide the leverage needed to keep the trimaran facing into the seas. In general your author is opposed to "half-bridles," however. Along with other safety experts, your author feels that the multihull bridle should make full use of the leverage afforded by the *maximum* beam of the yacht. The wider the base of the bridle, the greater the leverage - and the more positive its influence in terms of vessel alignment.

S/T-6 Trimaran, Pivercraft Nimble

Trimaran, Pivercraft Nimble

30' x 18' x 3 Tons

12-Ft. Dia. Sea Anchor

Force 5-6 Conditions

File S/T-36 obtained from John H. Baldwin, South Orleans, MA - Vessel name *Goodspeed*, hailing port South Orleans, trimaran designed by Arthur Piver, LOA 30' x Beam 18' x Draft 30" x 3 Tons - Sea anchor: 12-ft. Diameter *Para-Tech* on 400' x 1/2" nylon three strand tether and bridle arms of 45' each, with 1/2" galvanized swivel - Full trip line - Deployed in frontal trough in shallow water (20 fathoms) about 30 miles off Beaufort, North Carolina, with winds of 25 knots and seas of 6 ft. - Vessel's bow yawed 10° - Drift was 3 n.m. during 10 hours at sea anchor.

This file shows how a sea anchor can be used to "keep the sea" in terms of drift control. Groundings are among the fourteen major types of statistical accident data published in the Coast Guard's *Boating Accident Reports*. There are *hundreds* of groundings a year. Many a seaworthy yacht has survived the storm offshore only to run aground and be declared a total loss because of an error in navigation, or engine problems, or rudder problems. Quite often the needless loss occurs because of crew fatigue and impatience. The sight of the harbor range lights in the murky night is a temptation that sea-weary sailors would do well to resist, especially if it is a strange, windy harbor with a difficult, narrow entrance.

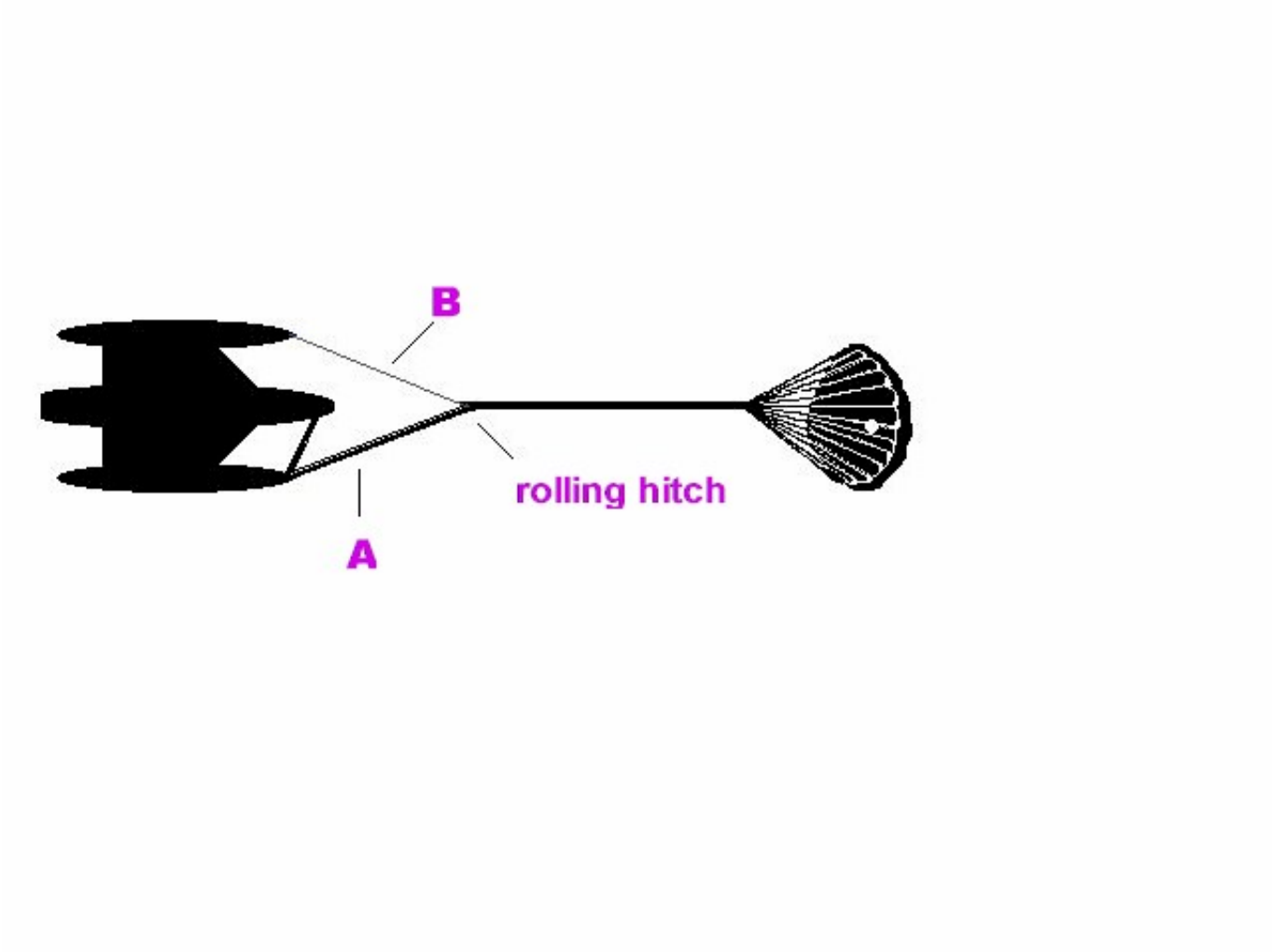
The scenario is all too familiar. The crew members have been cooped up in the heaving boat for days, maybe weeks. Likely exhausted, wet, cold, hungry and deprived of sleep, they can scarcely wait to set foot on dry ground, indulge in a steaming hot shower, inhale a couple of juicy hamburgers and climb into a comfortable, dry bed. So they decide to try to risk it - and run aground. Vessels equipped with sea anchors are better able to resist this temptation, since they can use the parachute to stand off until daylight. Instead of risking entry on a windy night, or trying to anchor the boat over a coral bottom with surf booming a hundred feet away, one can stand off a mile or two and use the parachute as an "offshore anchor," which is what your author used to do in the windy channels of Hawaii.

Goodspeed is an original Piver Nimble trimaran, used as a commercial fishing vessel by John Baldwin. Baldwin is offshore for long periods of time and often heaves to the parachute for sea layovers. He also uses it to stand off outside strange harbors, waiting for daylight. Transcript:

We deployed the sea anchor on the fourth day out.... There was no storm or nautical emergency. My crew mate Chris and I had been on a spinnaker run in the Gulf Stream, heading for Beaufort, North Carolina. Dusk found us still 30 miles from Beaufort with a freshening breeze from the south. Six months earlier we had learned a hard lesson: don't attempt to enter unfamiliar harbors at night. Tired and half seasick, we were approaching St. Mary's Inlet on the Georgia/Florida border. It was 4 am and we had been sailing all night on the working jib with the wind increasing from the north. "If I can find a light I'm going for it," I told Chris. I didn't have a large-scale chart and was nervous. Chris found the Waterway Guide *and on the last page read "the stone jetties of the entrance are awash at half-tide, constituting a hazard." A quick check with the tide charts in Eldrige and sure enough, it was nearing half tide. We spent a hard couple of hours jibing and standing off, until dawn brought us in with the fishing boats.*

Now, six months later, armed with our new parachute sea anchor, we doused the spinnaker, then hove-to the sea anchor with no trouble. Fishermen off the Pacific coast routinely deploy sea anchors at night. They know, and I know too, that nothing beats a sea anchor for peace of mind and a good night's sleep.

When using his sea anchor for station keeping offshore, John Baldwin has a unique way of obtaining the bridling advantage, without actually using a dedicated bridle (see image below). He gives the main tether (A) a few turns around the starboard float cleat, before securing it to big anchoring cleat on the main hull. He then brings a single, short utility line (B) from the port float and bends it onto the main rode by means of a rolling hitch. This way, even if the rolling hitch slips - he says it never has - throwing the turns off the starboard float will put the main rode back on the center hull. Of course, the purpose of this arrangement is to allow variable rode lengths for multihulls, in non-storm applications.



Setting up a variable length bridle

S/T-7 Trimaran, "Rose-Noëlle"

Trimaran, "Rose-Noëlle"

41' x 26' x 6.5 Tons

24-Ft. Dia. Parachute Sea Anchor

Force 8-10 Conditions

File S/T-7, obtained from John Glennie, New Zealand - Vessel name *Rose-Noëlle*, hailing port Nelson, New Zealand, trimaran designed and built by John Glennie, LOA 41' x Beam 26' x Draft 3' x 6.5 Tons - Sea anchor: 24-ft. Diameter military chest reserve parachute on 300' x 3/4" nylon three strand tether and bridle arms of 40' each, with 1/2" galvanized swivel - Full trip line - Deployed in a gale in deep water about 150 miles southeast of the East Cape of New Zealand with winds of 40-60 knots and seas of 20 ft. - Vessel's bow yawed 10° - Fouled trip line collapsed the parachute after 10 hours, allowing the trimaran to lie a-hull and be capsized by a rogue wave - Crew survived 118 days adrift inside the inverted hull.

On 4 June 1989 the trimaran *Rose-Noëlle* capsized some 140 miles east of the Wairapa coast of New Zealand. The crew of four spent 118 days adrift inside the upturned hull. The incident subsequently became a source of some controversy, leading to an investigation by the New Zealand Ministry of Transport. John Glennie's exclusive story was first published in the November 1989 issue of *New Zealand Yachting*. Later, John wrote a book about the ordeal called *Spirit of Rose-Noëlle*.

John Glennie is an institution in the land of Down Under. New Zealand and Australian magazines have referred to him as *Free Spirit of the Pacific*. John and his brother David started out by building a 35' Piver Lodestar trimaran in their Father's Marlborough farm shed in America. They named it *Highlight* and sailed away. After spending eight years roaming all over the Pacific, John and David wound up in Australia, where they worked on and delivered many famous boats, including Mike Kane's *Spirit Of America*, a Kraken 55 trimaran of Lock Crowther design.

Glennie's own boat, *Rose-Noëlle*, took nineteen years of intermittent work to build and launch. John sailed it to the Great Barrier Reef, then across the Tasman Sea to New Zealand, where he gained boat-building work at Paremata, working with the brother of New Zealand's America's Cup helmsman, David Barnes. Every cent that he earned went into equipping *Rose-Noëlle* for self-sufficiency on high seas. Innovative rigging, water still, solar panels, radios, radar, etc., and a 24-ft. diameter parachute sea anchor.

Rose-Noëlle set sail from Picton New Zealand on June 1st (winter Down Under), headed for warm waters

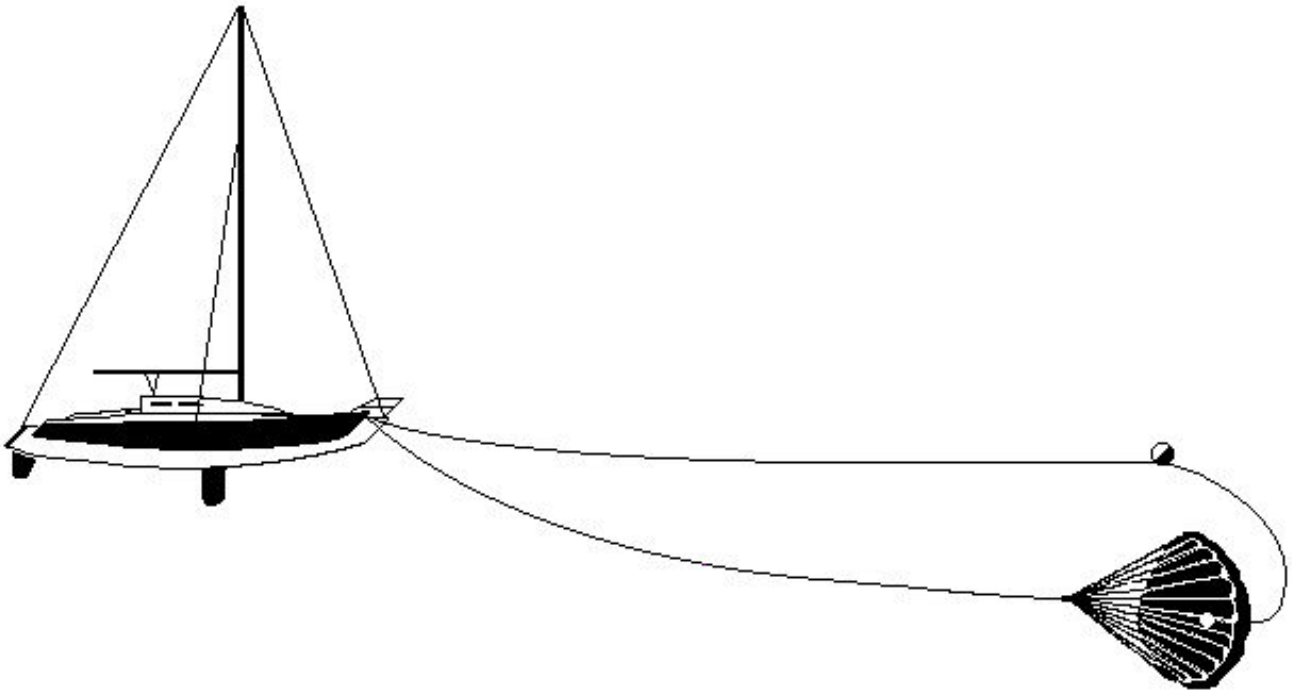
and Tonga. The crew consisted of John Glennie, Philip Hoffman, Rich Hellriegel and Jim Napelka. On the third day out they ran into a southerly gale and for a while used a Sea Squid (bullet-shaped Australian plastic drogue) to slow the boat down. Later they stopped the boat and deployed the parachute sea anchor. It pulled the three bows of *Rose-Noëlle* into 20-ft. seas and kept them there for the next ten hours.

The full trip line, probably left hanging loose in the sea, must have fouled with the parachute because sometime after those ten hours the trimaran began to yaw increasingly from side to side, until finally she was lying a-hull. It was night and little could be done. An hour or so later, the crew heard the approach of a great roaring noise, much like that of a huge - Hawaiian - surf wave. The rogue wave hit the boat broadsides and rolled her over very quickly. In the article that appeared in *New Zealand Yachting* Glennie stated that just before the capsize the wind had eased and he was concerned that without the wind "regulating" the seas, two or three waves might "ring hands and turn into rogues."

After the capsize it took the crew a while to settle down to the business of survival. Wrote Glennie, "I had to keep their hopes up and get them over the shock of the first stage. If people give up, they die." Eventually they all adapted, surviving the next 118 days adrift inside the inverted hull of the trimaran. There was plenty of food left inside, and the problem of fresh water was solved when John devised a system for collecting and storing rain water. From then on it was patience and perseverance, despite numerous gales, saltwater sores, and the occasional brawl that one might expect in such dire and cramped circumstances.

The inverted trimaran drifted "all over the place." It is estimated that she covered, ignominiously, a journey of nearly 2,000 miles, during which the cramped crew experienced somewhere between 17-20 gales - an average of one every week! And astonishingly enough, four months after the Royal New Zealand Air Force planes had given up the search for *Rose-Noëlle* she washed back up unto Great Barrier Island, at the edge of the Hauraki Gulf, the well-populated sailing area of New Zealand. Transcript of hand-written notes that accompanied John Glennie's feedback:

> *The para-anchor worked well and I was most impressed till it fouled.... The trip line fouled the chute and with the chute partially collapsed we lay a-hull.... The wave was so big that it would have rolled the Cutty Sark! They* [rogue waves] *are out there. I think three waves got together, so it was probably 60 feet high. I saw a similar 60-ft. vertical wall of water in 1968, mid-winter, 43° south, below Tahiti. Water was running down its face and I remember the noise it made as it came towards us.... Next time I won't use a trip line. I could have got the chute back in with the electric capstan in the calm after the storm.*



Full trip lines should be kept FAIRLY TAUT so they do not hang down in the sea and foul the rode and parachute.

A reminder that the Casanovas used full trip lines for eighteen years with seldom a foul-up. According to John Casanova, the trick is to have a small swivel at the float, and keep the trip line *fairly taut* - no excess slack hanging loose in the sea to foul with the parachute or rode. Bear in mind, also, that if the wind force increases the main rode will elongate, requiring that the full trip line be slackened off accordingly (otherwise it may trip the canopy). By checking the trip line tension on a regular basis, one can tell if it is too loose, or too tight. One should also use the binoculars to keep an eye on the big red float itself. If it is behaving awkwardly - as though it had hooked onto a big fish - it may mean the trip line is too tight and needs to be slackened off a little.

S/T-8 Trimaran, Cross

Trimaran, Cross

42' x 23' x 7 Tons

18-Ft. Dia. Sea Anchor

Force 9-10 Conditions

File S/T-8, obtained from Daniel A. York, Costa Mesa, CA. - Vessel name *Gold Eagle*, hailing port San Francisco, trimaran designed by Norman Cross, LOA 42' x Beam 23' x Draft 4' x 7 Tons - Sea anchor: 18-ft. Diameter *Para-Tech* on 400' x 5/8" nylon braid tether and bridle arms of 60' each, with 5/8" stainless steel swivel - No trip line - Deployed in gale-force winds in shallow water (25 fathoms) about 15 miles west of the Nicoya Peninsula (Costa Rica) with winds of 45-60 knots and seas of 10 ft. - Vessel's bow yawed 10° - Bearings taken from three shore lights indicated no noticeable drift during five hours at sea anchor.

This file is about a 42-ft. trimaran that used an 18-ft. diameter Para-Tech sea anchor to stand off a lee shore against the sudden onslaught of 40-60 knot winds. *Gold Eagle* was sailing to Puntarenas, Costa Rica, from Corinto, Nicaragua. In the evening of 22 May 1990 she was about fifteen miles offshore, about to clear Cape Blanco on the Nicoya Peninsula, when the wind came up out of nowhere. Incidentally, this is a common occurrence on the Pacific side of the Central American coast. Whether caused by a massive high pressure cell over Texas funneling air through gaps in mountains, or by the seasonal migrations of the Inter Tropical Convergence Zone, it is something one should *always* be prepared for in Central American waters. Transcript:

> *Wind (45 knots) came up very fast at approximately 2000 hrs. I rushed forward to drop the club-footed jib (already reefed). The aft reef grommet tore out along with 3' of sail before I could drop it. Under full power (40 hp. Mercedes Diesel with 18" diameter 3-bladed prop) boat was being blown backward so fast that the rudder was trying to jam hard over. Seas starting to come over port beam after engine secured as it was overheating. Dropped 18-ft. diam. para-anchor. Bridle shackle almost hung up on port ama cleat, but I cast it free just before strain on bridle. Boat immediately swung into wind and seas. Seas very short and steep as boat climbed and fell off crests.*

I was concerned we'd be blown to shore, but over the 5 hour period I took bearings from three shore lights (360°, 125°, 100°) with no noticeable drift. Winds maintained 50-60 knots for approx. 1 or 1.5 hours, then lowered to approx. 40-45. After five hours winds dropped to only 10 knots. Another trimaran, returning to Long Beach after participating in a trans-Atlantic race, had trouble with jammed sail track slides and was dismasted in the same blow. My sea parachute is one of the few items I purchased that performed as advertised and no defects or surprises. I appreciated the quality and the performance more than I can express. Wouldn't leave port without it ever.

S/T-9 Trimaran, Condor

Trimaran, Condor

40' x 28' x 3 Tons

18-Ft. Dia. Sea Anchor

Force 10 Conditions

File S/T-9, obtained from Phil Herting, Coconut Grove, FL. - Vessel name *Triple Shock*, hailing port Norfolk VA, trimaran designed by Condor Ltd., LOA 40' x Beam 28' x Draft 8' (20" board up) x 3 Tons - Sea anchor: 18-ft. Diameter *Para-Tech* on 400' x 5/8" nylon braid tether (no bridle) with 5/8" stainless steel swivel - Full trip line - Deployed in a gale in deep water about 120 miles west of Miami with winds of 50 knots and seas of 15-20 ft. - Vessel's bow yawed 45° (without bridle) - Drift was estimated to be 15 n.m. during 7 hours of deployment.

Triple Shock was on her way back to Miami from Jamaica, after participating in the Miami-Montego Race. The wind had been building for some time when the aluminum rudder cage split, leading to complete loss of steering control. The para-anchor was deployed to stabilize an emergency situation. No bridle was used, just a single rode leading off the main hull, as a result of which the bow would yaw considerably off the wind. With the weather deteriorating, a nearby Coast Guard vessel was asked to render assistance. Delivery skipper Phil Herting said that the seas were so large that the 110' CG cutter, *Madagorda*, would periodically disappear from view in the troughs. Transcript:

> *We were NNE of Great Issacs in deteriorating conditions when the aluminum fabricated rudder cage split. Upon breaking, the boat rounded up and then stalled. We immediately dropped the main and rolled up the balance of the jib. At that point we deployed the para-anchor. This device was utilized to stabilize an emergency situation and was deployed to ride out some bad weather. Because of the immediacy created out of the breakage we had to deploy it as fast as we could and with what line we had immediately available. For this reason the first line tied to the para-anchor was a 1/2" pre-stretched Dacron backup spinnaker halyard.*
>
> *This immediately proved to be a mistake. The shock load transmitted back through the line was*

unbelievable. Realizing our mistake we then attached 250' of 3/4" three strand nylon. Though the nylon reduced the shock loading, it created another problem. I elected not to attach the second rode to a bridle because I wanted to save that for the tow from the CG cutter. So we led the rode through the bow chock to a primary winch. This enabled us to adjust the line when replacing chafing gear. And the chafe was the problem. Because the distance from the winch to the chock was so great, it created a longer spring and chafe area on the line. In retrospect, I should have deployed the nylon rode first and then had a Dacron tail. This would have minimized the chafe at the chock.

The Madagorda, *the 110' cutter that came to our assistance, said that our rescue was done in the worst weather in which they had ever attempted one. They did a phenomenal job, though it did take 3 hours to get us a heaving line. One reason for this was the fact that the parachute was sitting right where they wanted to position themselves when getting us the towline.*

What are you going to do? I hate to think of the situation if we had not had the para-anchor with us. It should be considered a vital piece of gear when making any substantial offshore passage.

S/T-10 Trimaran, Searunner

Trimaran, Brown Searunner

31' x 18' x 2.2 Tons

12-Ft. Dia. Sea Anchor

Force 7-8 Conditions

File S/T-10, obtained from Donald Longfellow, Garden Grove, CA. - Vessel name *Take Five*, hailing port Ventura, Searunner trimaran designed by Jim Brown, LOA 31' x Beam 18' 6" x Draft 5' (2' 6" board up) x 2.2 Tons - Sea anchor: 12-ft. Diameter *Para-Tech* on 300' x 7/16" nylon braid tether and bridle arms of 45' each, and 1/2" galvanized swivel - Full trip line - Deployed in Papagayo conditions in shallow water (25 fathoms) about 20 miles off the coast of Nicaragua with winds of 30-40 knots and choppy seas of 6-8 ft. - Vessel's bow yawed 10° - Drift was estimated to be 3 n.m. during 6 hours at sea anchor.

Papagayo winds can come up unexpectedly. They are caused by an intensification of the trade winds in the southwestern Caribbean, blowing offshore through narrow gaps in the mountains of Central America, setting up a short, nasty chop that may run at a 30-50° angle to the predominant wave train. The real difficulty for small craft is not the size, but the steep and confused nature of the seas. *Papagayos* can last for a few hours, subside slowly, then come back up again. They are most prevalent from December to March. The name *Papagayo* comes from the Gulf of Papagayo - northern Costa Rica - where they probably blow the hardest. Their southern limit is fairly distinct, being about 10 miles south of Cabo Velas in Costa Rica. The *Papagayo* is harder to predict than its cousins to the north, the intimidating *Tehuantepeckers* of the Gulf of Tehuantepec (Mexican isthmus) and the *Santa Anas* of Southern California. The owner of *Take Five* has equipped her with a number of drag devices, including a Galerider. On 29 January 1991 he deployed a 12-ft. diameter sea anchor to cope with *Papagayos*. Transcript:

> *Because the wind was coming out of the breaks in the coastal mountains it was blowing 30 degrees off the direction of the primary wave track (120° magnetic). Adjusting the length of one bridle arm didn't rotate the boat sufficiently so I re-led the starboard bridle arm to a snatch block near the stern of the starboard float. This allowed the boat to face into the large waves coming from farther down the coast, which I considered more important than facing directly into the wind. The centerboard was up but side-to-side yaw wasn't a problem. Despite the atrocious looking sea state I eventually noticed that the boat decks were dry and, except for an occasional errant wave slapping the hull, the boat was quite comfortable. Drift was more than what I've*

experienced on other occasions that I've used the para-anchor. Perhaps there was a current present or perhaps it could be attributed to turning the hull 30 degrees to the wind.

S/T-11 Trimaran, Simpson

Trimaran, Simpson

43' x 27' x 5.5 Tons

18-Ft. Dia. Sea Anchor

Force 9 Conditions

File S/T-11, obtained from Frans Aeyelts, Halifax NS. - Vessel name *Amakama*, hailing port Halifax, trimaran designed by Roger Simpson, LOA 43' x Beam 27' x Draft 3' 6" x 5.5 Tons - Sea anchor: 18-ft. Diameter *Para-Tech* on 430' x 3/4" nylon three strand tether and bridle arms 70' each, with 5/8" galvanized swivel - Full trip line - Deployed in a whole gale in deep water about 260 miles north of Bermuda with winds of 40-50 knots and seas of 20 ft. - Vessel's bow yawed 10° - Drift was estimated to be 5-10 n.m. during 27 hours at sea anchor.

Charter skipper Frans Aeyelts has used the parachute sea anchor half a dozen times in Halifax to Bermuda runs. Like Voss and the Pardeys, he's not one to give any storm the benefit of any doubt. Transcripts:

> *Having used the chute several times convinces me that it is essential to the safety of the boat and crew. (Nobody is going to tell me otherwise, especially those who have never used one and have firm opinion about it!) October 22, 1987: This was the maiden voyage of* Amakama *to Bermuda, with final destination Barbados. Early during the morning the wind came up from the NW and kept increasing and veering. By noon we were clipping along nicely with a fresh breeze from the north. Wind force kept building and veering to NE. Speeds up to 16 kts. We decided that if the weather would not improve by 1600 hrs. we would put out the chute. Since this was the first try of the device in the open ocean, we wanted to deploy it in daylight. By 1700 hrs. the parachute had been deployed.*
>
> *Seas are continuing to build, so is the wind (Force 8). Foam streaking down the steep waves - breaking crests. Twice a rogue broke over the boat. Too rough to cook. Everybody in their bunks. From time to time we look out to see how the weather is. Very noisy down below - 36 hours is a long time to be cooped up with five people on a boat. Cross seas from the north aggravating the confused sea state. Chute behaved very well. Trip line* [full] *made it easy to retrieve. Very good device. To heave-to under such conditions would be dangerous - you are taking the elements 50-60° on the bows and may sustain damage or capsize. Running off...? Also dangerous - waves were too steep. Retrieved parachute 0815 hrs. next day. Motorsailed in rough conditions (close-*

hauled SE wind) to St. Georges Harbor, Bermuda.

May 28, 1988: Fast moving front. Sea and wind came around from SSE to NE very quickly. Situation was such that we could no longer sail and had to put out the chute. By midnight the sea state had calmed down considerably, but was still "lumpy." Chute performed admirably well again, giving us relief from a long wet watch in cockpit. I figured it was better to sit at the para-anchor than risk sailing on, not knowing what was going to develop later. Tim and myself were able to haul back the chute without difficulty.

October 8, 1988: Left Halifax harbor at noon. Crew of three, including myself. NE wind, already blowing strong. Forecast called for 40 kts. Sailed for 6 hours - sea and wind force kept building as we left land behind us. Going very fast. After 3 hours of this we dropped the jib, next the main, and finally the inner stays'l. Because we were over La Have basin (approx 40 miles south of Halifax) well on the continental shelf, the seas built up to short, steep waves in a very short time. With two inexperienced (multihull) sailors on board I did not want to sail the night in huge seas. Parachute deployed. Safety first. This was a short-lived gale. A schooner that had left only 2 hours before us blew out her sails in the same gale and had to limp back to port. Better safe than sorry!

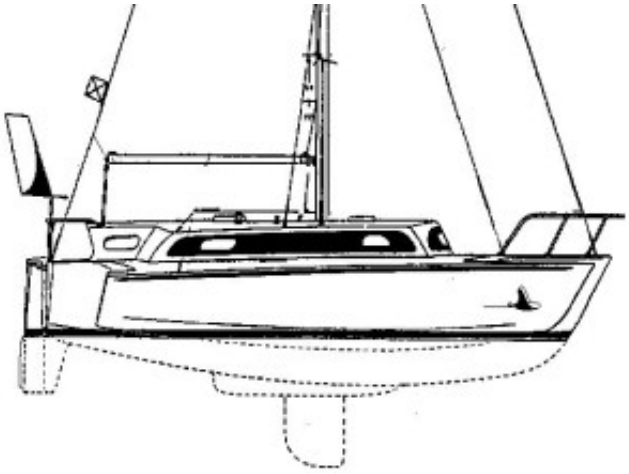
S/T-12 Trimaran, Searunner

Trimaran, Searunner

34' x 21' x 5 Tons

15-Ft. Dia. Sea Anchor

Force 7-8 Conditions



File S/T-12, obtained from Ted and Karen Cary, Weymouth MA. - Vessel name *Sequester*, hailing port Stuart FL, Searunner trimaran designed by Jim Brown & John Marples, LOA 34' x Beam 20' 11" x Draft 6' 5" (2' 6" board up) x 5 Tons - Sea anchor: 15-ft. Diameter *Para-Tech* on 400' x 5/8" nylon braid tether and bridle arms of 100' each, with 1/2" galvanized swivel - Partial trip line - Deployed in gale in deep water about 50 miles SW of Bermuda, with winds of 35-40 knots and seas of 8-12 ft. - Vessel's bow yawed 10° - Drift was estimated to be 10 n.m. during 10 hours at sea anchor (0.5 -1 kt. Gulf Stream).

By now the reader must have noticed the number of files that involve boats running into gales on their way to or from Bermuda. Transcript:

> *Before leaving Buzzards Bay for Bermuda I changed the boat to my secondary anchor and rode, and rigged my primary rode and bridle to the para-anchor. The 400' tether (two 200' sections) was then shackled to 30' of 5/16" chain, and that to the bridle's center thimble. Tether & bridle are all 5/8" double braid nylon.*
>
> *The rode was chainlinked and flaked in one of my forward wet lockers, in the wing deck. The legs of the bridle I led around the bow pulpit stanchions and secured with masking tape and light line, tied with slip knots. To deploy all I had to do was unbag the chute, pull the slip knots, tie on my tripline and slam dunk.*
>
> *As we approached Bermuda the wind headed us until it was nearly dead on the nose and building. I had the boat overloaded and in the steep, big waves (wind vs current) we were pounding the underwings mercilessly, making very little progress. Having the para-anchor we set it and had the option to stop, rest, and evaluate, and also run up an antenna wire for the Weatherfax to get some info. The developing LOW southeast of us was an unwelcome surprise and turned into Hurricane* Grace *two days later.... After 10 hours we made the decision to retrieve the chute and make a desperate motorsailing dash for Bermuda. Conditions were as bad or worse when we retrieved the chute as when we deployed it. One thing complicated the retrieval: we had a partial*

trip line [on two floats] *and the retrieve float never did stay downwind of the chute, but appeared to lie almost 90° from the tether between the chute and the boat* [probably due to the influence of the northwesterly current]. *To retrieve it we couldn't just follow up the rode but had to motor off to starboard to pick up the float ball - not easy. Next time will use a FULL trip line. In any case, we made it to Bermuda (cheated and came over the reef - love these shoal draft boats) with about one gallon of gas left, and both of us totally whipped. Harbor radio sent the rescue boat around to lead us into Hamilton, where we sat out hurricane* Grace. *No offense, but I'd rather be in port than on the parachute for that event.*

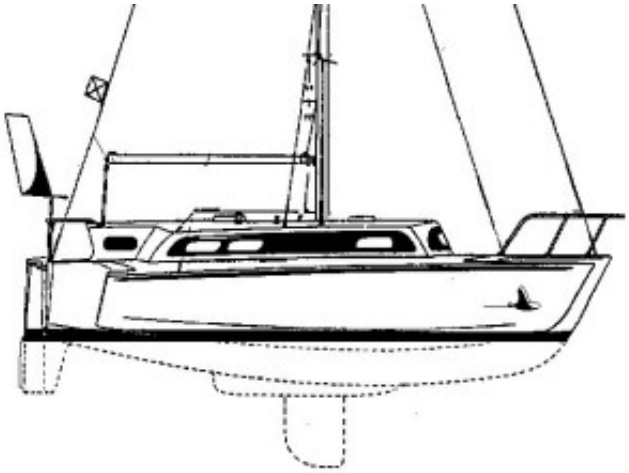
S/T-13 Trimaran, Searunner

Trimaran, Searunner

37' x 22' x 5.5 Tons

18-Ft. Dia. Sea Anchor

Force 8-9 Conditions



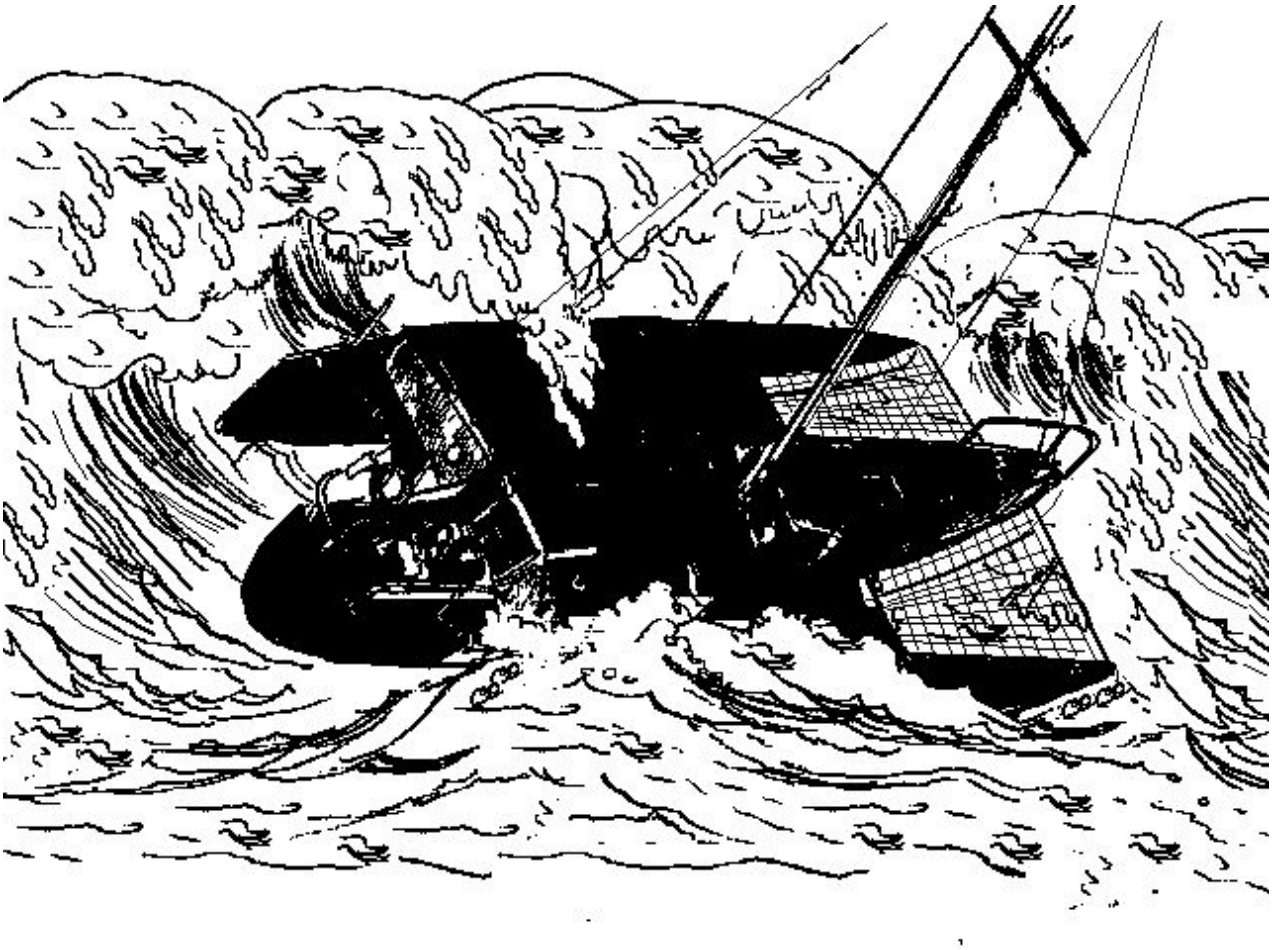
File S/T-13, obtained from Brian Hunt, Sacramento, CA. - Vessel name *Born Free*, hailing port Ventura CA, Searunner trimaran, designed by Jim Brown, LOA 37' x Beam 22' x Draft 6'11" (3' board up) x 5.5 Tons - Sea anchor: 18-ft. Diameter *Para-Tech* on 400' x 5/8" nylon braid tether and bridle arms of 100' each, with stainless steel 5/8" swivel - Full trip line - Deployed in a gale in 450 fathoms off the coast of Mexico with winds of 40 knots and seas of 20 ft. - Vessel's bow yawed 10° - Drift was 4.25 n.m. during 20 hours at sea anchor.

Brian and Trina Hunt were sailing *Born Free* from California to Norway, via Tahiti. In the trip down to Cabo San Lucas *Born Free* ran into nasty conditions off the coast of Mexico. Transcript:

> *We were actually having our best sail since the start of our voyage, nearly straight downwind with a single reef in the main and traveling along quite nicely with occasional surfs, which although exhilarating were not at all frightening. This was early in the morning and as the hours went by the wind continued to increase and the waves built in size until - under stays'l alone - we were surfing regularly down the faces of the waves which I would estimate to be 10-15' with very steep and sometimes breaking faces. It was really no fun anymore and with the conditions deteriorating I decided it was time to try the sea anchor. Deployment went well, using the DSB (deployable stowage bag), except for the tripline which fouled and had to be cut. We came bow-to the seas and the boat rode nicely. This was around 1:00 in the afternoon. As the day wore on the conditions continued to worsen and by nightfall I would estimate that the waves were in the 15-25' range, very steep and frequently breaking. The strongest winds and seas occurred at night, and not being able to see the surface of the water I could only estimate the wind at being something over 40 knots. Later, we met a vessel which had been in the same blow and they reported that their wind indicator was pegged at 60 knots for over 8 hours.*
>
> *During the worst part of the storm we would sometimes be hit from the side by a large sea and it*

would knock our bow approx 60° off the dominant train. It would take the boat about 10-15 seconds to fetch up on the sea anchor and turn bow-to the seas again. At first light the wind had dropped to about 25 kts and continued to drop through the morning. I then pulled the sea anchor in. We had no damage and had spent the duration of the blow in our bunks. This is not to say we weren't frightened - we were, right to our very cores. But what is really scary to me is the thought of trying to steer through that mess in the dark when you couldn't pick your way through the worst of the waves. We probably would have made it through, but at much greater risk and discomfort to our boat and ourselves.

I've since related this experience to many other sailors and I'm still amazed at the lukewarm attitudes toward sea anchors. I usually have to tell them three times that it was used off the BOW and not the stern! Most think it is a multihull tactic and not in the realm of monohulls. However, heaving-to, running off and lying a-hull all require searoom, the lack of which could mean disaster. Not to mention broaching, rolling over, pitchpoling. Why risk these things?



S/T-14 Trimaran, Cross

S/T-14

Trimaran, Cross

46' x 25' x 10 Tons

24-Ft. Dia. Sea Anchor

Force 6 Conditions

File S/T-14, obtained from Ron Clisby, Grants Pass, OR. - Vessel name *Nonchalant*, hailing port Portland, trimaran ketch, designed by Norman Cross, LOA 46' 6" x Beam 25 ' x Draft 52" x 10 Tons - Sea anchor: 24-ft. Diameter *Para-Tech* on 100' x 3/4" nylon braid tether and bridle arms of 100' each, with 1" stainless steel swivel - Partial trip-line - Deployed in a low system in deep water about 450 miles NE of Tahiti with winds 25-35 knots and seas of 10-15 ft. - Vessel's bow yawed less than 10° - Drift was 12.7 n.m. in 38 hours at sea anchor.

The family of Ron and Sue Clisby sailed *Nonchalant*, a big, comfortable Cross trimaran, around the world in 1994. En route to Tahiti they ran into a blow. The weather fax was down and rather than take any chances they anchored her to the surface of the Pacific from 1330 hrs on 4/23/94 to 0330 hrs on 4/25/95. Here is a transcript of Ron's feedback, handwritten sometime during those two days:

> *Yesterday we deployed our 24' Para-Tech sea anchor for the first time, and are very impressed with the results. We were en route from the Marquesas to the Tuamotus when we encountered nasty weather, thunderstorms, lightning, etc., two nights ago. Our SSB and therefore weather fax are inoperative so we have been depending on a buddy boat for wx info. Yesterday they said we had been in a tropical depression during the night. We had winds around 20-25 k with gusts to 35 k and seas confused and around 10-15 feet.*
>
> *It was still daylight and the kids were napping so we decided to deploy the chute. It worked beautifully and after some small adjustments we were inside baking bread. Today, our friends (hove-to 10 miles away) said the weather service is calling it a gale with winds to 43 k. They had wind gusts to 50 last night, but we had less (max 35 k) only 10 miles to the north.*
>
> *This morning 0945 the seas are calm (gentle roll) and we have only 4 k wind at present. There are still lots of rain clouds in the area but I can see little holes of blue sky popping up to the west. After further clearing, we'll retrieve the chute and continue to Takaroa or Ahe.*
>
> *P.S. With more complete weather fax info we likely would have continued on. But this has been a great learning experienced and we won't hesitate to use the chute when needed in the future.*

S/T-15 Trimaran, Cross

S/T-15

Trimaran, Cross

42' x 23' x 7 Tons

18-Ft. Dia. Sea Anchor

Force 12 Conditions

File S/T-15, obtained from Andrew Cserny, Eldorado, IL. - Vessel name *Gold Eagle*, hailing port Raleigh, IL, trimaran ketch, designed by Norman Cross, LOA 42' x Beam 23' x Draft 4' x 7 Tons - Sea anchor: 18-ft. Diameter *Para-Tech* on 400' x 5/8" nylon braid tether and bridle arms of 80' each, with 5/8" stainless steel swivel - No trip-line - Deployed in an unnamed hurricane in deep water in the Gulf of Mexico, about 200 miles WSW of Tampa, with winds of 100 knots and seas of 30-50 ft. - Vessel's bow yawed 10° - Drift was estimated to be 30 n.m. during two days at sea anchor.

Dr. Andrew Cserny purchased *Gold Eagle* (File S/T-8) from Daniel York in 1992. In March 1993 he and his wife set off from Mobile Bay, Alabama, for Cape Sable at the southern tip of Florida - six hundred miles as the crow flies across the Gulf of Mexico. En route they were hit by an unforecast, unnamed hurricane that did considerable damage to the Florida peninsula, sinking one freighter (30 people rescued, a number missing), driving another freighter aground, and sinking a number of small craft, among them a 39-ft. monohull, whose owner and wife were lost at sea. Here is a transcript of Dr. Cserny's harrowing experience - a sobering reminder of what the unpredictable sea is capable of:

> *We departed Mobile Bay the afternoon of March 10, 1993, on a rhumb line from the sea buoy off the entrance to Mobile Bay heading toward Cape Sable at the southern tip of Florida. The weather was fine, the forecast on the VHF called for possible thunder showers that night along the southeast coast of Alabama and the Florida panhandle, with winds gusting to 17 knots, choppy inland waterways and seas rising to 6-8 feet from the coast to 50 miles offshore...*
>
> *We sailed under a club footed jib, main sail and mizzen, this being a rather conservative sail plan for our boat, with the winds being anywhere from 8 to 18 knots during the night. Sea and wind conditions continued the same on the 11th and at daybreak we doused the club footed jib and raised the genoa instead, and continued on the rhumb line. Toward the latter part of the afternoon the wind started to head us and we kept going farther west of our rhumb line, so that by around five in the afternoon we were approximately fifteen nautical miles west of our rhumb line.*
>
> *At this point rather than tacking back toward land, which would have put us in a northeasterly direction and amounted to almost going backwards rather than toward Cape Sable, we decided to deploy the sea anchor and so to speak "park" the boat for the night, rather than trying the motor*

or trying to sail and really pinch the boat close-hauled. I was not expecting deteriorating conditions, I just wanted to rest for the night and to see if the wind would perhaps change and come from a more favorable direction so we could continue on the rhumb line. I was not aware that the storm was coming, therefore I did not lash down the sails as I would have. Matter of fact, I probably would have taken the sails off if I had known the storm was coming.

After deploying the sea anchor successfully, and watching the boat ride with an easy motion up and down the waves while tethered to the sea anchor, in roughly 6-8 foot waves, we decided to go to bed for the evening. All sails were furled and tied down with bungee straps. I awoke sometime after dark to a rhythmic crunching noise in the aft portion of the boat, which did not sound normal. When I went to investigate, I found that the sea state and the wind had built up considerably and occasional waves were slamming into the open cockpit area. When I lifted the hatch covering the steering compartment, I saw that the Morse cables attached to the steering quadrant had ripped loose from the wooden supports that were used to anchor them, and the steering quadrant was swinging wildly about. We secured the steering quadrant with lines 5/8 inch and 3/4 inch diameter, two of these lines on each side of the quadrant. Within half an hour these had chafed completely through.

The winds and seas continued to build in the dark, and by two in the morning I thought we were probably in a Force 10 gale. Sometime during the night we were hit by an immensely strong burst of wind which I presumed must have been a twister, because the pressure inside the pilot house fluctuated rapidly, the windows rattled, the doors to the pilot house rattled, and the sliding hatches tried to come off the top of the boat [lift off their rails]. *The front windshields flapped wildly up and down, the wind shrieked horribly with pitch and intensity I have never heard before although I have been in an automobile traveling at 135 miles per hour. It lasted maybe a minute to a minute and a half and it was during this time that the sails tore loose and began flapping wildly from the front to the back of the boat. The main sail was torn loose from its track in places. It was torn from the bolt rope, flopped wildly over the starboard side of the boat and self-destructed. In the same extremely high wind or twister that hit us, the mizzen sail was torn loose. The speaker for the loud hailer was torn loose from its mounting and carried away. The club-footed jib tore loose. It was shredded, and the boom flailed wildly about, causing holes and damages....*

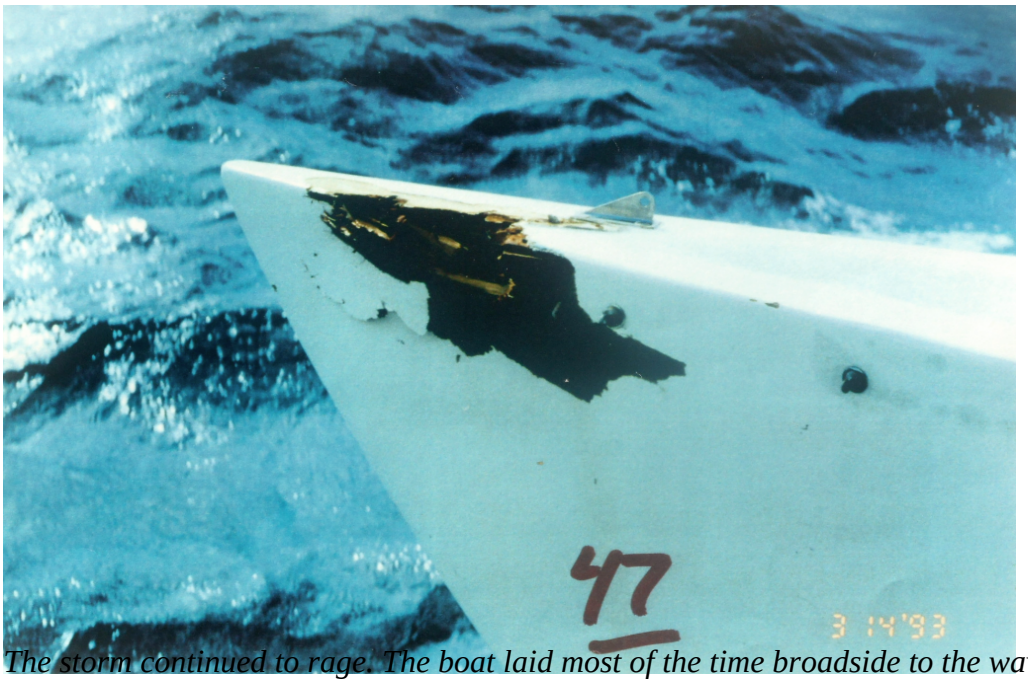
The seas continued to build, the wind shrieked, the sails continued to flog wildly, the spray was driven it seemed horizontally across the surface of the water and was leaking in around the top of the windshield and the left pilot house door fairly profusely. Waves were probably 25 to 30 feet in height, maybe higher, with breaking crests which regularly broke over the bow. One had to literally hold on all the time just to exist. Even sitting down, one had to hold on.

Then we were struck by what I would consider to be a rogue wave. I was holding on to the steering wheel in the pilot house at the time. I was thrown across the pilot house and crashed through the door on the right side and landed outside the cockpit on the right side of the boat. At the same time everything that was loose flew from the left side of the boat to the middle of the boat or over to the right side. For example, the toaster sitting on the left side of the boat on top of the kitchen cabinet flew across the boat and landed on the right side on top of the nav station, approximately two feet higher than where it was sitting on the kitchen counter. Everything in the

boat literally got scrambled. Rest was possible only on the floor of the main salon, wedged between the icebox on the right and the dinette and the galley cabinets on the left.

I am not sure exactly when, but I suspect probably when the rogue wave hit, the sea anchor also tore loose a bridle leg, carrying with it the hardware for mounting the trampoline, because, sometime after daybreak we noted that the bridle for the right side of the sea anchor was totally gone. There was a hole in the bow on the right side [starboard ama], *and the boat was riding to the sea anchor from one line, which was cleated off to the left side of the main bow. And sometime during the course of the day, this line chafed in two. But before it chafed in two, it periodically caught the* [steel] *anchor and flipped it out of its mounting on the bow, breaking part of the anchor bracket and bending another part - actually lifting the stainless steel plate that the anchor bracket and the pulpit were welded to. Eventually, the line to the sea anchor, now no longer being protected from chafe by the snatchblock on the float bow, chafed itself to destruction on the anchor bracket. I am not sure at what point the last attachment of the sea anchor parted, but after this, we were mostly broadside to the waves, and in a most vulnerable position for being flipped over.*

Gold Eagle of Raleigh, showing damaged starboard ama after the trimaran survived a freak storm in the Gulf of Mexico. "I am not sure exactly when, but I suspect probably when the rogue wave hit, the sea anchor also tore loose a bridle leg, carrying with it the hardware for mounting the trampoline, because, sometime after daybreak we noted that the bridle for the right side of the sea anchor was totally gone. There was a hole in the bow on the right side [starboard ama], and the boat was riding to the sea anchor from one line, which was cleated off to the left side of the main bow." (Andrew Cserny photo).



The storm continued to rage. The boat laid most of the time broadside to the waves which were breaking over the port float. The wind continued to shred the sails and I considered it almost suicidal to go outside and try to stow the sails which were basically destroyed by this time anyway.

On the morning of the 14th the wind had subsided sufficiently to enable us to get outside of the pilot house and at this point I rigged the mizzen sail, using the reef points in the mizzen to lash the upper part of the sail, which had shredded away from the lower part. I repaired the clew of the genoa. We used sails to steer the boat and were able to set a course heading toward Ft. Meyers, which was the nearest approach to land. We still had no steering. Once we got underway with the sails and were able to steer with the adjustments in the sails, the seas no longer broke over the transom and we were able to bail out the rear compartment, which gave us access to the steering quadrant. Fortunately I had numerous tools on board, as well as a good assortment of fasteners, and by cutting up some of the floor boards, and after hours and hours of jury rigging, we were able to effect a workable repair of the steering quadrant.... While I was effecting the above mentioned repairs, my wife June was able to make contact with a passing tanker, which was rather surprised to see us still out there afloat and under sail, and told us that they had been beaten up fairly badly, and we had just lived through a Force 12 storm with 30-50 ft. seas and 100 knot winds.

For the next three days we beat into seas ranging anywhere from 8-12 feet. The waves were coming directly at us, and at a normal cruising RPM of 1500 to 1700 RPMs we were making anywhere from two to four knots over ground as measured by the GPS. While beating into the wind and waves we took water in over the main bow where the trampoline attachment had torn loose, as well as where the cap for the anchor chain was torn loose, and everything in the front part of the boat got soaked. The starboard part of our float took on a considerable amount of water through the hole ripped out by the bridle. However, I used rags and fiberglass impregnated cloth to repair this defect, and was able to bail out the water from the right float. We dropped anchor in a bight just north of Matanzas Pass on the 17th. It was the first time we had been able to sleep in our bunks since the 10th.

Comments: *The sea anchor was eighteen (18) foot diameter, manufactured by Para-Tech Engineering, with a 5/8" nylon rode 400 feet long and bridle arms of the same material, 80 feet long, with stainless steel swivels. There was a trip line at the apex of the parachute. Actually, the initial part of the trip line consisted of a nylon strap, maybe 10-12 feet long, possibly slightly longer than that, to which was attached a plastic float, possibly 8-10 inches long, maybe 4-5 inches in diameter. Then attached to this was a length of nylon line maybe about 30 feet long.*

I made my first mistake here by taking the float off from the nylon strap, tying the nylon strap to the 30 foot nylon line, then attaching the float to the end of the nylon line. In retrospect, this was the wrong thing to do, and I suspect that the trip line kept fouling the parachute, causing the parachute to periodically collapse, then the parachute would unwind itself and it would hold again for a while and then it would collapse again, allowing the boat to surge backward to a much greater extent than it would have if the parachute had been fully opened out all the time. While riding to the sea anchor, at times we would head into the wind and waves and take the waves just fine, then all of a sudden we would start slipping and turning sideways with respect to the wind and waves. I'm sure at these times, the parachute anchor was collapsing. I went out on the bow and tried to pull the sea anchor in but this was impossible, even with the chute collapsed and taking the waves on the port beam, there was enough tension on the line that it made it impossible to pull it in. At times, the sea anchor would undoubtedly unwind and fully deploy itself and we would be riding quite securely on the bridle, heading into the waves again.

I suspect that when the rogue wave hit, the chute was collapsed, because the rogue wave hit us pretty much broadside on the port side of the boat. I suspect that at this time we came close to being capsized, and quite possibly the parachute anchor, even though it was collapsed and allowing us to lie broadside to the waves, probably kept us from going over. I do not know for a fact, but I suspect that the attachment points of the bridles were torn loose from the bows at this time, thereafter, the bridle was then attached to the bow of the main hull and really no longer acted as a bridle, chafing at times against the anchor and the anchor bracket. As a result of this, the lines eventually chafed through and we lost the sea anchor altogether. From then on we were lying a-hull, but always presented the port side and sometimes the port front quarter of the boat throughout the rest of the 1½ days that the storm lasted after this.

If we had been running downwind in these waves, I suspect that we might have been pitchpoled, and I'm certain that had we been running when the rogue wave hit we would have been pitchpoled. I also suspect that had the sea anchor been properly deployed and properly attached, that we would have survived the storm with only our sails blown out.

Lessons Learned: *1) I believe the weather forecast on the VHF is unreliable. Next time I venture offshore I will be listening to the weather forecast on the single side band. 2) When deploying the parachute anchor, next time the float will be attached at the end of the trip float line or the strap that comes directly off the apex of the parachute, then the longer trip line will be attached to the float. This float line will be fairly short and made of polypropylene line with float attached to it, making sure that it will not sink down and foul the parachute anchor. 3) I have replaced the sea anchor with another 18 foot parachute by Para-Tech. This one is now in a pack which can be deployed without taking the chute out of the bag. You can just throw the whole thing into the water, which I think is an improvement. The tether is 5/8" nylon, 500 feet long. There is an*

oversized stainless steel swivel. The bridle arms are longer now, made of 3/4" Dacron, which is less stretchy than nylon and hopefully better resistant to abrasion. The geometry of the attachment of the bridle to the boat is now different. I believe that it is significantly better. The two legs of the bridle now come through the points on the bows of the amas where the stainless steel plate holding the snatchblock is much more substantial than what was there before. The snatchblocks are considerably more substantial than the ones they are replacing. The bridle is led straight back onto the deck of the ama and tied off to a cleat which is through bolted to the main deck, and underneath is attached and through bolted to an L-shaped steel backing plate, in turn through bolted to the main crossbeam. With this geometry, all the strain will be taken by this oversized cleat and the snatchblock on the point of the ama will only act as a fairlead to be subjected to very little strain, and nothing like the forces that this same point was subjected to before, that being the reason why things pulled out. 4) The jacklines I had rigged before were of 1 inch nylon strap with 4800 breaking strength. I religiously used the harness and the tether whenever I ventured outside the pilot house. At the end of the storm the port jackline had chafed completely in two where it had been riding against the babyshroud on the port side. There were no cotter pins or rough or jagged edges on the babyshroud or on the turnbuckle. I'm sure that any round line would have also chafed in two. The new jacklines will be made out of stainless steel wire covered with plastic coating that will not chafe in two. 5) The Morse pushpull cables have been replaced with hydraulic steering. The attachment points are much more substantial than before. Previously, the anchor points for the cables were secured to a sheet of 3/4" plywood by four 1/4" stainless machine screws. The whole attachment point just literally ripped a 2 x 4" rectangle of the 3/4" plywood completely out and rendered the steering useless. The new steering parts are much more massive.

During the entire storm we moved approximately 30 nautical miles according to our GPS. However, during at least half of the storm, the anchor was totally gone and during the first half the storm the sea anchor worked off and on, so you can't really say that we drifted 30 miles at sea anchor. Having observed how the boat reacted to the sea conditions when she was being held by the sea anchor, and comparing the actions of the boat without the sea anchor, there is no doubt in my mind that the sea anchor is the ultimate survival tool in heavy weather offshore. I am also certain that had our sea anchor been deployed and attached properly we would have had a much easier time, and felt much more secure. The motion of the boat and therefore our comfort level inside the boat would have been much better. It is quite possible that the steering quadrant would not have torn up because we would not have surged backwards so much with each wave. I believe that with the sea anchor properly deployed, we would have had a frightening but manageable experience, instead of the almost three days of sheer terror that we lived through, not knowing from one wave to the next if we were going to be capsized.

S/T-16 Trimaran, Kantola

S/T-16

Trimaran, Kantola

35' x 24' x 3 Tons

24-Ft. Dia. Parachute Sea Anchor

Force 8-9 Conditions

File S/T-16, obtained from Gary Cagné, Vancouver, BC. - Vessel name *Spirit Of Tsitika*, hailing port Victoria BC, trimaran, designed by Jay Kantola, LOA 35' 6" x Beam 24' x Draft 5' 6" (2' 6" board up) x 3 Tons - Sea anchor: 24-ft. Diameter military chest reserve on 300' x 9/16" nylon three strand tether and bridle arms of 50' each, with 5/8" stainless steel swivel - No trip-line - Deployed in a gale in deep water about 50 miles off the coast of Baja California with winds of 35-45 knots and seas of 12-15 ft. - Vessel's bow yawed 10° - Drift was estimated to be 9 n.m. during 17 hours at sea anchor.

There is a certain grace and elegance associated with Jay Kantola's designs that one has to see to appreciate. His boats tend to remind one of certain benign and beautiful birds that roam across vast oceans on great wings. Not the feisty, competitive, acrobatic Frigate bird, whose flying skills and prize-winning antics one might associate with one of Richard Newick's masterpieces, but perhaps the magnificent, gentle, white-winged, black-browed Albatross of the Southern Ocean.

At least this was Shane Victor's impression when he first saw *Spirit Of Tsitika* tied up in Santa Barbara harbor. Two months after visiting with him, Gary Cagné and his companion Claire ran into a gale off the coast of Baja California. Transcript:

> *On the way to Cabo San Lucas we discovered an incredible lagoon on the east side of Mag Bay, in which we spent several days lounging and hiking and bird watching. It's finally beginning to warm up a bit. Just left this morning with a nice offshore light westerly filling the new spinnaker we found at a thrift store in Santa Barbara for $25!*

As you can see we finally had a good opportunity to use the parachute sea anchor, and we're ever happy we did. We had the wind on the nose for 24 hours or more with torrential rain the whole time, and with a long offshore tack we ended up 65 miles NW of Cape Lazaro (near Bahia Santa Maria) when the wind got up to 35 kts at 1500 hrs. So we opted to set the chute, rather than continue beating to windward in those conditions. As soon as we were deployed (the deployment bag worked fantastic) the wind increased to 45 kts and gusting higher, with a steep short chop (8-10 ft.) on top of a large westerly swell of about 12-15 ft.

The seas lengthened later on as the gale continued, enabling the bows to ride a bit higher. Initially they were picking up the tops of the [short, steep] *waves and spraying the whole boat, pouring rain all the while and the barometer continuing to drop. Pretty easy ride once the waves began lengthening, and about 0300 next morning the wind eased off a bit and switched to SW 25-30. By first dawn we had a light westerly and very confused seas coming from various directions. We got underway after winching in the chute (very easy) and arrived safely, with no damage, later that night in Bahia Santa Maria. The next day we heard about* Whistlin, *a 37-ft. Searunner and several other boats that ended up having to power* [jog] *through the storm, suffering miscellaneous damage - mostly losing gear over the side and diesel problems. One monohull suffered a knockdown, and the group closer in to shore reported gusts to 60 kts!* Whistlin *has a surplus parachute on board but still needs to re-sew the shroud lines to it.*

***Note**: When we retrieved the parachute, we found that the float line had twisted itself many times, and even part of it was caught in two of the parachute shroud lines. So we learned that it is necessary to have a swivel for the float line as well. Claire and I are feeling more confident now that we've had our first parachute sea anchor experience and know how well it works.*

S/T-17 Trimaran, Kantola

S/T-17

Trimaran, Kantola

34' x 24' x 3 Tons

28-Ft. Dia. Parachute Sea Anchor

Force 9-10 Conditions

File S/T-17, obtained from Richard R. Barrie, Van Nuys, CA. - Vessel name *Fifth Fox*, hailing port Channel Islands, CA, trimaran designed by Jay Kantola, LOA 34' x Beam 24' x Draft 3' x 3 Tons - Sea anchor: 28-ft. Diameter C-9 military class parachute on 400' x 3/4" nylon three strand tether and bridle arms of 100' each, with 3/4" galvanized swivel - No trip-line - Deployed in a Pacific storm in deep water about 1000 miles west of Guadalajara, Mexico, with winds of 55-70 knots and seas of 20 ft. - Vessel's bow yawed 10° - Drift was estimated to be 12 n.m. during 72 hours at sea anchor.

Sailing to Los Angeles from Panama, Richard Barrie decided to take one long - 1000 mile - tack out to sea and back, avoiding the *Pagagayos*, *Tehuantepeckers* and other hazards that one ordinarily associates with the Central American coast. However, *Fifth Fox* ran into a storm well offshore. Transcript:

> *During the last week of May, 1984, my wife and I with our two daughters left the Las Perlas Islands in Panama, and headed back to California. The first two weeks of the trip north were idyllic, 15-20 knots beam reaching with the spinnaker and the Tiller-Master doing all the work. During the second week of June the wind gradually went northwest and increased.*
>
> *Before noon on the second day of the wind shift, a strong gust hit us (we had put a reef in the main, but still had a 120 genoa up) and the lower after stay on the port side parted at deck level. My first thought was to deploy the parachute, fix the shroud and continue on. We deployed the chute off the stern* [on the fly] *going downwind without a trip line in moderate conditions. I fully expected to replace the lower shroud and continue on. While sitting to the chute during the first hour or so, I went up the mast with a new Sta-Lock attached to a new lower stay. While I was at the spreaders attempting to exchange the wire, the wind quickly increased from a steady 30-35 knots to a steady 50 knots with higher gusts, with the sea state increasing rapidly. I had never been seasick in all my life, yet I became nauseous. I could not continue with the work aloft so came down the mast and jury-rigged the lower at the deck with some wire clamps. That took the S-curve out of the mast so we could sail if the chute let go.*
>
> *After sitting on the parachute anchor for a few hours, I was in the cockpit when a huge wave pushed the boat up to the crest and back on the rudder. The rudder had been locked in place amidships with the Tiller-Master. In the middle of this particularly large cresting wave, I heard a sickening crack and looked down and saw the tiller head starting to swing independently of the*

tiller. It was very apparent what was wrong. Fortunately there was a hole in the rudder blade itself, so with a stout line tied to the port float near the transom, I dove in the sea and rove this line through the rudder blade, with a knot on either side, then on to the starboard float. This action no doubt saved the rudder....

For the next three days we were anchored to the parachute, with the wind screaming and the waves cresting. While it was difficult to sleep soundly, we could at least sleep. As time wore on, it became apparent that we and the boat were safe, even with the wind flicking salt water bullets at us at 50 or 60 knots. The wind moderated to 35 knots after the third day and we cast off the lines and sailed up to the float and retrieved the parachute quite easily. Previously we had deployed the parachute with a trip line and it fouled rather quickly. I resolved then never to use a trip line again. I will now carry two parachutes for insurance.

I took star shots each evening and morning during our three day stay in this part of the ocean and was quite surprised to find that we moved only 12 miles in a southeasterly direction.

S/T-18 Trimaran, Searunner

S/T-18

Trimaran, Searunner

40' x 24' x 7.5 Tons

28-Ft. Dia. Parachute Sea Anchor

Force 10 Conditions

File S/T-18, obtained from Steve and Cheryl Bow, Auckland NZ. - Vessel name *Labyrinth*, hailing port Auckland, Searunner trimaran designed by Jim Brown, LOA 40' 10" x Beam 23' 6" x Draft 6' 11" (3' 6" board up) x 7.5 Tons - Sea anchor: 28-ft. Diameter Australian army cargo parachute on 400' x 3/4" nylon three strand tether and bridle arms of 90' each, with 5/8" galvanized swivel - Partial trip-line - Deployed in a storm in deep water about 270 miles south of Kermadec Islands with winds of 50-60 knots and seas of 30-35 ft. - Vessel's bow yawed 10° - Drift was 6.2 n.m. during 41 hours at sea anchor.

Steve and Cheryl Bow cruised the world aboard their 40-ft. Searunner *Labyrinth*. On 15 June 1995 (a year after the Queen's Birthday storm) they left Auckland and headed north for Tonga. Two days later they ran into a Force-10 storm about 270 miles south of the Kermadecs. Transcript:

> *We are a two-handed husband and wife crew. It was our plan to leave NZ on the back of a low that was at that time centered near Mt. Taranaki. Following it was a huge high over Australia and the winds between the two promised fair sailing. No fronts or depressions were forecast or expected from the coming weather. Our first days run was a rolly 155 miles broad reach in a 30 knot SW breeze and we were feeling very happy about things until we discovered water in the bilge at 2200 hrs on the 16th June. A porthole under the wingdeck had blown in and was leaking considerably. We effected a temporary repair and that took us through to daybreak.*
>
> *At 0800 hrs we changed course and ran off before the wind for 6 hours while I epoxied the portholes closed with underwater epoxy. While we were running off, the latest weatherfax showed that a rapidly deepening low had formed north of Sydney and was heading our way - fast. If we hadn't had to run off to make the repairs we would have been OK, but as it was we were right in its path. Knowing that we were in for a rough night I went to bed, leaving Cheryl to do a long watch so that I would be fresh for the evening. When I awoke at 1800 hrs the winds were gusting over 30 knots from the NE and Cheryl had hove-to. We had two reefs in the main and the stays'l set; at this point the boat was comfortable despite the worsening seas and we settled down to sit it out. The 2000 hrs fax showed a second rapidly deepening low had formed behind the first.*
>
> *Between 1400 and 1930 hrs the barometer dropped from 1005 bar to 998 bar. When the winds*

reached 50 knots and the barometer was still dropping we had to make the decision - run off, or set the parachute. It was 1930 hrs and very dark, we could see the approaching seas only by the foam as they broke, and the spray was being driven horizontally by the wind. The seas were still building and had reached the unstable stage, with steep faces and rolling crests. We carry a SEABRAKE on board which was set up ready to go, however we opted to set the parachute for two reasons: 1) We were both very tired and probably not up to spending a considerable time helming a running yacht in steep seas; and 2) The NE wind would have been driving us back towards the North Island of NZ. With further depressions developing and no early respite expected, the parachute was selected as the better option.

We set the parachute. We had never set it before, however I had read all the information I could acquire and had watched the video prepared by Para-Tech. It had been assembled as per their instructions, complete with one of their deployable storage bags. It was deployed over the weather bow while still hove-to, and worked like a charm. It was gusting 60 knots and more by the time we had it set, and it was difficult to see or work on deck because of the driven spray. As the tension went onto the tether we were swung gently around bow to and then sat there. The hard part was getting the stays'l and main down and under control in the high winds. The centerboard had already been pulled up.

At 2400 hrs the barometer had dropped to 993 bar and the wind speed was rarely below 60 knots. The motion of the boat was good, just a steady rise and fall to the waves with an occasional loud BANG! as a cross swell broke against the hulls. Despite my previous fears of excessive strain on the yacht the bows were NEVER pulled through any of the breaking crests, instead rising up and over them. There was tremendous strain on the bridle and tether, which "hummed" at times. Despite the noise the motion was easy enough for us to get sleep and cook between watches.

Waves continued to break on either side of the yacht, but we appeared to sit in a "slick" behind the parachute where there was only foam. We rigged nylon chafe protection on the bridle near exposed metalwork on the yacht and I checked for chafe every hour, both there and at the snatchblocks on the bows. At the end of 41 hours we still did not have any chafe. A mistake I made was in relying on the hydraulic steering ram to hold the rudder amidships. The force on the rudder from cross swells and rogue waves was substantial enough to drive the hydraulic ram to the end of its travel, and the rudder hard over. This was cured by shackling sheets [ropes] *direct to the rudder and winching/cleating it off amidships.*

We sat to the parachute for 41 hours; the wind went up and down averaging 45 knots and sometimes dropping below 30 knots. At 1230 hrs on the 19th June the wind was still 30 knots but had backed to NW. We opted to pull up the parachute and make a run for it north to try and get above the depressions. All went well retrieving the chute except that just as I was about to pull it in over the side of the boat the retrieval line ripped off the apex of the parachute and the chute filled again! We were drifting broadsides at the time and making quite a bit of way. I nearly got pulled over the side and lost most of the skin off my hands while trying to re-cleat the tether. This could not have happened with a purpose-built sea anchor! A 28 ft diameter parachute is almost impossible to retrieve in those conditions with no retrieval line and only two crew. We tried for over two hours and in the end I had to cut it free.

If we had known what we would face for the next 48 hours we would have stayed on the chute. We started off hard-on into the wind which was averaging 25-30 knots. This became a tight reach as it was more comfortable. Seas were rough and confused and repeatedly broke against the hulls.... Each time we hit one we would stop dead in our tracks. The noise was incredible and with the front of the boat continually getting swept by the seas I was worried that something would get broken if we didn't slow down (it turned out that we did break a stringer in the forward section of the stbd float).

On 21st of June we finally ran out of the weather. Incredibly a fourth low had formed and taken the same path as the other three, but by this time we had climbed out above it. We would never put to sea for an ocean passage again without a parachute.

S/T-19 Trimaran, Piver

Trimaran, Piver

55' x 25' x 15 Tons

24-Ft. Dia. Sea Anchor

Force 11-12 Conditions

File S/T-19, obtained from Mel Pearlston, Petrolia, CA. - Vessel name *Surrender*, hailing port Petrolia, trimaran ketch, designed by Arthur Piver, LOA 55' x Beam 25' x Draft 4' 7" x 15 Tons - Sea anchor: 24-ft. Diameter *Para-Tech* on 600' x 3/4" nylon three strand tether and bridle arms of 75' each, with 5/8" stainless steel swivel - No trip-line - Deployed in a North Pacific storm in deep water about 500 miles west of Humboldt Bay (California) with winds of 70-80 knots and seas of 50 ft. - Vessel's bow yawed 10°.

Mel Pearlston was sailing *Surrender* back to California from Hawaii in 1992 when she ran into a September storm. A 24-ft. diameter Para-Tech sea anchor was then deployed, which kept her three bows snubbed into the seas for about three hours. The anchored trimaran was then struck by a rogue wave coming in at an angle of 30-40°. As to what happened next, the best that Pearlston and Shane could determine after long telephone conversations is as follows. Either the trimaran was picked up and carried sideways, inducing considerable slack in the system, which allowed the yacht to lie a-hull temporarily. Or the sea anchor itself was picked up and thrown - possibly fouled - by the same rogue wave, causing the line to go slack and the yacht to lie a-hull. Or a combination of both (Fig. 40).

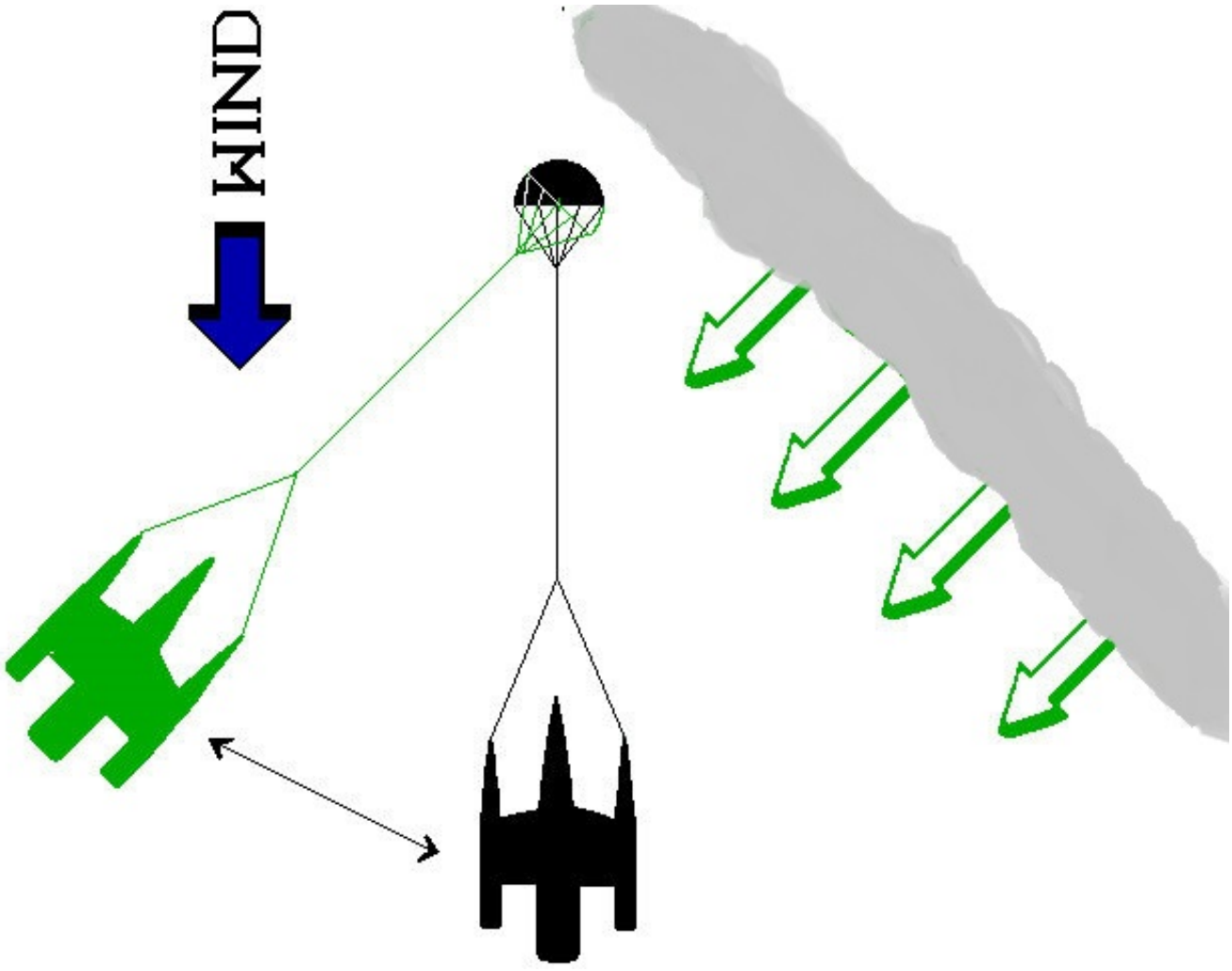
Although mercifully rare, large breaking rogues are capable of dealing swift and unexpected death blows to small craft. One needs to try to come up with additional tricks that might improve one's odds of survival in the event of such an encounter. Perhaps one such trick would be to deploy an auxiliary - smaller - sea anchor *on a much shorter line* off the approach ama, if one knew which side the rogue was going to come from. Or possibly the main hull, if one did not. This sort of strategy was once used on some of Richard Newick's earlier Vals, the idea being that if a capsize couldn't start it couldn't finish. Several OSTAR Vals, among them *Three Cheers*, rode out storms on double sea anchors. Perhaps this auxiliary sea anchor could be a weighted, 3-5 ft. diameter cone with a wire hoop sewn into the skirt to keep the mouth permanently open, deployed on 30-50 feet of line.

Conditions being life-threatening Pearlston made a quick decision to cut away the rig and run downwind. Transcript:

> Surrender *left Kauai, Hawaii in early September, 1992, when hurricane* Iniki *was just leaving the coast of Baja and turning west across the Pacific. There were three of us aboard* Surrender*, a modified Piver Enchantress, stretched to 55'.* Surrender *had been lovingly and heavily built over a twenty year period by a master craftsman, and I had been sailing her for five years in the Eastern Pacific. After sailing north on a port tack for a week, we turned right and headed across the top of*

the North Pacific High for our home port of Humboldt Bay. Just about this time hurricane Iniki *was devastating Kauai, destroying every boat on the island. The distress channels were full of incoming calls, spread over a thousand mile radius. We were counting our blessings for having left when we did, thinking that we were home free.*

I awoke three mornings later about five hundred miles west of Cape Mendocino to the blackest and most ominous horizon I had ever seen. The forecast was for a low pressure system to produce 40 knots of wind and seas of from 15 to 20 feet, but I didn't believe a word of it. The wind built quickly from the NNE to 45 knots, at which point I made the decision to deploy our 24' Para-Tech sea anchor. The anchor was attached to 600' of new 3/4" three strand, 75' bridle arms, a 5/8" SS swivel, and was secured to the boat by massive, custom-made stainless steel bails on the bow of each ama. No trip line was used, but two 24" diameter mooring balls were used for floats, together with a man overboard pole to make visual observations and recovery easier.



Surrender's close encounter with a rogue wave. Likely the rogue moved or threw the parachute and/or the boat, causing the

line to go slack. Note that if the tether is 600 feet long and the rogue is approaching at an angle of 45° the pendulum would have to swing through an arc of 450 feet before the boat could get a full assist from the sea anchor. In this sort of situation it might make sense to additionally deploy a small auxiliary sea anchor on a much shorter line off the approach ama (in this case the starboard ama), which was a tactic used on board some of Richard Newick's Vals in earlier days, to keep a capsize from starting. Perhaps this auxiliary sea anchor could be a heavily weighted, 3-5 ft. diameter cone with a wire hoop sewn into the skirt to keep the mouth always open. The amount of assist rendered by the big parachute, of course, will depend on the angle at which the rogue is approaching with respect to wind direction. Either way, if the parachute is not hopelessly fouled it should eventually re-exert its pull as the pendulum swings back into the wind. It may take a minute.

By the time the sea anchor was deployed and the boat buttoned up (which included lashing the helm amidships), the wind had built to fifty knots and the seas were building quickly. Over the next three hours we rode extremely comfortably to the sea anchor while conditions continued to deteriorate. The wind increased to a sustained 70 knots, gusting over 80. The larger waves were in the fifty foot range, and the swells were 600 feet apart. While riding to the sea anchor Surrender *did not yaw perceptibly. As we rose to each wave the boat would rise and begin to be carried back until the anchor rode came up tight. Then, like a huge rubber band, it would gently pull us through the top of the swell. It was truly a testament to the use of the sea anchor. To this day I remember thinking how eerie it was that we could be so comfortable in such conditions.*

At the height of the storm I felt the boat rising to a particularly large swell. At some point I realized that this wave had come from a point some 30 to 40 degrees off our starboard bow. At the top of the wave, after the anchor rode had stretched out and we were being pulled through the crest, something happened and the tension on the rode was suddenly released. Surrender *free fell backwards down the face of the wave, and upon landing was completely submerged. Sometime during this fall one of the forward salon windows was broken. After assuring myself that the boat was still upright, I took stock of our situation. The main cabin had three feet of water in it. All of the items stowed on the starboard side of the boat were now on the port side. Upon going topside, I found that our decks had been swept clean of all stowed gear, including items that had been secured with heavy webbed strapping. I nailed a piece of plywood, with a closed cell foam gasket secured to one side, over the broken window. Next I went forward and cut loose the sea anchor bridles because the boat was broadside to the swell and there was no appreciable tension on the rode, and I assumed that the sea anchor was gone. I did this so that the rode would not foul our prop or rudder as my intention was to run down swell and deploy drogues. In retrospect, this was a poor decision. I did not consider the possibility that the anchor was tumbled and/or fouled. All I could think of was not spending one more moment than necessary with Surrender broadside to those huge seas.*

While I unlashed the helm, I made my next mistake. I attempted to start the engine for maneuverability without checking the engine room. Apparently the starter had gotten wet and it immediately shorted out causing billowing clouds of smoke to emerge from the engine room. At the same time I realized that the helm was not responding and when I inspected the rudder post my worst fears were confirmed. The two inch bronze post had snapped below the steering quadrant. It appeared to have twisted like a piece of plastic almost 90 degrees before breaking. There was less than half an inch of mangled post left to work with - far less than that needed for my emergency tiller to attach to. The next eighteen hours passed in a blur. We bailed the boat out

with buckets, as the books and food on the cabin sole of the salon turned the water into a thick gruel that foreclosed the use of either our electric or hand pumps. The wind had subsided to fifty knots, and the seas to the 30 foot range by this time, and a small amount of headsail allowed Surrender *to ride hove-to quite comfortably. By the end of this period I was able to jury rig a steering quadrant to the rudder post utilizing a modified clamp-on quadrant from an Alpha auto pilot, and we got back underway. The next five days were spent limping into Humboldt Bay fighting the cold (we had no dry cloths or blankets) and our dwindling supply of amps.*

Better decisions would have left us with an answer as to whether some part of the sea anchor system had failed, or if the sea anchor had merely been tumbled and/or fouled, and if so, whether it might have eventually recovered and restored its pull. In any event, I have never traveled offshore since without two complete sea anchor rigs aboard, and would never hesitate to recommend their use for rest, repairs, or as a defensive storm tactic. I consider it the single most important tool we carry.

S/T-20 Trimaran, Horstman

Trimaran, Horstman

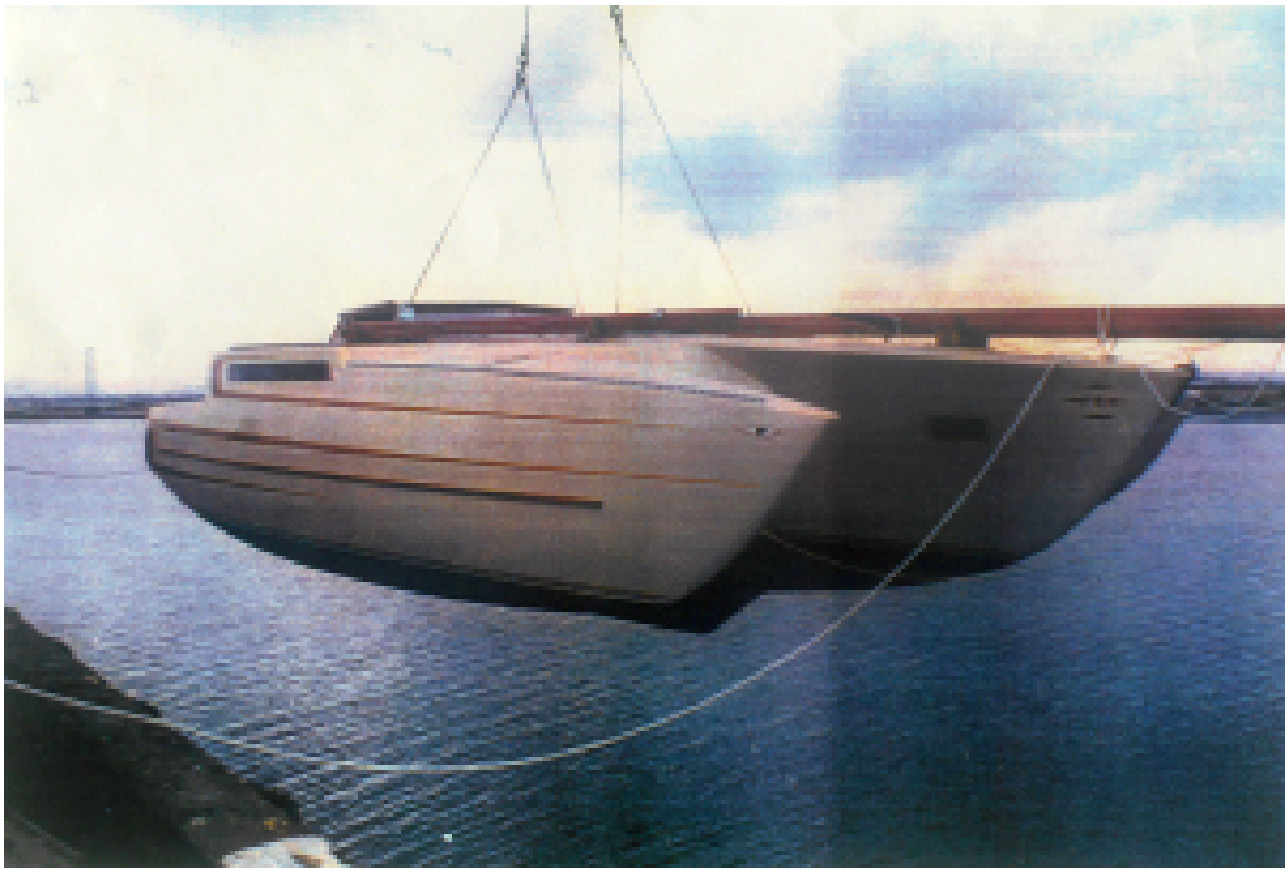
40' x 24' x 6 Tons

24-Ft. Dia. Parachute Sea Anchor

Force 8-9 Conditions

File S/T-20, obtained from Gary Habersetzer, Raymond, WA - Vessel name *Amenity*, hailing port San Diego, Tri-Star ketch designed by Ed Horstman, LOA 40' x Beam 24' x Draft 38" x 6 Tons - Sea anchor: 24-ft. Diameter military parachute on 400' x 5/8" nylon three strand tether and bridle arms of 60' each, with 1/2" galvanized swivel - No trip-line - Deployed in a gale in Mexican coastal waters about ten miles from Magdalena Bay with winds of 35-50 knots and seas of 8 ft. - Vessel's bow yawed 10° - Drift was minimal during 12 hours at sea anchor.

Gary Habersetzer is one of the original group of multihull builders/sailors who learned how to use parachute sea anchors directly from John Casanova (File S/T-1). The group included Carol Donovan, owner of the 35-ft. Horstman Tri-Star *Lion's Paw*, Jim Staggs, owner of the 41-ft. Nottingham trimaran *Whither*, Jack Beadle, owner of a 32-ft. Simpson Wild "Shifter" trimaran, and Bob and Marilyn Braggins, owners of the very first flush deck Horstman Tri-Star ever built, *Puffin.*



Amenity of San Diego. She is one of the early Horstman Tristars on which Messrs. Casanova, Habersetzer and others pioneered the use of large parachute sea anchors for multihulls. Her lines are similar to those of Tortuga Too in File S/T-1. *(Gary Habersetzer photo).*

Gary bought his first surplus military parachute from John Casanova in 1975, using it in a whole gale aboard his first multihull, a 31-ft. Piver AA trimaran off Cape Mendocino, California. When Gary, along with Bob Braggins, was invited to fly over and help sail a newly-built Horstman Tri-Star from Seattle to San Diego, he brought along two parachutes.

The story about him boarding the plane with two 28-ft. C-9 parachutes rolled up under each arm - causing not too little anxiety among the passengers - is well known in multihull circles. Bringing those parachutes turned out to be a wise decision, however, because the Tri-Star ended up having to use one in a gale off the mouth of the Columbia River.

In the July/August 1979 issue of *Multihulls Magazine* Joan Casanova wrote about the dangerous behavior of the boat prior to deployment (reproduced by permission):

The small Tri-Star rose above the monstrous waves, sliding swiftly down each face. Every few waves which passed under the boat were just a little larger than the last ones. It sent the tri skidding off at a 45° angle, nearly coming to complete broaching position in the trough. the action gave the helmsman anxious moments before the boat would respond to the helm. All aboard knew the dangers of that position. They were aware that the tri exceeded a safe speed. Below decks all gear was rolling in the aisle. It was only a matter of time before the growing seas would roll the lightweight trimaran over. Bob Braggins, skipper of Puffin*, reflects in his tone of voice those anxious hours, as if reliving them.*

> *"I'm sure we would've gone over if we hadn't put out the chute. We had difficulty putting it over the side at first. The wind got hold and wanted to open it on deck. As soon as it took hold in the water, the boat began to ride easily and we began to relax. It was my first time using a chute, and believe me, I am sold!!"*

Gary has used the parachute sea anchor too many times to list all of them. On the occasion of this particular file he and his wife Karen were sailing *Amenity* from San Diego to Cabo San Lucas when the wind and seas suddenly came up near Magdalena Bay. *Amenity* was hove-to for twelve hours, after which she resumed her cruise south. There is a photograph of Gary and Karen folding the parachute on *Amenity*'s deck in the July/August '79 issue of *Multihulls*. The photo was taken by Joan Casanova.

In 1976 Gary Habersetzer went into business for himself as head of Marine Repair Service in San Diego. After two decades of multihull building experience he founded *Pedigree Cats* in Seattle in 1995. The company now builds large multihulls. At this writing there are several large Horstman Tri-Stars in the works, including one that is 105 feet long. A 52-ft. Shuttleworth design with a high-tech Aero-Rig is nearing completion. *Pedigree Cats* has also received an offer to build catamarans for an Austrian concern.

The short note that Gary sent in along with the filled out DDDB form reads thus:

> *I think you now know why we list the chute as standard equipment on all the cats we build. We have used them and know that you should not leave the dock without one.*

S/T-21 Trimaran, Farriar

Trimaran, Farriar

27' x 19' x 1.3 Tons

12-Ft. Dia. Sea Anchor

Force 8 Conditions

File S/T-21, obtained from Steven C. Wann, Williamsburg, VA. - Vessel name *Dancer*, hailing port Williamsburg, trailerable trimaran designed by Ian Farriar, LOA 27' x Beam 19' x Draft 5' (14" board up) x 1.3 Tons - Sea anchor: 12-ft. Diameter *Para-Tech* on 300' x 9/16" nylon three strand rode and 1/2" galvanized swivel - No bridle - Partial trip-line - Deployed in a gale in deep water about 200 miles SSW of Block Island, RI, with winds of 40 knots and seas of 8-10 ft. - Vessel's bow yawed 30° - Drift was estimated to be about 2 n.m. during 10 hours at sea anchor.

The F-27 trimaran is trailerable, fast and seaworthy. Steven Wann used a para-anchor on his in a gale seventy miles off the New Jersey coast. Transcript:

> *I feel that I should mention that I have made one Pacific and four Atlantic crossings. While all of my ocean crossing have been in monohulls, I have made a few ocean passages in multihulls and expect that I will be doing more multihull ocean sailing in the future. I am aware of the differences between monos and multis, especially in regards to what I call "offshore tactics." For example, I have found that lightweight trimarans like the Corsair series do not go well to windward with waves coming from windward. As Sheldon Bacon mentions in his chapter entitled "Wind Waves" in the latest edition of Coles's* Heavy Weather Sailing*, seas take some time to build, and the "sea state" often lags behind the "wind state." Thus skippers of multis sailing offshore have to be aware that even though the wind might remain constant in strength and direction over a period of time, the ability of some mutihulls to continue to windward can diminish if the seas build.*
>
> *In the case of my DDDB form for 19 July '97, it should be noted that the waves were not commensurate in size with the wind force: they were smaller. However, I deployed the sea anchor because*
>
> *1) the wind and waves were from my destination,*
>
> *2) I was single-handed and tired,*
>
> *3) I was in no hurry, and*
>
> *4) there was sufficient traffic in the area to make me feel that maintaining way and a good lookout would be impossible.*

I would like to point out that I was not in any danger, I did not need assistance. In other words, I used the sea anchor not as an emergency device, but as part of my "normal" offshore tactics. I feel this is an important point.

In the case of my DDDB form for 16 August '97, I felt I was in an unsustainable situation: I had considerable gear failure (instrumentation, bowsprit and autopilot mounting, to mention a few), the wind and seas were from my destination and building, the weather forecast was for more of the same for the next two days, and I was exhausted. Thus I felt that I was unable to continue under those situations.

I would add that there are at least three situations in which I would use a sea anchor:

1) "I don't want to continue under the current weather conditions."

2) "I can't continue, but I don't need assistance."

3) "I can't continue and will need assistance when the present weather conditions moderate."

For the second deployment I had removed the trip line and float. I saw no advantage in their use during the first deployment and was concerned that the trip line could foul the chute in some way. Regarding bridles, I felt that Corsair's eyes near the bows of the outer amas were inadequate for the load that might be placed on them, were I to use a bridle. As I see it, the only advantage of a bridle on a multihull is to stop the boat from yawing, and in my case I did not see the yawing to be a problem. The yawing, which I felt was considerable, was in no way apparent belowdecks, and in any case is something that most multihull sailors have probably become accustomed to at ground anchor.

On deployment the first time, I was surprised how easy the movement of Dancer *became instantly, and how things quieted down. It was a "time out." This was repeated on the second deployment.*

I was also surprised at how much stretch there was in the rode, and how difficult it was to retrieve the rode and the sea anchor. The effort was much greater than just hauling in on a ground anchor rode, for at the time there was still considerable wind and sea. Even though the F-27 only displaces 2600 pounds, considerable effort was required to winch in the rode and sea anchor, and in the time it took to do so I worked up a good sweat. I had run the rode from the port fairlead to starboard of the bow cleat and back along the deck to the port winch, just forward of the cockpit. I would recommend this lead to other F-27 owners. There was so much strain on the rode that it would stretch six inches just from the bow to the winch!

Another surprise was that the sea anchor [without float] *took a position not near the surface of the water, but down maybe 30° from parallel to the surface of the water. While I didn't have any chain on the rode, the weight of the sea anchor, fitting, swivel and line were enough to sink the setup considerably, possibly because of relatively light wind conditions* [at retrieval time]. *On retrieval, I learned to watch the bow drop into a trough and then winch like mad!*

Section 3: Analysis & Lessons Learned

Analysis & Lessons Learned

Analysis & Lessons Learned: Sea Anchors

The time to take measures for a ship's safety is while still able to do so. Nothing is more dangerous than for a seaman to be grudging in taking precautions, lest they turn out to have been unnecessary. Safety at sea, for a thousand years, has depended on exactly the opposite philosophy.

Admiral Chester W. Nimitz

We now have 136 files in the database. In statistical parlance this might be an acceptable sample size were it not for the fact that it is divided up between 60 monohulls, 61 multihulls, 9 power vessels and even 1 rowing boat using a wide variety of drag devices. In essence the database is still young and we need many more files before each sample size is large enough to allow us to access a specific type of sailboat and pass a reliable judgment on its behavior in storms.

Nevertheless we are off to a good start. For one thing we now have crucial insights that apply to seamanship regardless of type of vessel or drag device being used; we have a clear dichotomy between sea anchors and drogues; we see the emergence of certain patterns; we can at least venture educated guesses about the behavior of *classes* of vessels. But perhaps we should concentrate on what we *do* have in the DDDB, rather than engage in guesswork and idle speculation. A bird in hand is worth ten in the bush.

A memorable scene from the Ron Howard film *Apollo 13* comes to mind. Apollo 13 is half way to the moon. It is moments after the explosion. Jim Lovell has uttered the famous words, "Houston, we have a problem." *Odyssey*, the damaged service module, is venting precious oxygen into space. The fuel cells are dying, master alarms are blaring, the instruments are malfunctioning and the full extent of the damage is unknown. The astronauts have lost attitude control and are in danger of drifting away into space. Pandemonium has broken loose on the spacecraft and in mission control. This is the scene in which we find the cool, calm and collected flight director, Gene Kranz, ordering everyone to quiet down, lighting up a cigarette and making the following statement: "Let's review our status... what do we have on the spacecraft that's good?"

Essentially this is the same sort of question we are now asking. Having gone through hell and high water - gales, cyclones, hurricanes and the Queen's Birthday Storm - we need to quiet down, review our status, and ask, "What do we have in the DDDB that's good?" The insufficiency of the individual sample sizes notwithstanding, all of our case histories have one thing in common: *heavy weather*. Not simulations, not tank tests, not abstract computer models, but real life heavy weather scenarios. Since these files do deal with the real world we should perhaps seize the opportunity to look for crucial insights that can be applied to seamanship, irrespective of type of vessel.

Preparation and Readiness

In sifting through the DDDB, the insight that singularly cries out for attention is the one rendered by New Zealand's Sir Peter Blake in File D/T-1. In his too-short career, this legendary sailor chalked up more than 500,000 blue water miles and had been through gales and life threatening storms on everything from small family monohulls to the maxi, record breaking catamaran, *Enza*: Sir Peter Blake:

> *I've been hove-to in cyclones, I've run before, I've used trysails, I've dragged things, I've been beam on, you name it, on every sort of vessel. To me the biggest thing is that you must be prepared. I think that a lot of people get into problems because sometimes these weather patterns creep up on you and then suddenly it really is very nasty and you haven't quite realized it, and then to get out the necessary drag device, whatever it may be, is almost too late. By then people are seasick if it's a cruising boat, or they're not too used to it, or not necessarily experienced. So to have something easy to put over, such as a Seabrake, or whatever drag device you are using, I think that is very important.*

Dana Dinius, whose yacht *Destiny* was pitchpoled while towing a Sea Squid in the Queen's Birthday Storm, renders an equally crucial insight in File D/M-12:

> *We learned that given a shorthanded crew, the rig you go into extreme weather with is most likely what you will be* forced *to stay with for the duration.*

Darryl Wheeler, who also survived the Queen's Birthday Storm, renders a similar verdict in File D/C-5:

> *Setting aside our experience of the event and looking at this from a seamanship point of view, we would offer the following. Make up your mind before you get in a situation of this type as to what you are going to do. Once you commit to a tactic it is almost impossible to change tactics.... It was all you could do to just hang on, let alone shackle and deploy a drag device.*

Roger Olson, after surviving two hurricanes on a Bristol Channel Cutter (File S/M-22):

> *Never expected it to get this bad or I would have used the parachute anchor. It was in the lazarette and my rope was still shackled to the anchor chain and anchor, all lashed forward. There wasn't a snowball's chance in hell that I was going forward in those winds and seas to unlash it, undo the shackle, etc.... I can't believe anyone would go forward in storm conditions to work anything on the foredeck.*

Dr. Andrew Cserny, who survived an unnamed hurricane at sea anchor on the trimaran *Gold Eagle* in File S/T-15:

> *One had to literally hold on all the time just to exist. Even sitting down, one had to hold on... the wind continued to shred the sails and I considered it almost suicidal to go outside....*

Robin and Maggi Ansell, who were hove to a sea anchor in cyclone Justin on a big monohull off the Queensland coast (File S/M-34):

> *There was absolutely no possibility in our weather conditions of being able to go forward each hour to check for chafe... it was impossible to go forward again as far as the bow during the rest of the 53 hours at anchor before our rescue.*

Stephen Edwards and Deborah Schutz in File S/M-38:

> *The conditions were so bad that it was impossible to be anywhere on deck. We used a harness just to visit the cockpit - almost all of our time we spent below deck.*

Captain William H. Price on the relatively stable platform of the 65' catamaran *Rose Marie* (File S/C-13):

> *Rain came horizontally so hard as to sting the face. Motion aboard the cat was so irregular. Any movement but hanging on was a chore.*

Lin and Larry Pardey have made the equivalent of five circumnavigations, emerging from numerous storms unscathed. They render a similar verdict in their writings. In fact it can be said that much of what might be called the "Pardey philosophy" has to do with preparation, readiness, and being able to beat Neptune to the punch. Lin and Larry Pardey, in *Storm Tactics* (by permission):

> *So the classic rule is "heave-to as soon as you think about it." A falling barometer, wind clouds, and a tired crew will confirm your decision to heave-to early. Be prudent; the longer you wait to round up into those overhanging waves, the more fearsome and dangerous it will become.*

Can we agree that irrespective of type of vessel, or type of drag device, or strategy or tactic, *readiness* and *preparation* are two of the most important considerations here? It doesn't make much sense to theorize, speculate and invest sums of money in sea anchors and drogues, only to find out too late that one dare not venture on deck to deploy *anything*. Common sense alone would seem to dictate that offshore one should always be ready and prepared, just in case.

But looking through the DDDB we see all too many examples of the opposite - a pattern of failure rooted in the human vice of inertia. Perhaps we are catching a glimpse of the biggest problem of them all. We see all too many sailors running into heavy weather unprepared, and then having a devil of a time trying to put everything together at the last minute.

File S/M-39 is a classic example. Here we find an intrepid Kiwi couple hanging on for dear life on the exposed, slippery, dangerous, cold, wet bow of a small sloop, trying to deploy a sea anchor after dark, well after the storm has hit. Ann Wilson:

> *Once outside, the force of the wind was terrifying. I was so scared of getting washed off I practically crawled up to the bow and between us we went about untangling the mess of rope....*
>
> *I found it hard to believe it was so much trouble. The whole performance had taken over three hours. (We have since devised a much easier system of deploying it from the cockpit, with chain already through the bow anchor roller fitting, with restraining pin in place, and the chain led back along the toerail, lashed in easy-release fashion, to the cockpit. We should, of course, have devised and tried this system before setting off.)*

In file S/M-36 we find a similar occurrence, leading to a fouled up mess of parachute and lines. Eleanor Tims:

> *When I went up onto the foredeck, it was found that the deck-light was not functioning, so I had only the fitful light of a flashlight shone from the cockpit towards me. First of all I launched the pickup buoy and line, followed by the float buoy, but these were torn from my hands by the wind (nearly 40 knots) and by waves sweeping over the deck and over me. I then realized that the genoa furling line made things complicated and that I ought to have launched all this gear beneath the furling line instead of above it, so I pulled it in and tried to stuff it back into the sea under the line instead of over. Trying to do this caused a tremendous snarl-up, so I was forced into spending a long time lying sprawled on the deck in the almost continuous dark, with waves washing over me, trying to sort it all out.*

The invincible Eleanor Tims has since also devised a method of launching everything from the safety of cockpit (it was only inevitable that she would). You can too. Roger Olson (File S/M-22):

This time I was better prepared. I had disconnected my anchor from my 5/8" nylon rope and pulled it all on deck. I tied the bitter end to the samson post, leaving about 10 feet for freshening the nip. I had already run the rope through a fairlead on the bottom of the Cranse Iron (this is how I anchor anyway) and led the rest aft to the cockpit. Where the rope led through the fairlead I had sewn on a meter of leather for chafe. This was set so the leather just passed through the fairlead so I could let rope out to "freshen the nip" if necessary. (Later I never checked for chafe because I was too frightened to go forward).

I led the rope along the top of the life line and lashed it in place with fine nylon thread (dental floss would work) and to the cockpit where I coiled it and used stops to hold the coil in place. The parachute anchor was kept in the lazarette. I already had added about 25 feet of 5/16" chain to the end of the swivel attached to the parachute. I removed the parachute anchor, chain and swivel as a unit in a bag....

I deployed the parachute early while I was hove-to. From the cockpit I deployed the float (enough buoyancy to float the chain and anchor on 20 feet of rope attached to the center of the crown of the parachute) over the windward side. This was followed by the parachute anchor, chain and rope. The boat was making slow leeway so I was able to maintain complete control of the rope until all (300' + 20' chain) was out. As I let go of the rope it broke the thread along the life line until the boat was riding bow to the wind and seas. I dropped all sails and went below.

The U.S. Pacific Fleet was caught unprepared in a typhoon in World War II and suffered horrendous weather-related losses. The incident moved Admiral Chester W. Nimitz to make sweeping policy overhauls that are now observed on all US naval ships in periods of heavy weather.

The embarrassment also prompted the admiral to make that famous statement of his about nothing being more dangerous than for a seaman to be grudging in taking precautions, "lest they turn out to have been unnecessary."

Read the opening quotation at the beginning of this section each time before you put out to sea. It pays to be ready, awake and prepared, even though you may never run into heavy weather.

Whatever your boat may be, and whatever strategy you decide is right for it, devise a method of implementing it in adverse conditions. Attend to all the details ahead of time, *before* you put out to sea. By the time the storm actually hits you may be tired, disoriented, seasick etc., and it may be too late to think about such things, let alone go out on deck and experiment.

Out at sea, if conditions are deteriorating and it looks as though you will have to heave-to to a sea anchor, heave-to early on in the game, as the Pardeys recommend. At the very least try to get everything deployed in daylight. Remember, in heavy weather everything is going to be twice as difficult and twice as dangerous after dark. Try to get everything set up and properly deployed before you lose the light of day. Here is some more good advice, aimed at multihulls in particular, from Chris White, author of *The Cruising Multihull* (courtesy International Marine Publishing):

> *With so many advantages and no serious disadvantages, the decision to deploy a sea-anchor becomes almost a non-decision: go ahead and do it. If you are tired and the weather is sloppy, ride to the sea anchor and get some rest. If the weather worsens you are all set to ride it out comfortably; if it improves you can start sailing again after a decent meal and a good night's sleep. As your mother said, that never hurt anyone.*

Happily there are success stories in the DDDB, well worn and new. Here are just a few of the newer ones. Stephen Edwards and Deborah Schutz on *Prisana II* (File S/M-38):

> *In the conditions we were caught in, we believe having our para-anchor set up, ready for deployment prior to leaving port, was crucial in the safe and easy deployment.... The anchor rode was fixed to a strong point at our bow, led aft and held in position by plastic cable ties at 6-inch intervals along the port side toerail to a deployment bag containing 125 meters of 18mm 3-strand nylon anchor rode. This was set up prior to our departure from Adelaide to cross the Great Australian Bight. Deployment simply involved reaching from the safety of the cockpit to the rode deployment bag, unlacing the top - removing the end of the rode and shackling it to the parachute anchor. Trip line floats were then fed overboard, followed by para-anchor in deployment bag.*

File S/M-31 is another example of preparation paying off handsomely. Here we find the 42' Bermudan Sloop *Lady Emma Hamilton* running into a whole gale in the North Sea - close quarters, shallow water, oil platforms and little room to run in. The owner took it all in his stride because he was well-prepared. R. Walton:

> *I just undid the straps and the Rode Bag toggles and tossed it overboard - it all sorted itself out and within five minutes we were riding head to wind. I am totally sold on the concept! We had been pooped twice before we hove-to and the seas increased in ferocity somewhat later.*

Manufacturers are constantly working on ways of making deployment and retrieval easier. Para-Tech sea anchors now come in a DSB (deployable stowage bag), for example. Look for easy deployment - *cylindrical* - rode bags to begin showing up on the market as well. One simply packs the rope inside, throws the heavy bag into the sea and long lengths of rope come out of the top of the bag. Victor Shane tries to avoid the bags that have full length zippers as he has seen a few cases of the rope coming out of these in clumps.

Bag or no bag, one should never throw everything into the sea carelessly. Looking through the DDDB we find all too many cases of the float line fouling the parachute during deployment.

The float line is generally considered a necessity, though some sailors - including the Pardeys - opt to take it off altogether. It is the 30-40' of line and float that keep the parachute from sinking should the wind die down (refer to the retrieval diagrams here).

One should always try to keep this short float line (and/or trip-line) away from the parachute in the initial stages of deployment. Either heave the float well clear before putting the para-anchor into the water, or hang on to the float and let the para-anchor pull it into the water along with the rode as the boat drifts downwind.

Either way, the important thing is to see to it that the 30-40 feet of coiled up nylon float line doesn't get carelessly dumped on top of the parachute in the water. Some fishermen use floating polypropylene for the float line. Polypropylene is weaker, chafes through more easily and the cheaper yellow "ski rope" turns into stiff "pretzels" when it dries out. But it does float, reducing chances of foul-ups. Consult the manufacturer about this option. A reminder that you will need a small stainless steel swivel next to *any* float that you deploy in heavy weather. The orbital rotation of the waves in effect places the float inside the rotating drum of a washing machine. That float may go through 40,000 wave cycles in a 48-hour gale. If it spins 40,000 times you can bet on major snarl-ups. Eleanor Tims, File S/M-36:

> *It took us about 50 minutes to bring the bundle in, and then the sad story could be seen. What had happened was that the tripping line had twisted round and round itself until it was as stiff and unwielding as a metal spring and that this metal-like mass had ensnared with it some of the shroud lines of the para-anchor.*

Perhaps it would make more sense to use flat, rectangular floats that don't spin as easily. Or one could easily ballast a round float by tying on a few fishing weights. Or one could perhaps devise a flagged, ballasted man-over-board pole type arrangement. At any rate, whatever float you use make certain there is a small, freely rotating stainless steel or bronze swivel between it and the line it is attached to. Make certain this swivel doesn't get fouled or somehow restricted during deployment.

If you opt for a full trip line make certain it is fairly taut or it will hang down and foul the parachute and rode. Make doubly sure there is a small stainless steel swivel next to the float and tie it on properly. The simplest way would be to use a large fender for the float - a fender with eyes on each end. Tie the small swivel of the float line to one eye of the fender; tie the full trip line to the other eye.

In file S/T-7 we find the trimaran *Rose-Noëlle* using a full trip line in a gale off New Zealand. The trip line was likely left loose - allowed to hang down in a great bight. It must have fouled because it eventually caused the parachute to collapse, allowing the yacht to come beam to the seas and be capsized by a rogue wave. John Glennie:

> *The para-anchor worked well and I was most impressed till it fouled.... The trip line fouled the chute and with the chute partially collapsed we lay a-hull.... Next time I won't use a trip line. I could have got the chute back in with the electric capstan in the calm after the storm.*

Are we looking at a problem pattern, a random string of events? Victor Shane leans towards the latter explanation. In the first place the problems seem to limit themselves to pleasure craft. Very few of the captains of the commercial F/V's interviewed by Victor Shane seem to have run into them. This is probably because they are used to deploying mile long nets, lines, floats - and sea anchors - on a daily basis. In the second place, even among pleasure craft the botched up cases are outnumbered by file after file of successful deployment. In File S/C-8, for instance, we find the catamaran *Catherine Estelle* successfully tethered to a para-anchor in a storm in the Gulf of Alaska for five days - likely 60,000 wave cycles. A big, red, round float was used in this case, properly tied onto a partial trip line with a small stainless steel swivel. There were no foul-ups. In File S/C-11 we find a small catamaran deploying everything after dark, in a maelstrom on Lake Erie. Thomas E. Cooke:

> *We were extremely fatigued and totally disoriented. With no horizon and our brains not functioning too well, (extreme fatigue does funny things to the mind) we decided to deploy the sea anchor and wait until daylight before doing anything else. We deployed the sea anchor in text book fashion. We have the DSB (deployable storage bag). Nothing fouled up, it was almost too easy. The boat slowly drifted downwind and when the rode ran out she swung straight into the wind. At that point we just rode the waves. We lashed sails down and made sure everything was secured and that was all there was to it.*

In File S/M40 we find the 45' monohull *Celtic* tethered to a para-anchor in the Gulf of Alaska for five days without any problems. The Casanovas (File S/T-1) never ran into the problem in eighteen years of cruising, even though they always used full trip lines. There are numerous other success stories, all of which inspire us to believe that fouling problems can be avoided through preparation, organization and early deployment. To believe otherwise is to concede the game to Murphy. From improperly set spinnakers to Danforth anchors carelessly thrown into the water, anything and everything can foul at sea if allowed to.

Chafe

Looking through the 136 files we see that chafe is the monkey wrench in the whole works regardless of vessel type or drag device being used. It makes little sense to invest in a drag device system that one cannot deploy. It makes even less sense to invest in one, go through all the motions of organizing and deploying everything at the onslaught of a gale, only to lose the whole kit and caboodle an hour later because of chafe. In this connection we have an unambiguous statement made by Professor Noël Dilly in File D/M-14:

> **"Chafe is the great enemy of all drag devices."**

This statement is all too frequently confirmed by the testimony of the DDDB. Jim & Lyn Foley on *Sanctuary* (File S/M-25):

> *As we worried about chafe, the para-anchor was working beautifully. The boat rode up the face of the waves punching through their tops as the huge seas rolled under us. No more green water came on board, no more near knockdowns. For four hours we rested below, taking turns watching and letting out the rode to combat chafe. But in spite of our efforts the line parted after an especially strong gust, and the sea anchor was gone.*

BJ Caldwell on *Mai Miti Vavau* (File S/M-27):

> *Main concern: chafe was definitely a problem. Before I leave on my next trip, I'm going to put a couple of feet of chain into every hundred feet* [of tether] *so chafe will be a non-issue.*

Robert K. Gwin on *Osprey* (File S/M-29):

> *The primary anchor had not been stowed before going offshore, so the bow roller was not available for use, and the anchor caused chafing... the rode was chafing on the bow roller next to the anchor due to the movement of the boat.... Attempts to re-route the rode resulted in the rode and the sea anchor being lost.*

Chris Brann on *Snow Dragon* (File S/M-32):

> *Unfortunately the outer covering* [of the double braid] *chafed, so I pulled enough rode in to put sound line on the cleats.*

William Dwyer on *Overdraft* (File S/M-37):

> *Overnight the rode had chafed through the teak cap rail below the chock in an arc, cutting downward 3/4" to 1" into the wood.*

Phil Herting on *Triple Shock* (File S/T-9):

> *And the chafe was the problem. Because of the distance from the winch to the chock being so great, it created a longer spring and chafe* [area] *on the line.*

Andrew Cserny on *Gold Eagle* (File S/T-15):

> *And sometime during the course of the day, this line chafed in two.*

Josh Tofield on *Ariel* (File S/C-6B):

> *Barometer dropped from 1018 to 1002 in 3 hours! Wind started one hour later and built to Force 10 where it stayed, never dropping below Force 9 in 48 hours.... Bridle (3/4" nylon) chafed completely through and had to be replaced with 5/8" backup bridle.*

Robert Burns on *Peter Sanne* (File D/M-15):

> *I found the bridle dangling over the transom, severed on both sides. The 3/4" nylon bridle had been abraded by the self-steering mounting brackets. There was damage to the stern pulpit and deck fittings, evidence of the forces and motion exerted on the hull by the* [series] *drogue before it parted the bridle.*

Never take anything for granted about chafe. Let there be no doubt in your mind that after you have spent all that money purchasing everything, after you have properly set up and organized it all, after you have successfully deployed that sea anchor off the bow, or series drogue off the stern, you stand to lose everything - including the shirt on your back - to Murphy and the little green chafe demon in his hire. A reminder: in addition to getting paid overtime in storms this little goblin gets a handsome bonus every time he succeeds in getting line to chafe completely through. There are many different methods of combating chafe. The Pardeys use reinforced plastic tubing (see illustration on page 90 of *Storm Tactics*). So does Noël Dilly (File D/M-14):

> *To counter chafe at the weight end* [of the series drogue] *we enclose the chain-to-rope splice in a spiral whipping so it cannot move. At the bridle end we enclose the lines in thick-walled polyethylene tube where they pass over the transom.*

Rags, rubberized chafe guards, plastic hose, garden hose, fire hose and leather sleeves are all fine and well, as long as they don't migrate. Don't assume they won't because they most certainly can and will. *Make certain they won't.* F. Bradford Smith (File S/M-30):

> *A six foot length of fire hose was slipped over the rode's bitter end using a boat hook as a needle, and was then run down the rode to the hawse hole, where it was made fast to the bow cleat. This was accomplished by cutting a "V" shaped notch in one edge of the flat fire hose, and then running a short piece of 3/8" line with a stopper knot through the hole and tying the fire hose to a cleat* [so it could not migrate]....
>
> *Every two hours or so a foot or two of rode saved on deck for the purpose was released to even out any chafe. No chafe or even black marks from the inside surface of the fire hose was ever noted.*

Rick and Linda Kasprzak who were hove to a Para-Tech sea anchor for five days in the Gulf of Alaska had no chafe problems (File S/C-8):

> *We had 50' bridle arms that went through a specially made SS bow plate.... The bridle was encased in 1/4" thick rubber tubing where it hit metal on the plate.*

Searching the DDDB for a definitive solution to the perennial problem of chafe, especially where monohulls are concerned, we find something in File S/M-34: *a length of chain*. Here is compelling evidence, provided by Robin and Maggi Ansell on the 55' x 40-ton ketch *ORCA*, tethered to a sea anchor for 53 hours in cyclone *Justin*, off the Queensland coast:

> *There was absolutely no possibility in our weather conditions of being able to go forward each hour to check for chafe, also the force of the water on the anchor line made the line like a steel rod, and one could never have got any slack to be able to replace a chafe guard. Realizing this from the start, Robin attached a ten foot length of half-inch section anchor chain to the eye of the line, which ran through the starboard bow roller. This took care of the chafe, as it was impossible to go forward again as far as the bow during the rest of the 53 hours at anchor before our rescue.*

Stephen Edwards and Deborah Schutz, who weathered 80-knots winds on *Prisana II* off Rottnest Island on the other side of the Australian continent (File S/M-38):

> *Due to the setup of 1 meter of chain at the bow we had no chafing.*

Solo circumnavigator BJ Caldwell in File S/M-27:

> *Before I leave on my next trip, I'm going to put a couple of feet of chain into every hundred feet* [of tether] *so chafe will be a non-issue.*

If your monohull is properly set up to bring chain on deck you can say sayonara to Murphy's little green chafe demon. Make certain you *are* properly set up, however, because chain has been known to saw right through the bow when boats have been left to fend for themselves in hurricane anchorages. At the very least make certain the chain can't jump out of the bow roller to do something silly like that. Captain Eric F. Roos on *Windcrest* (File S/M-21):

> *At one point the anchor chain jumped out of the stainless steel roller (we forgot to put pin through top of roller) and found its way down the starboard side and into the stainless steel chock causing only cosmetic damage. Due to the rugged nature of our chocks, we would intentionally place the chain in the chock in the future.*

CAUTION: The drawback with chain is that one may not be able to cut it away. In an extreme situation (large container ship on a collision course, for example), one can cut a nylon tether with a knife and get out of the way. One should always be able to cast chain off as well. Go down below and take a look inside the chain locker of any ocean going yacht. If the bitter end of the chain is secured to the hull by the sort of lashing shown on page 111 of Earl Hinz's *Complete Book of Anchoring and Mooring* (Cornell Maritime Press, 1968), you will know that you are dealing with a real seaman. If it is attached to the hull by means of a rusted out, frozen - fifteen year old - shackle, you will know otherwise.

Properly used, chain will eliminate chafe and provide for purely mechanical - catenary - shock absorption. But make certain that in an extreme situation you can throw it off and free the boat of the sea anchor system. ***If you foresee ending up in some such extreme situation (shipping lanes, strong ocean currents, etc.) you must rig up a full trip-line***.

Multihulls can say sayonara to the chafe demon by shackling the bridles to the bows, like the Casanovas did (File S/T-1).

Looking through the DDDB we also find some sailors just securing the bridle to strong cleats well forward on the amas. Curiously enough there seems to be very little chafe associated with this, provided that the cleat is the last thing the line touches. If the line is resting in a chock six feet from the cleat it

might as well be resting on a knife edge - the distance from the cleat to the chock creates a spring that lets the line saw back and forth across the chock. But if there is no chock (line leading directly off the cleat) there doesn't seem to be much chafe either. Colin Kenny on the South African catamaran *Manx* (File S/C-18):

> *At 01:30 Sue, braving the black night, high seas, 35 knots of wind (and no trampoline), checked the bridle* [leading directly off cleats, no chocks] *for chafe - nothing! Similarly at dawn - no chafe. After lying at anchor for 40 hours, we were surprised to find no signs of chafe.*

Jack Goodman on *Cat Morgan* (File S/C-14):

> *One of the nice things about the Edel Cat is that the cleats are on top of a rounded deck with NO CHOCKS. The bridle lines went directly from the cleats to the parachute touching only the smooth deck or forward aluminum cross beam at extreme angles, hence hardly any chafe at all.*

Many multihull sailors preferred to lead the bridles through snatchblocks and bring them back to cockpit winches. Because the bridle lines are bent around rotating blocks (instead of stationary chocks), Murphy's little goblin has a lot less to get his teeth into. And because the bridle arms can be adjusted from the relative safety of a multihull cockpit, one can "freshen the nip" easily. When purchasing snatchblocks choose the largest sheave diameter you can afford. The larger the diameter of the sheave around which the line turns, the lower the stress on the rope at that point.

Large snatchblocks are expensive but may come in handy for any number of other critical applications on a long ocean voyage. They can be used to rig up an emergency block and tackle system that may enable a sailor to re-raise a mast, or pull his grounded boat off a reef, to give just two examples. Make certain all fittings can handle the loads. There's not much sense in attaching $300 snatchblocks to $7 padeyes that are going to pull out in a gale. Andrew Cserny on the trimaran *Gold Eagle* (File S/T-15):

> *I am not sure exactly when, but I suspect probably when the rogue wave hit, the sea anchor also tore loose a bridle leg, carrying with it the hardware for mounting the trampoline, because, sometime after daybreak we noted that the bridle for the right side of the sea anchor was totally gone. There was a hole in the bow on the right side* [starboard ama]....

Multihull sailors should learn the lesson from Andrew Cserny's experience. Don't wait for disaster to strike before you learn the lesson the hard way and decide to finally beef things up on your boat. Human nature is governed by inertia and moves all of us to do too little too late - "a day late, a dollar short." Avoid this pitfall. Make the necessary improvements, preparations and reinforcements so disaster will not

repeat itself. Andrew Cserny:

> *I have replaced the sea anchor with another.... The tether is 5/8" nylon, 500 feet long. There is an oversized stainless steel swivel. The bridle arms are longer now, made of 3/4" Dacron, which is less stretchy than nylon and hopefully better resistant to abrasion. The geometry of the attachment of the bridle to the boat is now different. I believe that it is significantly better. The two legs of the bridle now come through the points on the bows of the amas where the stainless steel plate holding the snatchblock is much more substantial than what was there before. The snatchblocks are considerably more substantial than the ones they are replacing. The bridle is led straight back onto the deck of the ama and tied off to a cleat which is through-bolted to the main deck, and underneath is attached and through-bolted to an L-shaped steel backing plate, in turn through bolted to the main crossbeam.*

Monohull sailors can take the lesson from the owners of *Prisana II* (Files S/M-38):

> *We've realized the attachment point on bow needs to be extremely strong. Parachute anchor was shackled to 1/2 inch chain link welded to ship's anchor. Our ship's anchor was stored below deck level via custom bow fitting, then secured aft by 3/8 inch Ronstan rigging screws, secured to a 10mm stainless steel plate, bolted under the anchor winch. Winch and plate fastened by 6 x 3/8 inch stainless steel studs. Both the fixing point to the ship's anchor and to the plate were backed up by secondary systems. Ronstan rigging screw had 10mm chain back-up. Fixing to anchor was backed up by 5/8 inch stainless steel bolt, through anchor cheeks. Both systems failed! Ronstan rigging screw had 8 turns of thread removed. Back-up held, but ship's anchor smashed around, causing damage to our stainless steel bow fitting. Chain-link welded to ship's anchor was torn off and secondary chain from nylon rode took up the weight on 5/8 inch stainless steel bolt through anchor cheeks.*

If you are going to pay a metal shop to make up custom stainless steel deck plates, padeyes, fittings, etc., specify large stock and have them increase all the dimensions three or four times. Most metal shops charge by the hour anyway and you will end up paying the same sort of money for a skimpy deckplate as you would for a big, substantial one.

Take a good look at some of the no-nonsense fittings on a Coast Guard cutter or a Navy patrol boat. The ones on your boat should be somewhat similar, large and oversize, with many drill holes for attachment and backing. Most of the petite items found in marine stores don't fit the bill. Have specialty fittings custom-made for your boat.

Once made and installed these will pay handsome dividends in peace of mind in any anchoring situation. When your boat is bucking to a Danforth in forty-knot winds, fifty feet from rusty pilings in some godforsaken corner of the world, you will thank yourself. Besides, when fellow cruisers see those custom-

made no nonsense bow fittings they will realize that they are dealing with a real seaman.

Rope Diameter

Since rope failure can occur regardless of vessel type, the DDDB's overall sample size allows some useful analysis. That there are very few incidents of rope failure in the 136 files is significant, to say the least. While loss of gear due to line chafe is all too common, we find only three cases of rope failure - overloaded rope snapping outright. Two of these were caused by the rode length being far too short. The third case involved a large, heavy commercial fishing vessel using ridiculously small diameter rope.

In File S/M-32 we find the 31' x 10,000 lb. Hunter, *Snow Dragon*, tethered to a 15-ft. diameter Para-Tech Sea anchor by 300 feet of 5/8" double braid nylon in 45-knot winds and 15-20 ft. seas. The outer covering of the double braid had chafed and the owner had to pull in enough rode to put sound line on the cleats, (possibly compromising the balance between cover and core as well). Chris Brann:

> *This resulted in about 150 feet between the sea anchor and the bow.... This was not enough line to absorb the energy.... At about 1000 hrs. a large wave broke over most of the vessel... and then broke the 5/8" line (breaking strength 14,400 lbs.) I determined that the line had broken rather than chafed through by observing that the ends of the strands were all about the same length and were slightly fused.*

In File S/C-6B we find *Ariel*, a 43' x 25' x 15,000 lb. Crowther catamaran running into a horrendous storm on the way back from Hawaii. One leg of the 5/8" bridle arm snapped outright when a wave broke against the boat. *Ariel*'s tether was 250' x 3/4" nylon three strand. It should have been at least 400', preferably 500'. It would then have stretched and absorbed the shock that 250' of line obviously couldn't.

In File S/P-7 we find the 50' x 70,000 lb. commercial F/V *Kella Lee* using a 28-ft. diameter parachute sea anchor along with 500 feet of 1/2" (*half inch!*) nylon braid with a breaking strength of about 8,000 lbs., for station keeping applications. This seems to have gone on for about two years! The line finally parted in heavy weather, the failure occurring right at the thimble itself.

Way back when Victor Shane first initiated the *Drag Device Data Base* he was sure it would be filled with numerous cases of rope failure. It hasn't turned out that way. Perhaps one can infer something useful from this. Three cases out of 136 heavy weather files boils down to 2.3% - an extraordinary indication if reliable. This would seem to be telling us that if the tether is properly sized, long enough and in fairly good condition, one can stop worrying about it breaking and start worrying about more critical things - such as chafe.

Determining correct rope diameter for sea anchor applications has never been easy, however. Most safety experts try to dodge the issue, and with good reason. Rope diameter has to be small enough to allow adequate stretch and shock absorption. At the same time it has to be large enough not to break. We are

still a long way from reconciling these contradictory requirements in a simple formula.

Since there are so few cases of rope failure in the DDDB, it would at least appear that most of the tethers were more or less properly sized, everything else being equal. One will have to wait a few years, however, to see if the percentage holds out. There should only be about 20 cases of rope failure when there are 1000 files in the DDDB. Should this be the case one might then be able to nail down the "bounding box" - the size above and below which something never or always happens for a given displacement.

A crude exercise: In File S/P-7 we find rope failing when a 70,000 lb. commercial F/V tried to use 500' x 1/2" line with a breaking strength of about 8,000 lbs. - 11% of the displacement. Not enough strength, everything else being equal?

In File S/C-6B we find rope failing when a 15,000 lb. Crowther catamaran tried to use 250' x 3/4" rope with a breaking strength of about 15,000 lbs. - 100% of the displacement. Not enough stretch, everything else being equal?

In File S/M-32 we find rope failing when a 10,000 lb. Hunter tried to use 150' x 5/8" line with a breaking strength of about 14,000 lbs. - 140% of the displacement. Not enough stretch, everything else being equal?

In File S/C-3, on the other hand, we find a 12,000 lb. Prout catamaran using 300' x 3/8" nylon three strand tether with a breaking strength of about 4,400 lbs. - 37% of the displacement - and the rope did not fail. Does this mean that the line had the right combination of stretch vs strength, everything else being equal? It will take many more files and some rigorous scientific analysis to answer this question.

We have two cases of rig loss due to the failure of knots in the DDDB. In File S/M-39 we find a sailor deploying a sea anchor on 2 x 200-ft. lengths of rope, knotted together with bowlines. The entire sea anchor rig was lost when the rope failed at one of the knots.

In File S/C-17 we find the Dutch catamaran *Silver Heels* tethered to a 12-ft. diameter Para-Tech sea anchor in Force 9-10 conditions near the Bay of Biscay. The owner had used a bowline to tie the bridle to the tether. H.L. Andersen:

> *My mistake was to attach the bridle to the 400' tether using a bowline instead of a proper splice & thimble, and that's where the line eventually chafed through.*

If you get caught unprepared and have to tie lengths of rope together use the correct knots - the kind that tighten up on the purchase and don't invite chafe. Simple bowlines won't do sometimes. Use *double sheet bends* when attaching two lengths of rope together or, even better, use a carrick bend or double fisherman's (see this climbing site - climbers are pretty careful about the knots they use!) ; use *fishermen's bends* (also known as *anchor bends*) when tying lines onto rings, mooring bits, shackles etc. Always mouse the ends so the knots can't unravel. At the very least you can put on a "poor man's mouse" by

means of electrical or duct tape (Victor Shane likes to use two large, stainless steel diaper pins, available at drug stores).

These knots are not difficult to master. There are only half a dozen knots that you will really need. Get a good book of knots and see to it that your crew masters them thoroughly. Then practice tying them blindfolded because at sea you may have to do them in the dark. As Rob Mansell-Ward did, on the catamaran *Orinoco Flo,* in heavy seas off the eastern coast of Africa (File S/C-15):

> *We still stressed a bit on the perfectly reasonable assumption that our cocktail of lines & chain, and our cat's cradle of knots (double sheetbends) would certainly part. But no... the worst that happened from then on was a sharp jerk as the bows were yanked down as we came up over a big steep one.*

Rode Length

Here is a principle derived from Newton's laws: *The longer the stopping distance of an object in motion, the less the force required to stop it.*

This principle is incorporated into all sorts of human creations by architects, mechanical and aeronautical engineers, bridge constructors, crane operators, theme park designers, skydivers, bungee jumpers, etc. Even crash dummies are familiar with it.

Where automobile airbags are concerned, a controlled stopping distance of only twenty inches (as opposed to a non-controlled distance of zero inches) can make the difference between life and death in a head-on crash.

Applying the principle to sea-anchored boats we can predict similar reactions and look for confirmation in the pages of the DDDB. The yacht is held in alignment by the restraint of the large sea anchor. The elements will try to push the yacht away from the sea anchor, sometimes quite violently. The rode will try to limit the extent of that travel. The stopping distance will greatly determine the magnitude of the forces involved. If the rode is nylon and long, the stopping distance will be adequate and the loads manageable. If the rode is Dacron and/or too short, the stopping distance will be inadequate and the loads may cause major failure somewhere in the system. Once again Chris Brann on *Snow Dragon*, File S/M-32:

> *This resulted in about 150 feet between the sea anchor and the bow. This was not enough line to absorb the energy.... At about 1000 hrs. a large wave broke over most of the vessel.... The bow cleats are welded to a 1/4" stainless plate that is in turn bolted through the sides of the vessel. The strain curled this plate through more than 90 degrees, crushed the pipe forming the legs of the cleat, and then broke the 5/8" line (breaking strength 14,400 lbs.).... The strain also curled the main plate holding the forestay. Loss of this plate would have meant loss of the mast. The structure of the boat was also damaged, opening the joint between the hull and deck on the port*

> *side, and we started to take water in through the gap.*

Had the rode been 400 feet it would not have snapped, nor would it have damaged any of the hardware. A 400' x 5/8" rode would have stretched and absorbed the shock, instead of transmitting it more or less directly to the bow fittings on the boat. Josh Tofield again, catamaran *Ariel*, using only 250' of 3/4" tether in a severe North Pacific storm (File S/C-6B):

> *Later one leg of the 5/8" bridle SNAPPED in the center when hit with very large wave, throwing* Ariel *backward, shearing the foam & fiberglass off of one rudder completely, and leaving only half of the other rudder (which later broke off). Crew eventually added 100-150' of anchor chain to the 250' of 3/4" nylon tether and rode out the rest of the storm.... Moral of the story:* ***USE LOTS OF PRIMARY TETHER!*** *What is adequate for Force 9 is not adequate for Force 10!*

Compelling evidence in two back-to-back files: In File S/P-1 we find the 50' x 22-ton commercial F/V, *Sea Roamer*, tethered to a 28-ft. diameter C-9 parachute in Force 10 conditions by 150 feet of 3/4" Poly-Dacron rode. The rode was neither long enough, nor did it have sufficient elasticity to absorb the dynamic loads imposed by the wind and the seas. Those loads ended up being transmitted directly to the boat and the parachute, turning the latter into ribbons.

In the next file (S/P-2) we find a larger, much heavier (65' x 43-ton) commercial F/V, *Holly & Michael*, tethered to the exact same type of parachute (28-ft. diameter surplus C-9) in Force 9-10 conditions for 24 hours, without incident. The difference? This boat was using 450 FEET OF NYLON rode.

Nylon has much higher elasticity as well as resiliency compared to polyester. If it is long enough it can play a critical part by *buffering* the system loads - stretching and absorbing the peak loads, temporarily storing them, then "metering" them out to the boat and sea anchor in smaller - more manageable - doses. Delivery skipper Phil Herting on the trimaran *Triple Shock*, after the aluminum rudder cage broke in heavy weather (File S/T-9):

> *At that point we deployed the para-anchor. This device was utilized to stabilize an emergency situation and was deployed to ride out some bad weather. Because of the immediacy created out of the breakage we had to deploy it as fast as we could and with what line we had immediately available. For this reason the first line tied to the para-anchor was a 1/2" pre-stretched Dacron backup spinnaker halyard.... This immediately proved to be a mistake. The shock load transmitted back through the line was unbelievable.*

The Casanovas were stressing the need for LONG, NYLON sea anchor tethers twenty years ago. All safety experts stress the same need today. Most of the sailors interviewed by Victor Shane in the intervening years, in particular those experiencing life-threatening storms, have repeatedly emphasized the same need. Dana Dinius, who survived the Queen's Birthday Storm, for example told Shane that all things considered he might opt for a para-anchor next time around, but that the rode would have to be "500-700 feet long," (see also his concluding statements in File D/M-12). Robin and Maggi Ansell, after cyclone Justin (File S/M-34):

> *We had deployed the whole 500 feet of line, which probably was not enough in those conditions, but once deployed, it was too dangerous to consider adding further line (of which we actually had another 800 feet).*

Captain William H. Price, after experiencing Force 10 conditions on the 65' catamaran *Rose Marie* (File S/C-13):

> *The entire 600 ft. of rode payed out under control from purchase turns around the windlass drum and snubbing horns.... 600 ft. was adequate for those conditions. It served very well, though I could have wished for more in the locker, had the seas been higher, or more frequently breaking.*

Union Hardware

Aside from small deck fittings pulling out and a few bow rollers getting bent out of shape we don't find too many cases of union hardware failure - the hardware used to join sea anchor, tether, bridle and chain in the water. We must be doing something right as there are no cases of shackle failure in the DDDB. The two cases where hardware did actually fail involve galvanized swivels.

In File S/T-3 we have a 50' x 16-ton trimaran tethered to a large parachute in a horrendous storm south of Tristan Da Cunha. After 36 hours there was a jerk, the bows fell off the wind, and the big multihull lay beam to the seas. It is the owner's opinion that the galvanized swivel at the bridle/tether junction had seized - failed to rotate:

> *After recovering the remains of the bridle we saw we had lost the two shackles and the swivel. The remains of the arms of the bridle were unraveled and twisted around each other - everything else was lost.*

In File D/C-9, we find a 9-ft. diameter Shewmon sea anchor being set "on the fly" off the stern of the 44' x 6-ton catamaran *Anna Kay* in 80-knot winds in the Gulf of Tehuantepec. The vessel was surfing at 15 knots at the time. The 250' of 3/4" tether (far too short) smoked out, the sea anchor opened, there was a jerk and the rig was lost. Captain Fred Yeates:

> *As I tried to ease the line out we surfed down a huge wave and I lost control. We were surfing at 15 knots. I had to let go the rope. I had to get my feet out of the way of the lines that were running out. The line reached its end and stretched. The sea anchor opened, a beautiful sight. Then it shuddered, turned into a rag and disappeared.... When I retrieved the rode only one new shackle was at the end* [the connecting eye of the 5/8" galvanized swivel must have broken - ed.]

Sea Anchor Diameter

We have come a long way since Coles's days of "21-inch diameter Admiralty pattern cones." Both the US Coast Guard Report and the Wolfson Report, mentioned earlier, indicate the need for much larger diameters for use off the bow. US SAILING's prescription, which Victor Shane helped draft, states the following (*Recommendations For Offshore Sailing*, Appendix VII, Paragraph 4.26):

> *SEA ANCHOR. For yachts to 70 feet LOA and less, a sea anchor of a diameter at least equal to 35% of LOA with a tether that can be made up of stout nylon line equal to ten times LOA, with thimbles, shackles, and swivels at each end of tether. For multihulls, a bridle is recommended that is 2.5 times the BOA* [beam over all]. *A sea anchor trip line is optional.*

Back in December 1997 some of the wording in the above paragraph underwent rigorous debate in Compuserve's *Sailing Forum*. Participants included Captain John Bonds, executive director of US SAILING, Bill Doelger, chairman of the multihull council of US SAILING, Earl R. Hinz, as well as Victor Shane and a number of other sailors from around the world.

Some sailors objected to the ambiguity contained in the words "stout nylon line," for example. Others objected to relating sea anchor diameter to LOA (length over all), but could offer no alternative formula with *practical* applications. Others yet objected to relating tether length to LOA, justifiably arguing that it should relate to wave heights, as Shewmon recommends. But again, when pressed for *practical* ways as to how the average sailor might carry enough line on board, or go out on deck in a storm, measure the wave heights and keep adjusting the rode length accordingly, there was little forthcoming.

Because of the strong correlation between vessel length and everything else (displacement, draft, beam), Victor Shane argued that there is good reason to base sea anchor diameter on a percentage of the LOA, "35% of LOA" being a *practical*, easy-to-apply formula. Earl Hinz argued that this should be a

"minimum," in so far as flat circular, zero-porosity parachutes are concerned. Thus a 30-ft. yacht would need a para-anchor with a *minimum* diameter of 10.5 ft., a 40-ft. yacht would need a para-anchor with a *minimum* diameter of 14 ft., etc.

The debate raged on for several weeks. In the end, and with *practicality* in mind - avoiding unnecessary complications, while insuring that every boat was equipped with the minimum needed - the paragraph emerged for the most part in tact, with a few words amended. (Copies of the booklet are available from *US SAILING, P.O.Box 1260, Portsmouth, RI 02871-6015, USA*).

Sea Anchor Stability

Much of the reasoning behind the need for big parachutes has to do with the fact that sea anchor stability is largely a function of just that - *diameter*. The larger the diameter, the more stable the sea anchor in a given seaway, the more reliable its restraint, the less the chance of it getting thrown, tumbled, etc. A germane passage from the Wolfson Report, co-authored by Barry Deakin of the University of Southampton, reads thus:

Under cyclic loading, drogues and small parachutes can collapse and start to tumble so that they either cause themselves structural damage or tangle so badly as to be rendered ineffective. Large parachutes can avoid collapse by virtue of their higher drag causing the tow line to stretch rather than to pull the parachute through the water.

There is now significant correlation between this aspect of the Wolfson test results and the full scale real life experiences contained in the DDDB. The correlation, as such, covers the entire gamut of vessels and sea states. In general, the boats that used larger diameter para-anchors fared better than those who tried to use smaller devices. The problem files - where the sea anchor failed to do an adequate job of pulling the bow/s into the seas - involved smaller diameters.

For yachts under 70 feet LOA, the "bounding box" relating to sea anchor diameter seems to start somewhere around 12 feet and end somewhere around 28 feet. Few problems were encountered when sea anchor diameter was 12 ft. and greater; it does not appear that there might be any advantage in using a sea anchor larger than 28 feet in diameter.

Possible exceptions to this generality would be smaller Shewmon sea anchors, provided their design will in fact allow them to remain well below surface activity throughout storms, and also smaller BUORD-type parachutes used in conjunction with the "Pardey bridle," provided the turbulent field or "slick" set up by the vessel in question will be potent enough to smooth down the waves to the point where they can no longer tumble sea anchors. These exceptions notwithstanding, Victor Shane increasingly leaned towards 12 feet as the cut-off point for minimal diameter.

The reasons for this opinion were again put to the test in the Compuserve debate. Part of Shane's argument centered around parachute industry standards as they relate to *nominal* versus *inflated* diameters. Para-anchors manufactured in the US, in Australia and in New Zealand all use US parachute industry standards - they go by the *nominal* diameter. This means that a 12-ft. diameter para-anchor (a

circular parachute with a nominal diameter of 12-ft. when laid flat on the ground) will have an *inflated* diameter of about 8 feet in the water (.65 to .70 of the nominal for flat circular fabrications, according to US parachute industry standards). This places the center of the canopy only 4 feet below surface action. Imagine this parachute on the crest of a 30 ft. breaking wave and you can see how precarious its footing might be.

In light of the above, one might say that most attempts at determining sea anchor diameter on the basis of vessel size, or vessel displacement, or vessel beam, or vessel draft are flawed. It makes much more sense to go with a large diameter regardless, because a big parachute stands a far better chance of staying put and not getting tumbled by surface waves. The Pardey strategy notwithstanding, the interaction between a para-anchor and wave formations has little to do with the size, weight, width or draft of the vessel in question. Or as Earl Hinz put it, "Neptune cares not a whit about whose craft is riding out his storm." A large diameter para-anchor cannot be pulled through the water so easily and is far less susceptible to the problems relating to sea anchor stability. Its basic shape may get partially distorted by the passage of an unstable wave, but if the canopy is big enough some part of it will "grab" and provide enough drag to keep the yacht aligned and under restraint. Call it the shotgun approach if you like, but there's not much sense in relying on a sea anchor that is itself being thrown by the waves.

Convincing evidence about small size vulnerability can be found in File D/M-18, where we find the Cal T-2, *Paper Dragon*, using one of Jim Buoy's heavy, 36-inch diameter, Coast Guard approved sea anchors off the stern in Force 9-10 conditions. Wes Thom:

> *In the daylight we could see that the waves were not less than the height of our spreaders (about 25') and about 150-175' from crest to crest.... We could look behind and watch the drogue start up a wave as we came over a crest. We could see it tumble on its own crest as we slid down the back side of ours. About the time we were in the trough it would grab again, and up and over the next crest we would go. We could clearly see the yellow cone tumbling repeatedly. It would get rolled, get tossed around, go end over end and everything in between.*

In File D/T-2 we find the 31-ft. trimaran *Galliard* using a 5-ft. diameter sea anchor off the stern in Force 9-10 conditions. At one point it collapsed and had to be reeled in for a sorting out.

In File D/C-9 we find the 44' catamaran *Anna Kay* using a 9-ft. diameter sea anchor off the stern in Force 12 conditions in the Gulf of Tehuantepec. Captain Fred Yeates:

> *The sea anchor was getting rolled by the steep, confused waves, from the left, then from the right. Later, as I was watching, it got caught by two cross-seas and collapsed right before my eyes.*

Granted, the conditions in the Gulf of Tehuantepec were atrocious - relatively shallow water, currents, conflicting wave patterns, etc. But so were the conditions off the Queensland Coast during cyclone Justin,

where we find the 55-ft. ketch *ORCA* tethered to a much larger para-anchor. *ORCA*'s 24-ft. diameter Para-Tech sea anchor did not give any indication that it was being rolled about and/or collapsing. Maggi Ansell, File S/M-34:

> *It was like the water was boiling... it didn't have a pattern to the swell. It just hit us from all sides.... The force of the water on the anchor line made the line like a steel rod, and one could never have got any slack to be able to replace a chafe guard.*

In File D/C-3 we find a 34-ft. Prout catamaran, *Sundsvalla*, using a 9-ft. BUORD parachute in Force 9 conditions near the Bay of Biscay. A breaking wave threw the parachute and tangled it around itself. Thomas W. Kintz:

> *Finally, a breaking wave caught the drogue and tangled it around itself. We left it deployed, but effectively lay a-hull all night and into the next day. Took several breaking waves over the boat - not recommended!*

Granted, some of these problem cases involve sea anchors being used *off the stern*. Yes, this does complicate the overall analysis - these vessels may have been bungee jumping.

The files do nevertheless make us aware of the stability limitations of smaller para-anchors. In File S/T-19 we are stunned into silence by the possibility that a 24-ft. diameter Para-Tech sea anchor (the biggest one Para-Tech makes for small craft) might have been picked up and thrown by a great rogue wave coming in at an angle.

Whether this was in fact the case, or whether it was just the 55-ft. trimaran herself being picked up and thrown sideways on the surface of the sea is not known - turn to the diagram in the middle of File S/T-19 and try to guess for yourself.

The fact is that the line went temporarily slack, allowing the yacht to fall out of alignment and come beam to the seas. Although we have no way of knowing exactly what may have happened, whether the big parachute actually lost its footing, and if so, whether it was in the process of momentarily recovering and restoring system tension, the incident does provide food for thought - some of the stacking waves in the Queen's Birthday Storm were reputed to be 80 feet high. All of which drives home the point about erring on the large side when selecting a sea anchor diameter.

Perhaps the key variable in the Casanovas' unblemished 18-year success formula was the large diameter of the parachute they were using. Joan Casanova on *Tortuga Too*, tethered to a 28-ft. diameter C-9 parachute in Force 11-12 conditions (File S/T-1):

> *It was the type of a wave which pitchpoles yachts in these oceans, the type which every voyager*

> *sailing in the high latitudes of the Southern Ocean fears. While we watched, horrified, this monster welled up for a second time, curling over as if breaking on a beach, then roaring in foamy masses on top of* Tortuga Too.... *We were so shaken by this experience that it seemed an eternity before we regained our composure to check the boat's condition, but she was all right. In fact,* Tortuga Too *recovered faster than we. There was no structural damage. She had returned to her original position of facing the storm and was already climbing the next wave....*

Rudder Concerns

By anchoring a yacht to the surface of the ocean, large parachutes reduce the strains on the rudder and its fittings, though these had better be heavy duty as well. Joan Casanova again (File S/T-1):

> *Although* Tortuga Too *survived this mammoth wave crashing on her deck, there was no backing down on her rudder, nor any structural damage to the hulls.*

In file S/C-5 we find the 50-ft. catamaran *Sebago* attempting to use a 4-ft. diameter sea anchor off the bow in Force 9 without much success. The cat would drag it round until she was almost lying a-hull. When she was momentarily head-to the seas *Sebago* would likely have been drifting down on her rudders as well.

In sharp contrast, in file S/C-6 we find the 43-ft. catamaran *Ariel* using an 18-ft. diameter para-anchor in Force 9 conditions without any problems. The bows remained adequately snubbed into the seas and there were no undue strains on the rudders.

In file S/C-7 we find the 35-ft. catamaran *Marney* trying to use a 9-ft. diameter porous BUORD parachute in Force 7-8. Roger Ayers:

> *The sea anchor was deployed from the bows, but allowed too much leeward drift (estimated 2-3 knots), and also allowed us to fall back off the steep, short seas, which had built up in the southerly current. I think that falling back off a larger 15 ft. wave at an angle, we broke both tillers. Note that a catamaran with two large transom-hung rudders, when backing into a trough and burying the sterns, exposes two blades, and two sets of cheeks to the force of the water, approximately 4 times the area of a typical trimaran spade rudder. It is therefore essential that this type of boat (like a Wharram) make no sternway, else use the sea anchor off the stern.... We now have a 24' diameter parachute for use off the bow.*

In contrast, in File S/C-3 we find the 37-ft. catamaran *Rhayader* using a 12-ft. diameter - zero-porosity - Para-Tech sea anchor in Force 9 without complaint. The twin bows stayed adequately snubbed into the seas and there were no undue strains on the rudders and steering assembly.

When modern, purpose-made sea anchors first surfaced there was a concern about rudder vulnerability. It was thought that sea-anchored boats would "drift-down" in storms and break off their rudders. It hasn't turned out that way. Going by accurate drift figures obtained from GPS readings there really isn't much "drifting down" to speak of. It turns out that being tethered to a big parachute is much like being anchored to a Danforth.

Not that rudders aren't vulnerable in storms. Assuredly they are, as is everything else. A moving part like a rudder is vulnerable in a storm regardless of whether the vessel is anchored to the seabed, or anchored to the sea's surface, or lying a-hull, or hove-to, or running off.

Remember, rudder breakage was a common problem among the yachts that elected to run off during Fastnet '79, several rudders in fact "exploding" outright - see second plate in the photographs appearing after page 232 of *Fastnet Force 10* by John Rousmaniere.

There are a few cases of rudder and/or rudder fitting failure among the sea anchor files. We find most of these clustered among the multihull files, perhaps indicating a weakness in rudder construction, especially where the "home-built" multihulls are concerned, rather than a systemic flaw relating to the strategy of sea anchoring.

In File S/T-19, for example, we find the 55-ft. Piver trimaran, *Surrender*, being possibly picked up and thrown sideways by a great rogue wave. The 2-inch bronze rudder shaft snapped below the quadrant, the owner reporting that it "appeared to have twisted like a piece of plastic almost 90 degrees before breaking." A heavier - stainless steel - rudder shaft might have been called for here. At any rate, the rudder didn't break off where the shaft enters the hull. A moot point because if this boat been lying a-hull without a sea anchor she may very well have been capsized by the rogue wave. Had she been running off, she may very well have been pitchpoled. So the breakage of the shaft below the quadrant and the temporary loss of steering would seem to be more than offset by the fact that the boat remained upright and was sailed thousands of miles back home.

In File S/T-15 we find the 42-ft. trimaran *Gold Eagle* having rudder problems while tethered to an 18-ft. diameter Para-Tech sea anchor in an unnamed hurricane in the Gulf of Mexico. According to Andrew Cserny the anchor points for the cables on the rudder quadrant were secured to a sheet of 3/4" plywood by four 1/4" stainless machine screws. The whole attachment point just literally ripped out a 2" x 4" rectangle of the 3/4" plywood and rendered the steering useless. Andrew Cserny:

> *When I lifted the hatch covering the steering compartment, I saw that the Morse cables attached to the steering quadrant had ripped loose from the wooden supports that were used to anchor them, and the steering quadrant was swinging wildly about. We secured the steering quadrant with lines 5/8 inch and 3/4 inch diameter, two of these lines on each side of the quadrant. Within half an hour these had chafed completely through....*

Later on during the night *Gold Eagle* was hit by a genuine breaking and/or rogue wave, throwing Andrew Cserny violently across the pilot house. One might have expected the rudder to have snapped right off where the shaft enters the hull. But it didn't. Cserny was able to restore steering later on:

> *Fortunately I had numerous tools on board, as well as a good assortment of fasteners, and by cutting up some of the floor boards, and after hours and hours of jury rigging, we were able to effect a workable repair of the steering quadrant.*

In file S/C-6B we find the catamaran *Ariel* hove to a 18-ft. Para-Tech sea anchor in a storm in the North Pacific. The tether was too short and could not absorb the force of a breaking wave. This resulted in one leg of the bridle snapping and *Ariel* being thrown back against her rudders. Josh Tofield:

> *Later one leg of the 5/8" bridle SNAPPED in the center when hit with very large wave, throwing* Ariel *backward, shearing the foam & fiberglass off of one rudder completely, and leaving only half of the other rudder (which later broke off).*

In file S/M-38 we find the 46-ft. Tayana, *Prisana II*, tethered to an 18-ft. diameter para-anchor in 65-80 knot winds off Western Australia. The same storm system produced a tornado with 200 kph winds, cutting a 2-mile swath of destruction through Perth, taking roofs off houses and uprooting trees. Again one might have expected the rudder to snap off where the shaft first enters the hull. It didn't. Deborah Schutz:

> *The rudder was lashed to center at the quadrant, which broke twice - 6mm pre-stretched cord broke first, then 16mm nylon braid also didn't hold. We managed to make it hold on 18mm nylon anchor rode. Small twist, 10-15° in 2-inch 316 stainless steel rudder shaft at the point where quadrant is fixed.*

When asked whether the para-anchor saved the boat Deborah Schutz answered without hesitation: "Absolutely!!!"

Rudders are replaceable. Lives are not. Besides, looking at the DDDB from a statistician's dispassionate point of view, rudder failure does not appear to be a problem pattern where sea anchors are sufficiently large and where the rudders themselves - stock, shaft, post, quadrant, fittings, cables, etc. - are of adequate design and construction. And it goes without saying that they had better be, otherwise they may fall apart in the course of ordinary passage making, as with *Snow Dragon* (File S/M-32) and *Rose Marie* (File S/C-13).

Transom-hung and keel-hung rudders should have *three* connection points - heavy duty ones. Tillers should be tied with heavy shock cord (layered bungee) to absorb some of the stresses. Ditto quadrants on wheel systems - just locking the steering wheel may not be enough.

Note that the weak point seems to be where the shaft meets the quadrant. This union must be precisely machined - toothed or keyed - with no slack or play. For long term cruising safety, install rudder stops - or rope - to limit rudder travel, as the Pardeys recommend in *Storm Tactics* (page 32). Without stops the rudder can fold against the transom and may very well snap off if the boat is driven backwards.

Drift Control

When it comes to reducing unwanted drift, the most cursory glance at some of the files will prove eye opening. Most of the figures relating to drift were derived from LORAN and GPS readings and are quite reliable. In file S/M-9 the owner of *Bounty Hunter* reported that she drifted 11 n.m. in 14 hours (Force 8 conditions). Without her sea anchor (9-ft. BUORD) the Hunter 40 (high freeboard, big mast, fin keel) would have probably drifted at 3 knots broadsides, or a distance of 42 n.m. That's a reduction of 74%, even with the relatively smaller, porous para-anchor.

The Pardeys have consistently reported their rate of drift to be about 5/8 knot, using the same para-anchor (BUORD) in conjunction with a storm trysail. In file S/M-6 the owner of the J-30 said: "We made about 0.5-0.7 knots sternway, checked by the Loran. It went to 4-5 knots when it [9-ft. diameter BUORD] twisted shut." This was in Force 11 conditions.

In File S/M-16 the 31-ft. Cape George Cutter *Halo* ran into a southerly gale about 100 miles northwest of San Francisco. Her owner beat into the gale for a while and then decided to deploy a 12-ft. diameter Para-Tech. *Halo* was sea-anchored for 20 hours, drifting only 6 miles - less than 0.4 knots.

In File S/M-22 the Bristol Channel Cutter *Xiphias* was tethered to a 12-ft. diameter para-anchor in cyclone *Tia* off the Queensland Coast, drifting about 5 miles in three days, likely in and out of a current.

In File S/M-27 the Contessa 26, *Mai Miti Vavau* was tethered to a 12-ft. diameter Para-Tech in 50-knot winds off the African coast for 24 hours, drifting only 3 miles.

In File S/M-31 the Bermudan Sloop *Lady Emma Hamilton* was tethered to an 18-ft. diameter Para-Tech sea anchor in 40-45 knots near oil platforms in the North Sea, drifting about 7 miles in 23 hours.

In File S/M-34 the 55-ft. ketch, *ORCA* was tethered to a 24-ft. diameter Para-Tech in cyclone Justin for 53 hours near Australia's Great Barrier Reef. "Without the sea anchor, they would have found us on the reef," said Robin Ansell.

In File S/M-35 we find Robert Bragan and son repeatedly heaving to the sea anchor to hang on to precious ground with the wind on the nose.

In File S/M-38 we find the 46-ft. Tayana *Prisana II* tethered to an 18-ft. diameter para-anchor for 59

hours in 65-80-knot winds off the western coast of Australia, the wind blowing from the northwest. Without the sea anchor the big, fin-keeled yacht would have likely drifted at 3 knots broadsides - 177 miles, putting her up on the beach. *Prisana II*'s remaining option would have been to turn and run back, losing in a few hours the miles she had suffered days to gain.

Drift control is of major concern when it comes to lightweight, high-windage, shallow-draft multihulls. In File S/T-1 Joan Casanova reported, "in all times anchored, only once drifted 15 miles in three days..."

The three days in question were spent tethered to a 28-ft. diameter C-9 en route to the Falklands from Cape Horn, with the anemometer pegged at 100 mph. Without her 28-ft. diameter para-anchor the 39-ft. Horstman Tristar would have probably drifted broadsides 3-4 knots, or a distance of 216-288 miles in 72 hours. That's a reduction of 93-95 percent in unwanted drift.

In file S/T-6 the trimaran *Goodspeed*, waiting for daylight to enter the harbor of Beaufort, North Carolina, drifted about 3 miles during 10 hours at para-anchor (12-ft. diameter) in 20-25 knots of wind. Without the sea anchor she would have probably drifted at 2 knots, a distance of 20 miles. That's a reduction of 85 percent in unwanted drift.

In File S/T-4 the trimaran *Crystal Catfish IV* drifted a maximum of 2 miles during 12 hours at para-anchor (18-ft. diameter). Without the sea anchor she would have probably drifted at 3 knots, a distance of about 40 miles in 12 hours. That's a reduction of 94 percent in unwanted drift.

In File S/C-2 the catamaran *King Kat* lay to a 24-ft. parachute from midnight till daybreak outside the rockbound harbor at Flores Island (Azores). Her owner said: "Checked position with beacons. Don't think we drifted a foot in 8 hours."

In File S/T-8 we find the trimaran *Gold Eagle* fifteen miles off the coast of Costa Rica, using an 18-ft. diameter Para-Tech sea anchor to stand off a lee shore in 45-60 knot winds. The owner said: "I was concerned we'd be blown to shore, but over the 5 hour period I took bearings from three shore lights... with no noticeable drift."

In File S/C-3 the catamaran *Rhayader* drifted 12 miles in 66 hours at para-anchor (12-ft. diameter). Without the sea anchor she would have probably drifted at 3 knots, a distance of about 198 miles - over dangerous shoals. That's a reduction of 94 percent in unwanted drift.

Commercial fishermen need to stay on top of the fishing grounds. In file S/P-2 the F/V *Holly & Michael* drifted 15 miles during 24 hours at sea anchor (28-ft. diameter parachute). Without the sea anchor she would probably have drifted about 3-4 knots broadside, a distance of about 72-96 miles, or a reduction of 79-84 percent in drift.

In file S/P-4 the F/V *Captain Gorman III* drifted about 9 miles during 48 hours at para-anchor (24-ft. diameter). Without the sea anchor she too would probably have drifted about 3-4 knots broadside, a distance of about 144-192 miles, or a reduction of 94-95 percent in drift.

In file S/P-5 the F/V *Ashly G* drifted 4-5 miles during 24 hours at para-anchor (24-ft. diameter). Without the sea anchor she would have drifted at 3-4 knots broadside, a distance of about 72-96 miles. A reduction

of 94-95 percent in unwanted drift.

These numbers tell us that, currents notwithstanding, large parachute sea anchors are like "portable moorings." They are worth their weight in gold when the chips are down and there is a lee shore involved.

File S/C-6A is the classic example. The 43-ft. catamaran *Ariel* was off the Mexican coast. The wind was blowing Force 9 and three rocky islands, *Islas Tres Marias*, were to her immediate lee. These islands are Mexican prison colonies. Pleasure craft venturing too close have been known to be approached and sometimes rammed by Mexican gun boats.

Ariel's owner deployed an 18-ft. diameter Para-Tech sea anchor, which kept her "anchored" for 20 hours. Apprehensive about those islands to leeward, he kept a close eye on the GPS readings. How much did the boat drift in those 20 hours? *Only 2 nautical miles!* That's 0.1 knots, or about 600 feet per hour - the length of two football fields. This translates into *positive control* over a wide range of marginal situations. Without her seaborn parachute, the shallow draft, high windage catamaran would have probably drifted broadside at 3-4 knots.

Aside from the prospects of having to beat into 15-18' head seas, her remaining option would have been to run. *Ariel*, with owner, wife and two small children on board, would have had to turn and run off, getting blown all the way back to Cabo San Lucas, whence she departed several days before.

Pitch and Roll

The ride at sea anchor can be quite uncomfortable, especially where monohulls are concerned. There is pitch and roll, bucking and hobby horsing, as when conventionally anchored in an exposed roadstead. BJ Caldwell, Contessa 26 in Force 9-10 (File S/M-27):

> *I wouldn't say the ride* [at sea anchor] *was comfortable. It was like a rodeo or a roadstead anchorage with no barrier to the fetch.*

R. Walton, Gauntlet Bermudan Sloop, Force 8 (File S/M-31):

> *Boat motion was quite extreme, with gunnel to gunnel roll being set up, then dying down again every few minutes.*

One should not confuse comfort with safety however. Lying a-hull, for example, can be very comfortable, giving a false sense of security, even though it is known to be a formula for disaster in storms. Case in point, File S/M-39. With the sea anchor deployed the ride aboard *Karoro* was uncomfortable throughout

the night. Ann Wilson:

> *Jim played out the warp and then the chain, and slowly we swung around into the waves.... The gentle hove-to movement had changed to a jerky sideways rock, but now we were parting the waves with the bow and not taking them every which way.*

The ride became deceptively comfortable when the sea anchor was lost and *Karoro* came beam to the seas. But that was when she came to grief. Ann Wilson again:

> *Saturday morning, June 22, suddenly Guy said "We're going backwards." Jim saw the loose chain out of the front hatch and said, "My God I think we've lost the sea anchor...." Jim raced about... "It's OK," said Guy, "it's a much nicer motion now"* [the vessel now lying a-hull].... *Jim lashed the tiller to one side and we lay a-hull with no sails. The motion was certainly more comfortable.... It was mid-afternoon when we were knocked down. There was no warning. No roar as the rogue wave approached us. It was deceptively quiet.... It seemed like slow motion as I rolled out and hit the table, breaking it off the wall. Then the sound of rushing water. I looked up and saw a waterfall pouring through the gap in the companionway.*

Where pitch and roll are major concerns, the Pardey method is the antidote, and the transition to peace and quiet can be dramatic. Imagine motoring into the seas on a windy day, the yacht pitching up and down, rolling and bucking. You hoist the sails and turn off the motor. The bow falls off, the sails fill, the yacht heels, and everything quiets down.

The transition before and after heaving-to is quite similar. Once the trysail fills and the yacht heels everything quiets down. Everyone who has used the Pardey method will readily confirm that it is the most comfortable way to ride out gales. A reminder once again that the yacht must be properly hove-to, in the manner described by Lin and Larry Pardey in *Storm Tactics*. Go out on a windy day and practice heaving-to with sails until you can do it in your sleep. Then practice heaving-to with your sails and the sea anchor.

Wind Alignment: Side-to-Side Yaw

Presently there are 92 sea anchor files in the DDDB. Of these, 40 are monohulls, 42 multihulls and 9 commercial fishing vessels and other powerboats. If the boats were all the same, the sea state was always the same and all the deployments were experimentally controlled, one could begin extracting patterns. Unfortunately they are not.

Extracting patterns from the behavior of so many different boats in so many different sea states - what the scientist would call "multivariate data" - is difficult. But a skilled statistician would try nevertheless,

proceeding cautiously, on the premise that one case history can no more prove a generality than a single swallow can make a summer.

While sea state tolerance - the ability of a boat and its crew to survive heavy weather - is a function of many complex things, if we can for one moment plot it as a function of alignment, we may be able to infer patterns from yaw angles. Alignment has an inverse relationship with side to side yaw. The greater the alignment, the smaller the angle of yaw and vice versa.

Ordinarily the bow tries to fall off the wind. It can only fall so far before it comes up short against the rode, which tightens up and pulls it back into the wind. Theoretically, the sum of the force of the wind on the yacht can be thought of as being exerted against the CE or *center of effort* - the imaginary point through which all wind forces tend to act on a boat.

The wind force is opposed by the resistance of the hull in the water. Theoretically, the sum of the hull's resistance can be thought of as being exerted against the CLR or *center of lateral resistance* - the geometric center of everything below the water line. The distance between the CE and the CLR provides the basic yaw lever.

The pictures below show two extremes.

CE (center of effort) well forward of the CLR (center of lateral resistance) produces a long, positive yaw lever. This vessel will yaw a great deal at anchor

CE to the rear of the CLR produces a short, negative yaw lever. This vessel should yaw very little at anchor.

If the CE is well forward of the CLR, as with the cat-rigged vessel shown in the upper image, the yaw lever can be said to be *positive*, resulting in a great deal of side to side yaw at anchor.

If the CE is well to the rear of the CLR, as with a schooner shown in the lower image, the yaw lever can be said to be *negative*, resulting in very little side to side yaw at anchor.

Most of the monohulls cataloged in this publication have yaw levers that are *positive* - CE forward of the CLR. Depending on the rig, keel type and position of the CLR, some of the yaw levers are long, some short, resulting in varying degrees of side to side yaw.

Logically that's what one is looking at in the tables shown on the next page. These tables aim at encouraging the reader to extract his or her own truths from the DDDB. For reference purposes, note that data is given in the same order as the files themselves.

Yaw data for sea anchors used off the bow

MONOHULLS

LOA	Keel	Rig	Wind	Diam	Yaw
32'	Long	3-mast	40-50	1.8'	???
40'	Full	Yawl	40-60	24'	10°
24'	Full	Cutter	40-70	9'	15-20°
30'	Full	Cutter	60	12	(PB)
75'	Full	Schooner 60	28'	10°	
30'	Fin	Sloop	60	9'	10°
32'	Full/CF	Cutter	35-40	9'	40-90°
27'	Full/CF	Cutter	35	9'	40-90°
40'	Fin	Sloop	40-50	9'	20-30°
40'	Full	Yawl	35-40	12'	10°
22'	Fin	Sloop	20	12'	10°
33'	Fin	Sloop	35-45	12'	30°
26'	Full	Cutter	40	9'	(PB)
24'	Full	Sloop	35	9'	40-80°
42'	Full/CF	Ketch	35	12'	45°
31'	Full	Cutter	35-40	12'	40-90°
34'	LA Fin	Cutter	40-45	12'	10°
34'	LA Fin	Cutter	40-50	15'	10°
30'	Fin	Sloop	40-45	9'	20°
49'	LA Fin	Ketch	50-60	18'	10°
51'	Full	Yawl	40-50	24'	15°
26'	Full	Cutter	60	12'	45°
42'	Full/CF	Cutter	40-45	18'	20°
39'	Full	Ketch(M)	65-75	7'	15-20°?
40'	LA Fin	Cutter	55-70	28'	10-20°
27'	Full	Sloop	35-45	9'	30-45°
26'	Full	Cutter	50	12'	30°
35'	LA Fin	Sloop	30-40	15'	30°
36'	LA Fin	Sloop	45-50	15'	20°
46'	LA Fin	Ketch(M)	40-50	24'	10°
42'	Full	Sloop	40-45	18'	20°
31'	Fin	Sloop	45	15'	30°
38'	Full	Ketch(M)	20	15'	10°

55'	Full	Ketch	65-85	24'	25°
40'	Fin	Sloop(R)	30-40	12'	30°
29'	LA Fin	Sloop	35-45	12'	30°?
42'	LA Fin	Cutter	35-45	18'	20°
46'	Fin	Ketch	65-80	18'	20-30°
30'	LA Fin	Cutter	50	12'	20°
45'	Full/CF	Ketch(M)	40-50	18'	10°

PB Pardey bridle - held vessel 50° to wind

CF Cutaway forefoot

LA Low aspect (fin keel)

M Mizzen flown as riding sail

R Riding sail flown on backstay

MULTIHULLS (Trimarans)

LOA	Beam	Rig	Wind	Diam	Yaw
39'	22'	Ketch	80+	28'	20°
31'	18'	Sloop	50-60	20'	20°
50'	27'	Ketch	50	28'	20°
40'	28'	Sloop	40	18'	10°
30'	25'	Cutter	45-50	5'	10°
30'	18'	Sloop	25	12'	10°
41'	26'	Sloop	40-60	24'	10°
42'	23'	Ketch	45-60	18'	10°
40'	28'	Sloop	50	18'	45° (NB)
31'	18'	Cutter	30-40	12'	10°
43'	27'	Sloop	40-50	18'	10°
34'	21'	Cutter	35-40	15'	10°
37'	22'	Cutter	40	18'	10°
46'	25'	Ketch	25-35	24'	10°
42'	23'	Ketch	80+	18'	10°
35'	24'	Sloop	35-45	24'	10°
34'	24'	Sloop	55-70	28'	10°
40'	24'	Cutter	50-60	28'	10°
55'	25'	Ketch	70-80	24'	10° (90°RW)
40'	24'	Ketch	35-50	24'	10°
27'	19'	Sloop	40	12'	30° (NB)

MULTIHULLS (Catamarans)

LOA	Beam	Rig	Wind	Diam	Yaw
65'	30'	Cutter	40	28'	5°
30'	14'	Sloop	35-40	24'	10°
37'	16'	Cutter(A)	35/60	12'	10°
40'	20'	Sloop	30	12'	??
50'	30'	Sloop	40-50	4'	45-60°
43'	25'	Sloop	45-60	18'	10°
43'	25'	Sloop	50-55	18'	10°
35'	17'	Ketch	35-45	9'	30°
36'	20'	Cutter	70	18'	10°
36'	17'	Cutter	35-45	24'	10°
29'	16'	Sloop	40	12'	10°
39'	18'	Cutter(A)	45-50	18'	20°-30°
65'	30'	Ketch(M)	55-60	24'	20° (NB)
35'	29'	Sloop	40-50	15'	10°
40'	24'	Cutter	70	18'	??
40'	26'	Cutter	45-58	16'	20°
36'	18'	Sloop	45-55	12'	30°
34'	22'	AeroRig	40	18'	20°
44'	23'	Sloop	80+	18'	Capsized
49'	24'	Cutter	40-45	15'	10°

NB No bridle used

RW Struck by rogue wave

A Single mast stepped aft (Prout)

Let the reader who is a statistician try to extract patterns from these tables. Not an easy task! If we had 1000 files the job would be a lot easier. All the same, we can see some rather obvious patterns relating to *classes* of vessels.

Note, for example, the obvious differences between monohull and multihull yaw angles. The wide beam of a multihull allows the use of a restraining bridle, reducing side to side yaw. One might say that a multihull's beam lever nulls out its yaw lever. Note the greater yaw angles of the multihulls that did not use bridles. One can see the correlation between sea anchor diameter and yaw angle quite clearly among the multihull files as well - find the largest bridled yaw angle and note the diameter of the sea anchor being used.

Looking at the monohull table we see that by and large the yawls - and the one schooner - behaved well at sea anchor, some even competing with the multihulls by yawing as little as 10° off to each side. We can see a faint correlation between amount of wind and yaw angle - the pressure of the wind against the mast, rigging and hull tends to push the yacht away from the sea anchor, taking up the slack and reducing side to side yaw. The largest yaw angles seem to associate themselves with lower wind speeds. This observation is backed up by the testimony of the Pardeys in File S/M-3:

> *We do not feel para-anchors should always be used with a riding sail or bridle. The riding sail only provides extra comfort for the crew. The parachute anchor* [with no bridle] *did hold* Seraffyn *almost directly head to sea. The tacking through the eye of the wind mentioned in our first book was just a nuisance, not a danger. The boat never fell more than 15 or 20 degrees away from the wind, i.e. she never lay even close to beam on, but only swung a few degrees either side of head-to-wind when the parachute anchor was lead directly off the bow, with or without a riding sail....* ***If there was a lot of wind, the para-anchor held her pretty close to head to wind.*** (Emphasis added).

And the testimony of R. Walton on *Lady Emma Hamilton*, Force 8 in the North Sea (File S/M-31):

> *Once wind moderated the yaw increased, but at the peak of the wind boat held almost dead into wind.*

There are many unknowns in these tables. For one thing the positions of the CE and the CLR are in reality quite fluid - attitude dependent. The position of the CLR changes constantly as waves pass under the boat. When the bow is lifting over a crest and the stern is submerged the CLR moves aft. When the bow is immersed in a trough and the stern is out of the water the CLR moves forward. One can infer a relationship between pitch and yaw from this - more pitch equals more yaw - and roll - everything else being equal.

This, in turn, would lead to an additional inference about the relationship between hull shape and yaw angle. Victor Shane has long suspected that fore and aft buoyancy has something to do with behavior at anchor - a long box would pitch a great deal more than a bowl. A design that places a great deal of buoyancy fore and aft - some of the modern boats - would be more susceptible to pitch-induced yaw than a design that does not, say one of Bill Garden's classic designs with a narrow bow section and counter astern. Perhaps one can infer something about the value of canoe sterns from all this.

There are other unknowns, the most complex of which involves orbital rotation. Going by the generalization, "slack is bad, tension is good," one can see orbital convergence producing slack in the rode, which would then allow the bow to fall off the wind.

In 15-ft. seas, for example, the orbital diameter is also 15 feet. If the boat and the sea anchor are out of

synch on the wave trains - the boat in a trough and the sea anchor on a crest - they will converge. The boat will move towards the sea anchor 15 feet and the sea anchor will move towards the boat 15 feet. This will, momentarily, produce 30 feet of slack - the bow will fall off and the yacht may briefly come beam-to the seas. Looking at the above tables, one can only wonder as to how much of the yaw angles were produced by orbital rotation, irrespective of rig type, keel type, wind force or sea anchor diameter.

File S/M-16, for example, has the authors puzzled. Here we have a 31-ft., full-keeled cutter, *Halo*, using a 12-ft. diameter Para-Tech sea anchor in 35-40 knots of wind and 14-ft. seas. By all tokens the sea anchor was large enough, and yet the yacht was yawing up to 90° - briefly lying a-hull now and then.

Victor Shane asked her owner, Steve Lockwood, the usual questions. Was there something different about this particular Cape George Cutter? The answer was no. Did she have a big, heavy inboard engine, or a great deal of weight situated aft? The answer was no. Did she have a great deal of windage up front - heavy roller furling gear? No, the sails are hanked on.

So then why did the boat yaw so much? Shane strongly suspects that there just wasn't enough wind. The sea anchor was deployed on 300' x 1/2" nylon three strand rode along with 50' x 5/16" chain. Perhaps the yacht and the sea anchor were out of synch on the wave trains. Perhaps a little adjustment in rode length might have reduced the yaw angle.

Maybe, in lesser winds - when it is safer to go on deck - rode adjustment is advisable, especially if the bow is falling 90° off the wind now and then. The Crealock 34 in File S/M-17, on the other hand, behaved extremely well on the same sea anchor (12-ft. diameter Para-Tech), in 40-45 knot winds. *N'ISKU* seemed to be quite happy, yawing no more than 10° off to each side. Sandy and Les Bailey:

> *We did not observe surge or shock loads on the rode. The boat always seemed to head into the wind and seas at the same angle (<10°) and did not sail about at anchor. The entire system worked perfectly, probably because of a) the length of the rode, b) the catenary induced by the chain in the middle of the rode, and c) the boat and anchor were in crests and troughs in synchrony.*

Victor Shane suspects some inherent virtue in the Crealock design - the canoe stern, the shape of the keel, the relative positions of the CLR and the CE, etc. Note that the Crealock in the very next file, S/M-18, also behaved very well, even though no chain was used, and her skipper says nothing about synchronizing the boat and the sea anchor on the wave trains.

Fancy Free II deployed a 15-ft. diameter Para-Tech on 300' x 1" nylon three strand. Were boat and sea anchor accidentally synchronized in crests and troughs? Is this why she was yawing only 10° off to each side? Unknown. If fifty Crealocks and fifty Cape George Cutters had used identical para-anchors in the Queen's Birthday Storm answers would have been forthcoming. For now we have to make do with probabilities.

There are other complications. Much like the wing of an aircraft, the curvature of the hull itself will

sometimes produce lift, causing the yacht to sail forward and creating slack in the rode. Add high freeboard at the bow, roller furling, a pilot house, a big cockpit dodger, a radar arch, etc. and the picture becomes complex indeed.

Going by generalities and the law of averages, the cause does seem to be rooted in the concept of the *yaw lever* described above. Thus one should be able to reduce yaw by reducing the yaw lever. How does one reduce the yaw lever? By stepping the mast aft? By making major modifications to the hull, and/or installing daggerboards well forward?

Fortunately there are simpler ways. Going by the premise, "slack is bad, tension is good," one could start the engine and place it in slow reverse, for example. This would pull the boat away from the sea anchor, take up slack and reduce side to side yaw. The method really works (try it at regular anchor and see for yourself). It is one option, providing the engine/s are up to the task and the fuel tanks are clean. If the fuel tanks are dirty the agitated motion of the yacht in a storm will place the sediments in suspension and clog up the fuel lines.

The most logical way of reducing side to side yaw, however, would be to invest in a good riding sail. Any riding sail flown on the backstay will instantly move the CE closer to the CLR, reducing the yaw lever. In the above table, note the differences between the yaw angles of the ketches that flew mizzens (look for the letter "M" after "Ketch") and those that didn't.

In particular note that one catamaran ketch did not use a bridle, but flew a mizzen instead, yawing no more than 20° off to each side. On the surface this would seem to be telling us that riding sails can do for monohulls what bridles are doing for multihulls. Every boat that has ever flown a riding sail astern has been able to improve its behavior at anchor.

Can one fly a small riding sail in a full blown storm? Yes, but only if it is especially made for the purpose - heavy cloth, triple-stitched construction, no belly, no roach, adequate leech and foot lines, etc. An ordinary sail will flog itself into ribbons in 50 knots. A small, heavy, flat, vane-type storm sail shouldn't. The Pardeys provide useful guidelines about the construction and use of riding sails in *Storm Tactics*, having used such sails themselves in high winds. Lin and Larry Pardey (by permission):

> *Can you really carry sail in 70 or 80 knots of wind? Although fear of the unknown has kept many people from trying to set sail in extreme winds, properly built and properly sized storm sails with good leech and foot lines will definitely work in these winds.... We ourselves lay hove-to in 89 knots of wind off Cape Palliser (60 miles east of Wellington), using just our 9-ounce triple-stitched Dacron storm trysail, which is about 33% of our mainsail area.*

Breaking Waves

Even with a proper riding sail, wind alignment is a fickle business, especially in large seas when big

waves can block the wind in the troughs. A moot point, because when waves are actually breaking a vessel can only be carried so far before she comes up short against the rode, which should positively yank the bow around.

In File S/M-22 we find the Bristol Channel Cutter *Xiphias* hove to a 12-ft. diameter para-anchor in cyclone Tia, off the Queensland coast. The bow of the yacht was falling about 45° off the wind in the troughs, but being pulled straight on the crests. Roger Olson:

> *I remained below for the better part of three days. I still don't know the strength of the winds as my hand-held indicator wasn't working properly - it was stuck at 60 knots. The boat did tack in this position. In the trough there was little pull on the parachute anchor and the boat would set up to 50° from center. As she neared the crest more tension would be put on the rode, pulling the vessel straight.... With the parachute anchor I never really felt in danger.*

Where real transverse motion of water is concerned, one can perhaps infer something about the behavior of a boat in breaking seas from its behavior in a strong current. There is some similarity between the behavior of a boat that is being pushed away from a sea anchor by a breaking wave and the behavior of a boat that is being pulled into 55-70 knot winds and 24-ft. seas by a strong current. We find just such a remarkable scenario in File S/M-25. Jim & Lyn Foley, using a 28-ft. diameter parachute on the Valiant 40, *Sanctuary*:

> *We deployed the parachute to windward, with no problem, but the line went taut so fast and so tight that we couldn't get the double-lined fire hose chafe gear in place. We tried motoring up on the anchor to relieve pressure - but with 55 knots of wind on the nose, and the parachute in 5 knots of opposing* [Gulf Stream] *current pulling us INTO the wind and waves, we couldn't get the rode to slacken..... The rode was so taut instantly that we could see the 3-strand 5/8" nylon reducing in diameter. It was stretching down to 1/2" or less.... Meanwhile, as we worried about chafe, the para-anchor was working beautifully. The boat rode up the face of the waves, punching through their tops as the huge seas rolled under us. No more green water came on board, no more near knock-downs.*

There is an opposing argument. It has validity and it goes something like this: "OK, so the sea anchor will exert a strong, positive pull on the bow if the boat is hit by a breaking wave. But will it do so quickly enough?"

In books, in magazines, among opinions expressed on the internet, and in Compuserve's *Sailing Forum*, this seems to be the main objection to the use of sea anchors in "ultimate" conditions.

Some sailors argue that the yacht may get struck, capsized and rolled by a breaking wave, in the second or two that it takes for the sea anchor to exert its influence. One can speculate about all sorts of things. A

50-ft. rogue wave coming in at right angles and breaking down its full face right on top of the boat. "Plunging breakers" and "spilling breakers" so violent, so anomalous, so instantaneous as to throw the yacht end over end in spite of any and all drag devices being used. No doubt there *are* such phenomena in creation - tsunamis nearing land, stacking waves in the Queen's Birthday storm, to give two examples.

Yes, there are times when men can do little or nothing to help themselves. Yes, lightning does strike humans. But what should one do? Take up residence in a granite cave?

The circumstances leading to the tragic capsize of the catamaran *Bayete* in File S/C-19 notwithstanding, the dread pattern has yet to show itself in the pages of the DDDB - the best current evidence. Many of the sailors contributing to this publication may have come close, but the *pattern* is not there, given the multitude of heavy weather files.

For example, one might have expected *Prisana II* (File S/M-38) to have come to within a hairsbreadth of being "rolled at sea anchor." But it does not appear that this was the case, her owners being quite certain that the sea anchor actually saved the boat.

How close did *Tortuga Too* come to being capsized between Cape Horn and the Falklands? How close did the Pardeys come to being rolled in the Bay of Bengal? Scientists look for *patterns* in the data. One capsized catamaran does not yield such a pattern, especially in view of the fact that it may have deployed the sea anchor improperly - attaching one arm of the bridle to the middle of the crossbeam instead of to the other bow.

So far we don't find such a pattern in the DDDB, even among the multihull files, where it would be easy to spot. Rick and Linda Kasprzak on the catamaran *Catherine Estelle*, Force 12 in the Gulf of Alaska (File S/C-8):

> *The boat handled very well, but it was unnerving to be held to survival by a thin 5/8" line. Sleep was impossible. The sea anchor definitely saved the boat and I'm sure our lives. It operated flawlessly on those 2 days and the other 3 days during the other 2 gales.*

Andrew Cserny on the trimaran *Gold Eagle*, in a no-name hurricane in the Gulf of Mexico (File S/T-15):

> *I suspect that when the rogue wave hit, the chute was collapsed, because the rogue wave hit us pretty much broadside on the port side of the boat. I suspect that at this time we came close to being capsized, and quite possibly the parachute anchor, even though it was collapsed and allowing us to lie broadside to the waves, probably kept us from going over.... Having observed how the boat reacted to the sea conditions when she was being held by the sea anchor, and comparing the actions of the boat without the sea anchor, there is no doubt in my mind that the sea anchor is the ultimate survival tool in heavy weather offshore.*

Rudolph L. Kirse III on the catamaran *Banana Split* (File S/C-10):

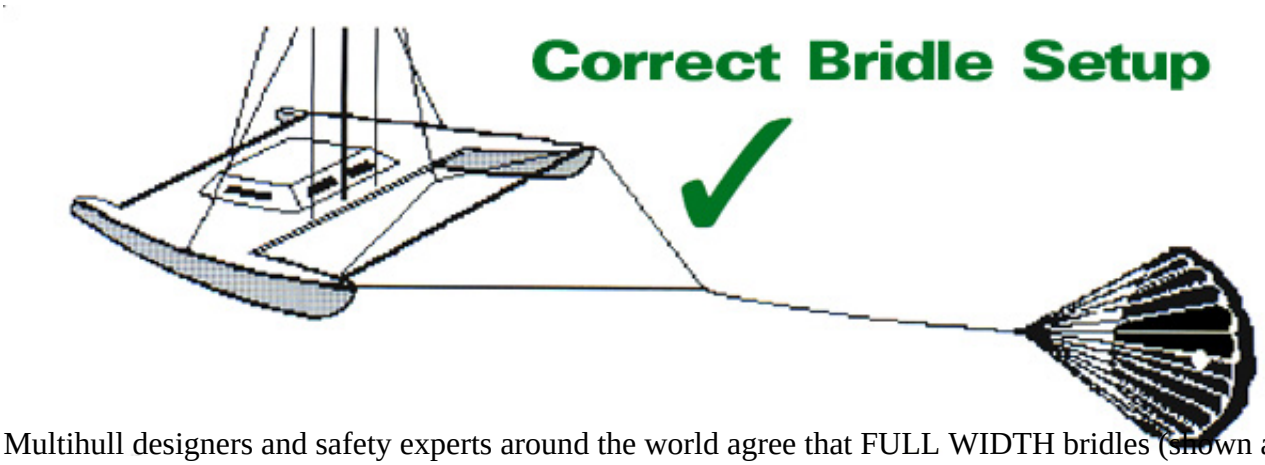
> *Neither I nor the boat would be here without the sea anchor...*

H.L. Andersen on the catamaran *Silver Heels* (File S/C-17):

> *First time I deployed the sea anchor was in a Force 10 storm (BBC Radio 4) 120 miles NW of Cape Finisterre (Spain).... I am convinced it saved the catamaran and me.*

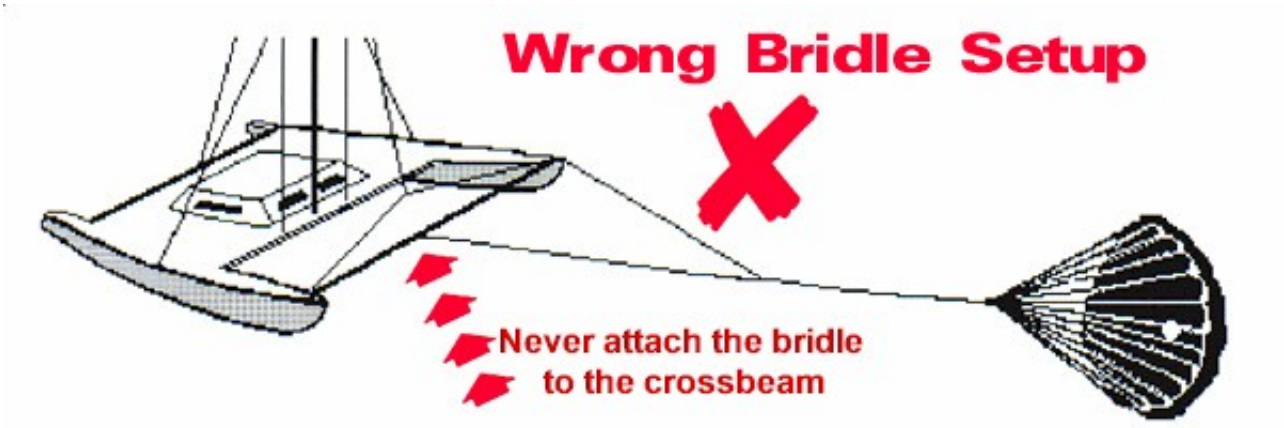
Catamaran Bridle Advisory

CORRECT BRIDLE SETUP



Multihull designers and safety experts around the world agree that FULL WIDTH bridles (shown above) should be used by multihulls for anchoring inshore and offshore in severe conditions. Because this bridle is secured to the extreme outboard tips of the strong hulls themselves it affords maximum leverage and security when it comes to keeping the yacht facing squarely into the seas. Ideally, catamarans should be set up at the factory with heavy duty, well backed up pad-eyes or rollers to accommodate a FULL WIDTH - ordinarily SYMMETRICAL - bridle.

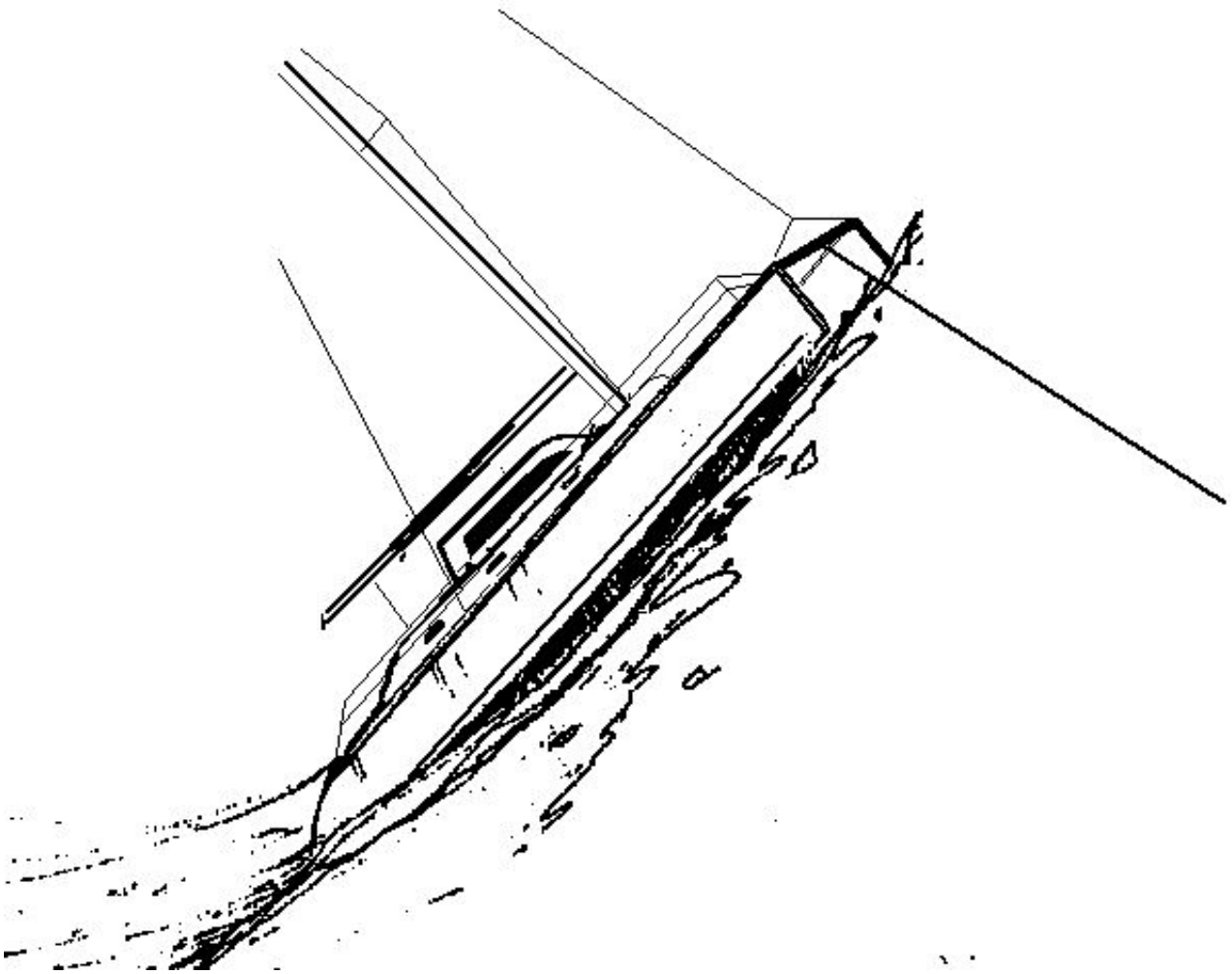
WRONG BRIDLE SETUP



Many modern catamarans have a centrally located anchor roller situated amidships on the weakest part of the boat, i.e., the forward aluminum crossbar that holds the trampoline up. This arrangement may be convenient for casual anchoring in relatively stable conditions, but it is not advisable for storm anchoring. On some catamarans where there is a solid foredeck (notably *Privilege* and *Prout*) the problem is less critical. On other catamarans, however, leading a single line, or even the "half bridle" (shown above) through the center bow roller is not advisable.

The aluminum crossbar that holds up the trampoline is usually far weaker than the mast. It is not uniformly braced like a mast, and many large holes have to be drilled into the middle of it to accommodate the anchor roller, and/or seagull striker. The severe up, down, outward and diagonal forces exerted by the anchor rode onto the middle of this relatively weak aluminum cross member (as the bows

pitch acutely up and down in a storm) can cause it to fail, with serious consequences. At the very least the yacht will no longer face into the seas. In a worst case scenario, failure of the crossbar may lead to the loss of the entire mast and rig and/or capsize. It seems very likely that this was the cause of the capsize and ultimate loss of four lives from Bayette (S/C-19).



Pitch-up attitude showing how an anchor line leading over the bow roller situated in the middle of the relatively weak aluminum cross member may buckle it downward. Note that the strong downward pull of the anchor on the aluminum cross member is being opposed by thousands of pounds of displacement load as the steep wave tries to "lift" the boat horizontally. This sort of scenario might easily be encountered in a storm while at regular anchor inshore, or at para-anchor offshore. Note also: should the aluminum cross member break and the yacht capsize, the anchor line will likely fall between the hulls, perhaps giving the impression that the yacht had pitchpoled backwards.

In setting up your boat, make sure that the attachment points for the bridle as sufficiently strong. Some boats, such as the Robertson &Caine Leopards come with a very strong bracket on the inside aspect of each bow.

Others may need some beefing up. See, for example, the custom built attachment points that Dave Abbott added to his Privilege catamaran Exit Only (scroll down to find the section on Sea Anchor Chainplates).

And note, too, his comment that "Parachutes work extremely well on our catamaran".

Analysis & Lessons Learned: Drogues

The behavior of ships on stormy seas is so hard to understand and so important to be predicted, that it is worth any amount of hard thinking, and painstaking observation, and subtle reasoning we can expend on it. **J. Scott Russell**

We now have 39 drogue files in the DDDB, divided up between a variety of monohulls and multihulls. As of yet the small sample size and the varied data do not allow us to access a specific type of sailboat and render a precise judgment about its behavior and vulnerabilities in storms. On the other hand we are off to a good start when it comes to understanding drogues.

For one thing we now have a clear dichotomy between low-pull drogues like the Galerider and medium-pull drogues like the series drogue; we see the emergence of certain patterns; we can venture educated guesses about the behavior of *classes* of vessels. We can postulate, for example, that the classes of monohulls that don't tend to behave well with a sea anchor off the bow would tend to behave well with a drogue off the stern because the yaw lever is now reversed.

For the same reason, we can postulate that the classes that tend to behave well with their bows pointed into the seas will tend not to behave as well with their sterns pointed into the seas, everything else being equal. All the more reason for the owner of a yawl, a schooner - or a Prout catamaran with the mast stepped aft - to have a drogue as well as a sea anchor on board.

Speed Limiting (Low-Pull) Drogues

In searching the literature for critical insights about excessive speed we find the following in the writings of John Voss:

> *To sum up, I have found that breaking wind waves in the open ocean become dangerous only when the vessel is driven through the water, and the faster she is traveling the more damage a sea is likely to inflict. Pooping seas, i.e., seas breaking over the stern when running, are the worst of all.* (*Venturesome Voyages,* Grafton Books, 1989).

One dare not take Voss's words too lightly because the old sea dog was methodical, learning his lessons the hard way plying the seal trade between Vancouver and Yokohama.

Running full bore in storms may be an option for Volvo round-the-world racers. It is not an option for the mom and pop cruiser. Many decades after Voss wrote these words, we find a similar statement in the DDDB, made by John Abernethy, inventor of the Seabrake. Abernethy also learned his lessons the hard

way in Australia's Bass Strait.

Heaving-to or using a sea anchor was not the right thing for Abernethy because he was always within a stone's throw of safe harbor. In the middle of the Pacific, Voss was constrained to learn the art of heaving-to. Thirty miles offshore, Abernethy was more concerned about finding ways of ducking back into harbor as quickly and as safely as possible. In making his desperate runs back to harbor the prevailing winds - roaring forties - would have been aft of the port beam. The occasional Southerly Buster would have had him running directly downwind. Running before 50-knot winds and 30-ft. seas in the Bass Strait is no picnic. Likely he would have been towing large game fish behind *Papeo* as well, perhaps a great white shark - too big to be carried on deck.

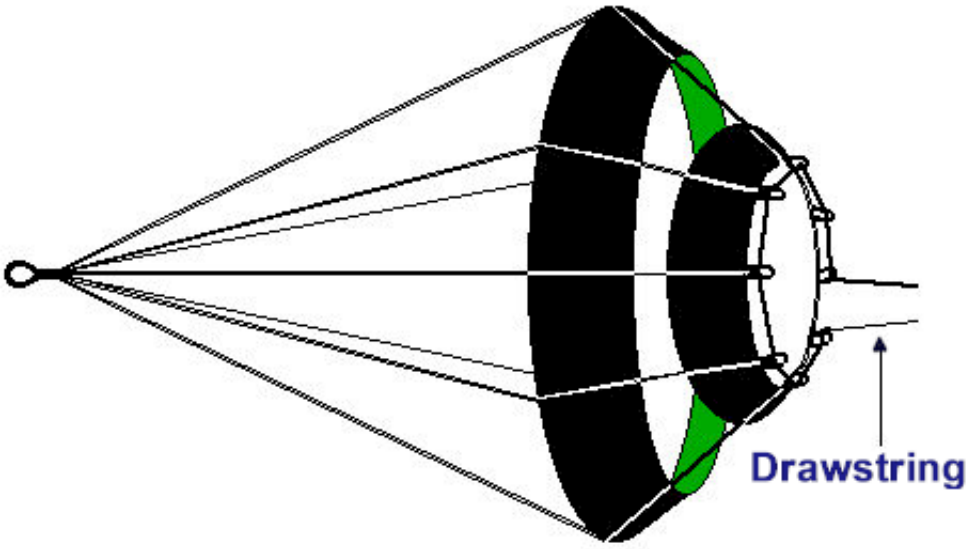
Invention arrived on the wings of serendipity. It took two lines to tow big trophy fish, one leading to a hook in the mouth, another tied around the tail. Abernethy learned that he could vary the drag of the fish by adjusting these two lines. Pulling in on the tail line would increase the drag. Slackening off on it would reduce the drag. In a decade or so of doing this he learned the pitfalls of too much and too little speed. Later on in his life he incorporated that wisdom into the drogues he invented. John Abernethy, (File D/M-10):

> *As a commercial fisherman and charter boat owner based in the most dangerous stretch of Bass Strait, I was routinely operating in heavy seas and often towing large game fish in them. I was frequently involved in Search and Rescue operations as well, towing various types of distressed vessels to safety.*
>
> *Typically, conditions involved combined seas in excess of 20 feet and sustained winds of 30 knots or more. On many outings I have encountered 50 ft. seas and 50 knot winds.*
>
> *The incident that occasioned the birth of Seabrake involved 80 ft. combined seas and winds peaking at 100 m.p.h. There were other factors that contributed to the development of Seabrake. Contact with many who have lost vessels in the Bass Strait in the past 40 years, for one thing. My own experience showing that "speed kills," and that conventional cone-shaped drag devices don't assist and in fact can be dangerous, for another. Moreover I have found that towing items such as large game fish, bundles of rope, etc. on a short warp can create too much drag and cause a "stall" at the wrong moment - the bottom of a trough. And towing them on a long warp does not always produce the desired effect either. Drag and restraint can vary from too much to too little, depending on the direction of pull and how much rope remains in the water....*
>
> *As a final comment I need only repeat my earlier statement, "speed kills." While running before heavy seas it is important to try to keep the speed range below 6-7 knots, but above 3 knots. Slowing down below 3 knots will result in loss of steerage and allow a vessel to wallow, which is equally unsafe....*
>
> *The ultimate goal is to maintain helm and choice of direction while keeping the ship's speed below 6 knots. In survival conditions the trick is to prevent taking on board any water and keeping the vessel as buoyant as possible, which means avoiding breaking crests or becoming bogged down in troughs. This is only achievable if the vessel has headway and helm.*

How much should a speed-limiting drogue slow a boat? We are looking for the speed above and below which something never or always happens - a statistical bounding box. Abernethy's words, "below 6-7 knots, but above 3 knots" may be giving us a glimpse of that box. Average speeds of 3 knots might be found in the lower end of the box. Average speeds of 4-5 knots might be found in the middle of the box. Average speeds of 6-7 knots might be found in upper end of the box.

With this knowledge in hand, a sailor could then try to keep the speed of his yacht within the box by means of the appropriate speed-limiting drogue, or, if necessary, by adding or reducing storm sails, or by making adjustments in rode length, etc. Dr. Gavin Le Sueur, an accomplished sailor and a participant in the rough 1988 *Two Handed Around Australia Race*, seems to lend credence to the Abernethy bounding box in File D/C-8:

> *While crossing the Southern Ocean from Perth to Adelaide all competitors went through gale after storm. We could not carry full sail for 3000 miles! We towed drogues and warps for most of the way. The last Sea Squid worked famously.... It was speed limiting to approximately 7 knots. We no longer surfed down waves, and often would add sail before taking in the Squid so that we could maintain a constant 7 knots and not stall in the troughs....*
>
> *We read about textile drogues and have tried four systems since 1992. The first was a scaled down parachute. It worked out but slowed the cat to less than 3 knots in 35-knot winds. Too slow to avoid getting pooped. We then tried a "series" drogue, provided as a trial. It slowed the boat, but was a stowage mess and very impractical. We then tried a textile drogue that was fluted. It was like a normal parachute (3ft diameter) but with the middle ten inches removed and the continuous shrouds holding the two pieces of material together* [see image below]. *This fluted drogue worked as well as the parachute - 3 knots and too slow in 35-knot winds and 12ft seas. We had the drogue re-shaped by Para-Anchors Australia, the outlet hole enlarged and a rope tie put into the ends of the shrouds so that we could adjust the outlet* [as with a drawstring bag].



Adjustable pull, "fluted" drogue conceived by Australian Gavin Le Sueur is similar to drogue used by NASA to lower the Pathfinder mission onto the surface of Mars. Note the drawstring arrangement on the smaller ring, allowing the outflow diameter to be adjusted from 14" to 4" to increase or reduce pull. The optimal pull for a particular boat will have to be determined through prior trial and error and in practice runs. The drogue cannot be adjusted while in use.

In May 1990, the traditionally designed 35-ft. yacht *Saecwen* deployed an Attenborough drogue (louvered stainless steel design) while running before a storm in the Atlantic. The drogue seems to have slowed the yacht down too much. She began to be overwhelmed by the larger breaking seas. *Saecwen* was pooped three times in twenty minutes, whereupon her owner Charles Watson retrieved the drogue and ran under bare poles.

Shortly thereafter the yacht was thrown onto her beam ends by a big sea, causing some damage. Watson thinks that a smaller drogue - one with less drag - might have been better, allowing slightly higher speeds. Unfortunately more information was not available. *Saecwen*'s plight is described in the fourth edition of *Heavy Weather Sailing* and does seem to fall into consistency with the Abernethy bounding box - "below 6-7 knots, but above 3 knots."

The notion that a speed-limiting drogue should not slow a yacht down *too* much keeps cropping up in both classic and contemporary literature. Predictably, it is a fixture in the school of thought that favors the active approach, at the pinnacle of which one finds the legendary exploits of Dumas and Moitessier.

In File D/M-2 we find Bernard Moitessier towing assorted warps, pigs of iron and a cargo net in the Southern Ocean. As the storm builds he becomes increasingly dissatisfied with the baggage trailing in the water.

At a certain stage he decides to cut away the whole lot and run unimpeded under bare poles, adopting the

technique of "putting down the helm" to keep the bow from burying in the next wave. Having done so, he seems much happier, for he writes, "She had no longer anything in common with the wretched boat of the night before which had made me think of the little hunter trying to parry the blows of a gorilla, with his feet caught in the undergrowth."

Perhaps something with less drag would have been more to his liking. Perhaps attaching the warps to a point well forward of the rudder would have allowed more steering and he would not have elected to cut them away. Or, perhaps, with a series drogue deployed he might have been happy to leave the helm altogether and retire to his bunk, instead of fighting it and arguing with the ghost of Dumas. We will never know.

Dana Dinius' use of the Sea Squid in the Queen's Birthday Storm seems to support the speed limits defined by Abernethy's box. Without the drogue *Destiny*'s speed would have shot up to 14 knots. With the drogue in tow, her speed seems to have settled down in the middle-high end of the box. Sailors inclined to the active approach should read and re-read File D/M-12. *Destiny*'s somersault off that rare 80-ft. stacking and cavitating wave notwithstanding, Dinius' account is a defining moment in our understanding of the active drogue approach. Dana Dinius:

> *We found our drogue set-up to be optimal in conditions that far exceeded what we expected that night.* Destiny *was held to 3-4 knots in the troughs and 7-8 knots running down the giant wave faces. There seemed to be little or no yawing, and steering control, while being a little sluggish from the trailing drogue, was responsive enough to handle the storm. The ride in general, although very wet, was relatively smooth.*
>
> *Although the speed was well under control we still felt it necessary to hand steer the boat. The blast of wind hitting the transom as we raised up out of the trough (generally 35 knots in the trough and 80+ on the crest) was strong enough to drive the stern of the boat hard to port or starboard. Reaction had to be quick and complete enough to bring the stern back around before the breaking seas engulfed it. Failure to complete this maneuver left us exposed at an angle to the breaking seas, which would in turn push the boat further around, greatly increasing the danger of a broach/roll. There were times we were hit so hard that* Destiny*, even with the helm hard over, barely corrected stern to the seas before the next wave crest. It is our feeling that the autopilot (an Auto Helm 6000-Mark II) would not, at the peak of the storm, have been able to correct fast enough to complete the maneuver....*
>
> *Twice during the night our drogue broke loose and pulled out of the wave behind us.* Destiny *shot from 7 knots to 14 knots in the bat of an eyelid. Had there been any way to extend the rode at that point we would have, but by then the weather was critical. The cockpit was constantly awash. Hanging on and steering was all we could manage. We learned that, given a shorthanded crew,* ***the rig you go into extreme weather with is most likely what you will be*** **forced** ***to stay with for the duration*** *[emphasis added]. Hindsight tells us that even if we didn't think we would use it, we should have rigged more line. Our suggestion is to have the stern anchor rode rigged so you can attach the drogue at a moment's notice....*
>
> *We found that directly downwind was the most stable and survivable course. In our case, at 7 knots, burying the bow was not a concern. Our biggest concern was being caught sideways and*

> *rolled. We attempted to cheat to the SSW whenever possible to work out of the dangerous SE quadrant of the storm, but found it almost impossible to make much ground without putting the boat at risk of a broach.*

Dinius says, "At 7 knots, burying the bow was not a concern." Another important insight. All things are not always equal at sea and relying on speed alone may be misleading. Besides, how can one tell if one is in or out of the bounding box at night, without a large, accurate - brightly lit - speedometer right before one's eyes? Dinius' words give the sailor another indicator. If the bow is burying itself in the base of the next wave, one is probably traveling too fast. If the stern is getting buried by the preceding wave, one is probably traveling too slowly. In File D/M-7 we find the Nor'Sea 27 *Synthesis* out of the bounding box, burying her nose into the base of the next wave - taking green water over the bow up to the mast now and then. When the 30" Galerider was deployed she seems to have settled down into the low end of the box. George Purifoy:

> *No longer are we rushing crazily toward a cold swim. The boat has slowed down to about two knots or so, even on the steep downhill faces of the waves. Those monster waves are still rushing at us from astern, but* Synthesis *just lifts her stern and all the foam and tumbling water just moves by. Beautiful! I still have to steer, but not with the strain and concentration of before. All of a sudden the storm seems manageable.*

Note that Purifoy kept the storm jib up for the duration of the time in which the drogue was deployed. Without the storm jib the yacht may have slowed down too much - left the box at the low end - in which case she might have gotten pooped by following waves.

In File D/M-3 we find *Southerly* becoming unmanageable in the Gulf Stream, her speed racing to 12 knots - well out of the bounding box. The crew deployed the prototype Galerider, whereupon she settled back into the box. Commodore Snyder:

> *At one moment the boat had been charging like a mad bull, with the helmsman struggling at the wheel; in the next, she was docile and under full control. The helmsman found that* Southerly *would still answer her helm - though slowly - and that she could steer through about 90°. Everyone relaxed, and the off-watch turned in, even though the motion wasn't all that comfortable, with the cross sea still rolling us 20° either side of vertical. But the boat was safe.*

In File D/M-11 we find William A. Forest using a 36" Galerider on his 29-ft. Islander *Seraphim* in a Pacific gale:

> *As soon as the Galerider was deployed and the rode adjusted I had instant control. It was amazing.... It should also be noted that I had a 90 sq. ft. storm jib up. In order for the drogue to work properly it is necessary to have forward motion.*

In File D/M-17 we find the cutter *St. Leger* running off in the Queen's Birthday Storm under bare poles, her speed racing to 12 knots - well out of the bounding box. When the 36" Galerider was deployed her speed dropped back into the middle of the box. Michael and Doreen Ferguson:

> *At about midnight on day 2 of the storm we decided to deploy the Galerider as our boat speed was now 11-12 knots in precipitous seas. We deployed the Galerider using a single line off the starboard quarter, approximately 250 feet of 3/4 inch three strand polypropylene line.... Our plan was to slow* St. Leger *down, whilst still maintaining steerage using the "Sayes Rig" vane, due to shorthanded crew. Immediately upon deployment our boat speed was reduced to 3.5 to 4 knots and we felt much more comfortable....*
>
> *We observed the Galerider for hours! A small "half-moon" section of the drogue was visible at times, and we noted the three strand polypropylene tow line did not unwind, nor did the Galerider oscillate or rotate. And best of all, this enabled the wind vane to steer the whole time.*

St. Leger towed the Galerider for 60 hours in 60-knot winds, emerging from the Queen's Birthday Storm intact. In all that time the drogue did not tumble, porpoise, squid, kite, zig-zag, oscillate or rotate - a tribute to the inventive genius of Commodore Snyder and the craftsmanship of Hathaway, Reiser and Raymond.

Fine tuning the statistical bounding box is not easy. There are too many variables. For one thing all rudders are not the same - some sailboats are a lot easier to steer than others. For another thing, and depending on hull speed, the entire box may have to be shifted downward or upward. A 70-ft. yacht's bounding box may turn out to be "below 9-10 knots, but above 5 knots," for example. One would need a thousand files - accurate records of exact speed before and after deployment - and computer models to fine tune precisely the box. In the meantime one can take comfort in the knowledge that no computer will ever be able to match the information processing capacity of the human brain itself. Many experienced sailors are already fully aware of the limits of their vessels and know - instinctively - when to subtract/add sails, or deploy a drogue, or lengthen/shorten the rode, for example.

At this stage of the game we can perhaps make educated guesses about the speed ranges that might accommodate self-steering, for example. *Destiny*'s speed range seems to have been at the upper end of the box - "3-4 knots in the troughs and 7-8 knots running down the giant wave faces." She had to be steered manually with Sea Squid in tow. Dinius says, "It is our feeling that the autopilot (an Auto Helm 6000-Mark II) would not, at the peak of the storm, have been able to correct fast enough to complete the maneuver."

Perhaps at the upper end of the bounding box one should plan on remaining in the cockpit and steering the boat manually, everything else being equal. *St. Leger*'s speed range seems to have been in the middle-low end of the box, allowing the wind vane to take over so the shorthanded crew could rest below. Being able to leave the helm and rest below is an important consideration in heavy weather, especially for shorthanded crews.

At what speed range might one be able to hand everything over to an autopilot for a given boat? Well, it looks as though the average speed might have to be brought right down to the floor of the box - say 3 knots for certain rigs or keel types. In File D/M-8 we find the Morgan 382 *Windsprint* in Force 10 conditions, averaging 7 knots under bare poles without drogue. The owner deployed five 14-inch plastic cones - Davis "flopper stoppers," shaped like Mexican hats. The yacht's speed was reduced to 1.5-2 knots. He lashed the helm and was able to retire below. If the speed had not been lowered sufficiently, he may have had to remain in the cockpit and steer manually.

Remaining at the helm for long periods - days at a time - can be extremely debilitating, even on routine downwind passages. When sailing downwind in strong trades, for example, one had better have a reliable method of self-steering. If not, warps, drags or chain can be used to take the edge off the most extreme turns of speed, making life much more bearable. Slowing the boat will result in an increase in the apparent wind as well, increasing the effectiveness of the windvane. One really needs a good speed-limiting drogue if the wind pipes up to 30 knots and more, however. In File S/M-27 we find singlehander BJ Caldwell deploying one of Para-Tech's 36-inch Delta Drogues in stiff trade winds:

> *The smaller drogue kept the mast above the water for about 10,000 punishing miles. I trailed it about 100 feet behind the boat whenever there was a risk of broaching. In the Indian Ocean I often had about 15 percent mainsail and 6 percent jib with the drogue out. I ended up using it for about a week during my 21-day passage from Cocos Island to Mauritius....*
>
> *My average speed with drogue in tow was approximately four knots. Without the drogue I would have been hitting seven, while averaging 5½ knots. I used the device on and off for the whole trip. Instead of yawing and broaching, the drogue would keep the stern aligned with the seas and allow me to still make four knots - and boil water for coffee. I never had to steer manually. The drogue helped the windvane steer in large following seas.*

Perhaps the rule of thumb is reversed between sea anchors and speed-limiting drogues. Perhaps in selecting a sea anchor one should err on the large side, but in selecting a speed-limiting drogues one should err on the small side. The consensus seems to be this: one does not want too much drag from a speed-limiting drogue at ordinary speeds. One wants the drag to kick in at higher speeds, when control is becoming difficult.

Anyone who has been foolish enough to lower a bucket into the sea while underway will confirm that the drag of even the smallest drogue can increase precipitously at higher speeds. The relationship between drag and speed is not linear. It increases as a function of the square of the speed: $D = f(A, cd, V^2)$, where D is the drag in pounds, A is the area in square feet, cd is the drag coefficient (different shapes have

different drag coefficients), and *V* is the velocity or speed in feet/sec. At 12 knots, even a calf bucket, a crab pot or a plastic milk crate can generate a significant amount of drag - enough to take the edge off the most extreme turns of speed for the average yacht. Purpose-made drogues are much superior to calf buckets, crab pots and milk crates. Well designed drogues - those with high geometric porosity, and those utilizing the guide surface principle - can provide a hundred or so pounds of pull at low speeds, but thousands of pounds of pull at high speeds. And the pull that they provide is smooth and steady throughout the range. The pull provided by the big yellow cone in File D/M-18 was anything but smooth and steady. Wes Thom:

> *We could look behind and watch the drogue start up a wave as we came over a crest. We could see it tumble on its own crest as we slid down the back side of ours. About the time we were in the trough it would grab again, and up and over the next crest we would go. We could clearly see the yellow cone tumbling repeatedly. It would get rolled, get tossed around, go end over end and everything in between. But it wasn't getting turned inside out, and it seemed to be doing its job when needed.*

Unless single element textile cones are carefully fabricated from very porous - mesh-like - fabric, they may behave erratically under tow. Even when they are properly positioned, and even when they do seem to be working, the drag they provide can be a hit or miss, on-again off-again affair, nothing like the steady pull of a Galerider, a Seabrake, or a Delta Drogue.

In File D/T-4 we find BJ Watkins having to abandon the Val 31 trimaran *Heart* because of the erratic performance of the large, conical drogue - likely the same size and make as the one used by Wes Thom in File D/M-18. The cone was improperly bridled as well, exacerbating BJ's problems It would grab and let go, allowing *Heart* to surge ahead on wave faces now and then.

In sharp contrast, in File D/C-6 we find Robert Harnwell using a Seabrake GP-24 (guide surface cone) on the Prout catamaran *Malaika*, with far better results:

> *Deployed the drogue a number of times across the Atlantic. From England to the Azores the wind was straight behind. In the gale she was surfing 10-12 knots down the big ones, slewing around at the bottom. In a big, heavy boat like ours that's really fast. Deployed the drogue and it slowed the boat down to about 5 knots - like putting on the brakes. At one point had to roll out more jib to keep up speed and control the boat. We had a sail up throughout the 48 hours with the drogue. Most of the time she would track straight, slewing around only at the bottom of the waves.*

Owners of Prout catamarans should consider carrying speed-limiting drogues on board, along with the sea anchor. Prouts are among the few sailboats in creation that have their masts stepped aft. With their CEs (centers of effort) farther back, these boats tend to behave well with their bows pointed into the seas, but perhaps not quite as well with their sterns pointed into the seas - everything else being equal.

Unless one moves the CE up by carrying storm sails well forward, boats like these may "slew around" more than others when running downwind. All the more reason to deploy a suitable drogue on downwind legs, or at the very least a warp and chain affair, something that will take the edge off extreme turns of speed, help keep the stern aligned and take the pressure off the helm. With a drogue in tow, the mainsail down and a storm jib well forward, Prouts should be able run downwind - in reinforced trade winds, for example - as well as any other multihull.

In File D/T-8 we find Warren Thomas deploying a 4-ft. diameter conical drogue behind the trimaran *Lady Blue Falcon* in an unnamed hurricane. The drag exerted by the cone was anything but steady. At times the cone would pull out of the wave faces as well, allowing the boat to lurch ahead at incredible speeds. To compound matters, the bridle being used interfered with Thomas' ability to steer. Warren Thomas:

> *I used the drogue off the stern of my Piver Lodestar in a mild hurricane 300 miles north of Bermuda, approx. 360 miles east of Cape Cod. Got blown 570 miles in 5 days, running completely out of control. Drogue's bridle would NOT let me steer at high speeds of 22 knots on 2-3 minute continuous runs.*

Bridles do not seem to lend themselves to the active approach. John Abernethy does not ordinarily favor their use, preferring to use a single towline so that the boat can be steered with the drogue in tow. Peter Blake did not use one on *Steinlager* (File D/T-1):

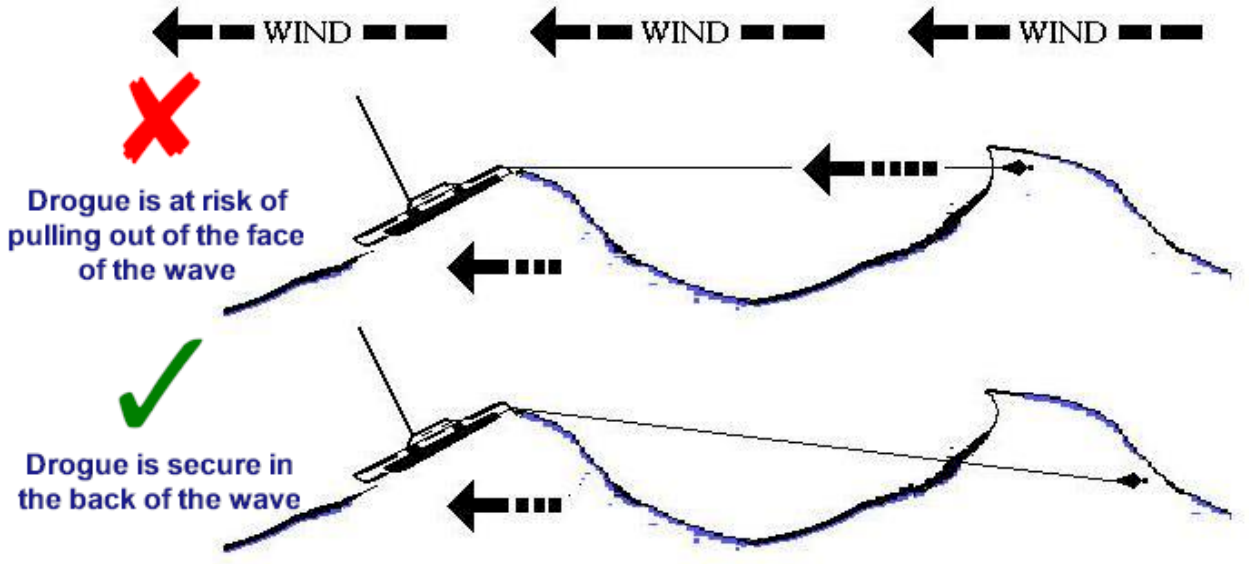
> *Using the Seabrake without a bridle the trimaran steered very well* [without autopilot]. *We pulled the centerboard up and the boat basically blew down wind with the Seabrake off the back. It was really great, no keel to trip over, no roll, no yaw, nothing, just straight downwind, fantastic. Multihulls are very good like that, much better than monohulls. No need for bridle, just a single tow line coming to a great big winch.*

On one occasion Blake did use a bridle on *Enza*, however, probably because steering was not an issue. One may *have* to use a bridle if the helm needs to be left unattended for long periods of time. Otherwise the use of a bridle does not seem to lend itself to the active approach. While bridles do enable the drogue to keep the yacht better aligned when the helm is unattended, they also interfere with steering when it is manned. **For maximum steering one should bring a single towline well forward of the rudder**.

Positioning a Speed Limiting Drogue

A reminder: low-pull drogues need to be properly positioned. Most of the sailors featured in this publication seem to have done that, positioning it *on the back* of a wave, with the yacht sliding down the face of one. In this connection Michael and Doreen Ferguson seem to have stumbled onto something important in the Queen's Birthday Storm (File D/M-17):

> *... as* St. Leger *slowed down in the troughs of the huge seas the tow line and Galerider tried to catch up to us, leaving a loose coil of 12 to 15 feet of* [polypropylene] *tow line floating in close proximity to the vane's trim-tab steering paddle.... Mike began bringing in the slack each time we were in a trough, using a primary cockpit winch, until the Galerider was approximately 80-90 feet behind the boat* [no resulting slack now]. *The drogue was in the same wave as* St. Leger, *but on the other side of the crest* [on the back side]....



> *We towed the Galerider without incident for 60 hours, with winds at 60+ knots.... At approximately 0800 hrs on day 5 the wind had dropped to 18-20 knots. The low pressure system was east of the Kermadec Islands and moving away from us. The seas were still high, but we readily retrieved the Galerider, which was in almost new condition with no damage or excessive wear after a tough workout!*

> *We should also mention that the New Zealand Air Force Orion aircraft searching the area* [for other vessels in distress] *made a low pass over us and we advised them by radio that we were OK and not in need of their assistance. Our sails were set and we spent the next week hard on the wind in light northerly winds with very lumpy, confused seas. We arrived safely in Suva, Fiji, where we exchanged tales of the "Queen's Birthday Storm" that claimed three lives and seven cruising yachts. Everyone involved was interested in what "worked" and what didn't.*

A strategy that worked in the Queen's Birthday Storm deserves careful attention. Two things stand out in the *St. Leger* file. The relatively short rode used. The precise adjustment that Michael Ferguson was able to make in its length.

The fact that it was 3/4" polypropylene needs to be considered as well. Polypropylene floats: excessive slack would tend to be quite visible on the surface. *St. Leger* started out with 250 feet of rode separating her from the Galerider. Slack was being formed in the wave troughs - loose coils could be seen floating next to the transom. Ferguson kept taking in the slack until in the end there was about 80-90 feet of tether separating the yacht from the Galerider, this in 40-ft. seas. This would have placed the yacht and the drogue on different parts of the *same* large wave (in contrast to the next wave as depicted in the image above).

One advantage of a speed-limiting drogue would seem to have to do with short rode applications such as this. One would never dare use such a short rode for a sea anchor, or even a medium-pull drogue. A low-pull speed-limiting drogue seems to allow it however; something that can be quite useful. For one thing, one can see exactly where the drogue is, and try to position it accordingly, perhaps on the same big wave, as with *St. Leger*.

This raises another interesting point. Depending on exactly where the yacht and the drogue are in relation to one another, the amount of drag might vary by many hundreds, if not thousands of pounds. In 1994 three drag device manufacturers conducted combined tug tests in Tampa Bay, Florida. Daniel C. Shewmon of Shewmon, Inc., Skip Raymond of Hathaway, Reiser and Raymond, and Don Whilldin of Para-Tech Engineering Company pulled a variety of sea anchors and drogues behind a tug, measuring their pulls on a vacuum gauge. The results were subsequently published in Shewmon's *Sea Anchor and Drogue Handbook* (Daniel C. Shewmon, 1995). Table 21 on page 153 of this publication shows a 35" experimental Galerider producing the following:

260 Lbs. of drag when pulled at 4 knots

580 Lbs. of drag when pulled at 6 knots

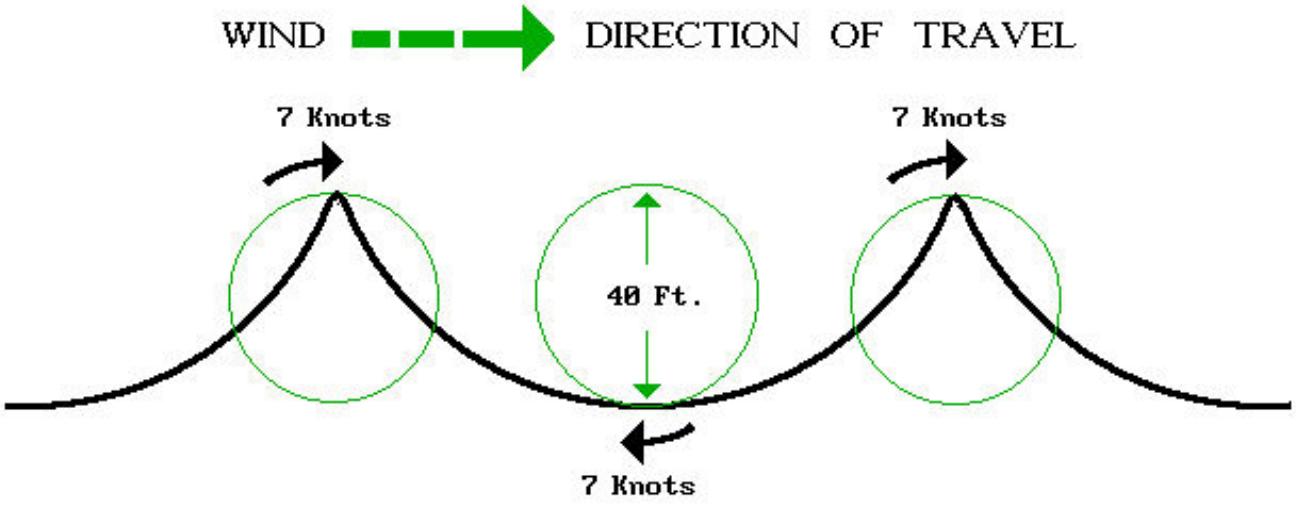
1000 Lbs. of drag when pulled at 8 knots

1600 Lbs. of drag when pulled at 10 knots

That's a difference of 1340 lbs. between 4 and 10 knots. In theory at least, some of the change that

produced the 1340 lbs. could be reproduced by re-positioning the drogue on different parts of a big wave offshore. In 30-ft. seas, for example, the molecular speed of the orbital rotation of such waves may be about 5 knots. With the boat centered on a crest, the drogue centered on a crest and both sailing downwind at 4 knots, the 35" experimental Galerider would provide about 260 lbs. of restraint.

However, with the boat centered on a crest and the Galerider centered in a trough, one might expect a 10-knot divergence , in which case the pull would quickly increase to 1600 lbs. - and much more than 1600 lbs. if the yacht were to be situated in 50-ft. seas.



Trochoidal wave theory:(from Greek 'trochos' meaning 'wheel'): Although the waves look like they are moving to the right, in fact the molecules of water merely rotate in circles. the diameter of the 'wheel' is equal to the height of the wave. The period of the wave determines the time it takes for the 'wheel' to make one revolution. The approximate speed of the water molecules on the surface of the water at the peak and trough can be determined by dividing the circumference of the wheel (= ? x wave height) by the wave period.

However, there is a caveat to this: once the wave passes, and the boat is now in the trough, with the drogue now on a crest, instead of divergence we now have convergence. At this point the drogue might well go completely slack!

Most likely this is what Michael and Doreen Ferguson discovered in the Queen's Birthday Storm. The times when the rode went slack were probably the times when the drogue and boat where in convergence on a wave. By progressively shortening the rode they were then able to bring them more and more into synch until they were close enough together on the same part of the wave to avoid the extremes of divergence and convergence.

So where to position the drogue? That would seem to depend on the boat and the conditions on the day. The crucial goal is to avoid having the boat surfing out of control down the face of the wave to then nose plant into the wave in front. By adjusting the length of the rode, as Michael and Doreen did, one can, hopefully, find the optimal position for the day's conditions.

Of course that depends on conditions being safe enough for one to work in the cockpit making adjustments. If that is not possible, then most likely a more passive approach (e.g. longer drogue and/or a medium pull drogue) needs to be taken.

To Quarter or not to Quarter

One of the standard questions your authors ask those who have used drogues in heavy weather is this: "All things considered, would you quarter the seas with a drogue in tow, or would you run directly downwind?"

This is one of the important questions. Should one take the seas squarely on the transom with a drogue in tow, or should one try to quarter them? John Abernethy is of the opinion that, so far as possible, one should try to quarter them. John Abernethy, File D/M-10:

> *Reading the immediate wave astern and manoeuvring to expose the least amount of stern - quartering the seas rather than taking them on square - is all that needs to be done in order to avoid both the PUSH and the FALL as a dangerous wave passes under the boat.*

It should be noted that all of Abernethy's charter boats had wide transoms. The owner of a yacht with a canoe stern might not have to worry about the same "PUSH and FALL." Peter Blake was cautious about answering Victor Shane's question (File D/T-1):

> *I don't necessarily go along with the idea of quartering the seas* [with drogue in tow]. *I think that it depends on what you are on, and if you're on a multihull it's definitely much better to be running squarely downwind, because if you're running with the wind on the quarter you're likely to dig a bow* [ama] *and loose it much more easily. Better to run absolutely downwind* [in a multihull]. *It's dangerous to take the seas on the quarter, and much, much better to take them square on the transom; that's in a multihull - a trimaran or a catamaran. A monohull, I think, is a different scenario, and I might agree with the quartering idea.*

Dana Dinius, after steering *Destiny* through the worst part of the Queen's Birthday Storm with a Sea Squid in tow (File D/M-12):

> *We found that directly downwind was the most stable and survivable course. In our case, at 7 knots, burying the bow was not a concern. Our biggest concern was being caught sideways and rolled. We attempted to cheat to the SSW whenever possible to work out of the dangerous SE quadrant of the storm, but found it almost impossible to make much ground without putting the boat at risk of a broach.*

St. Leger, on the other hand, seems to have towed the Galerider off the quarter in the same storm, "We deployed the Galerider using a single line off the starboard quarter...." Her owners were on an extended cruise and Shane was not able to confirm this and a number of other points. In File D/M-19 we find *Adele* towing one of Seabrake's solid MK I drogues off the quarter in Cyclone Bola, around the treacherous North Cape of New Zealand. W.R. Allen:

> *With the wind generally NW we streamed the Seabrake from the starboard primary winch, which meant the brake was mainly on the quarter, though when the occasion demanded with a particularly big sea we would run straight before. I am not aware of any period when the brake was not on the back of the next wave. On the crest of a wave we would occasionally pull the brake clear* [out of a wave face] *but it always dug in to hold us for the next one. We made no adjustments to the spring-loaded mechanism which was set to operate* [kick in and generate 70% more drag] *at 5 knots, and generally we were able to maintain that speed.*

(Note that they pulled the drogue out of the face of a wave when their boat was on a crest. It may be that increasing the length of the drogue slightly might have mitigated that problem)

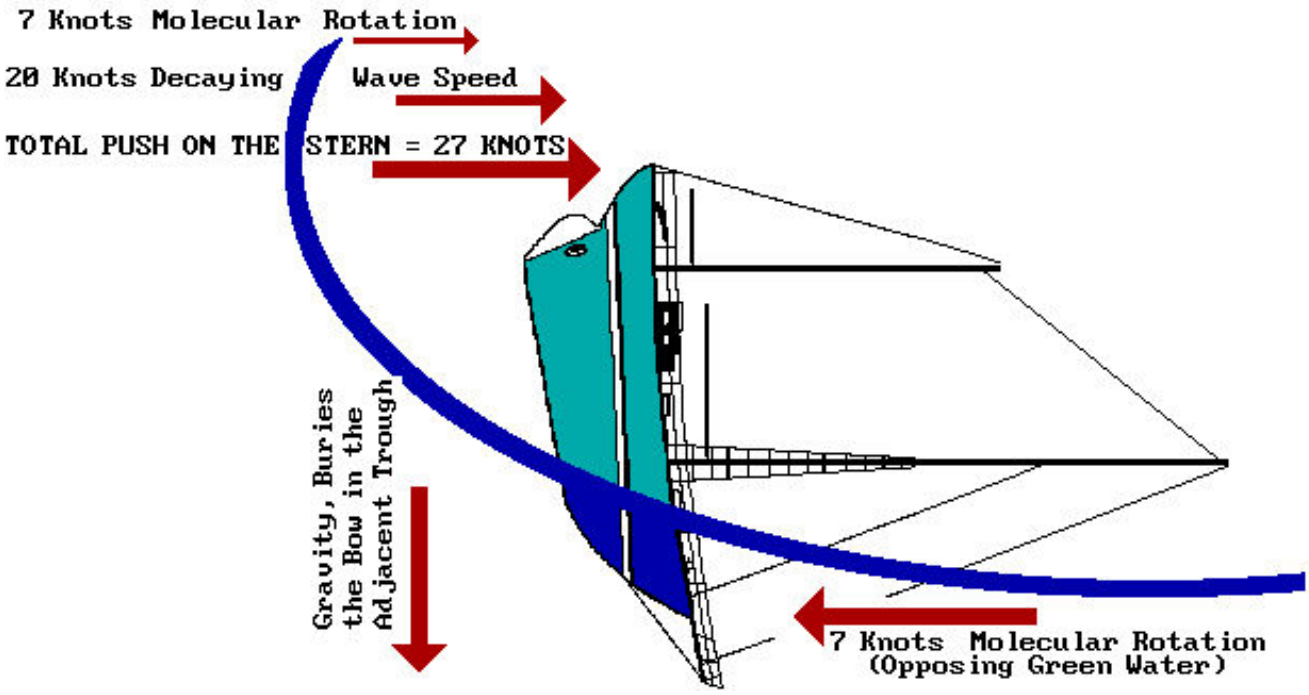
Moitessier took to quartering the seas after he cut away all warps. Probably his predecessor Vito Dumas quartered them as well. One simply cannot believe that Dumas would have chosen to run straight down the wave faces with a full compliment of sails up (he is said to have bragged about never reducing sails in storms). To do so would have buried the bow and produced the cartwheels - "Catherine wheels" - that Moitessier quips about in his imaginary arguments with Dumas' ghost.

"Catch-22"

The criterion that sets a speed-limiting drogue apart from any other drag device is that its low pull allows a significant amount of directional control through the helm. It is an interactive - *steering-assist* - device, in some sense doing the job of a long steering oar trailing far behind the boat. You can - and may have to - steer the boat while towing the drogue.

All of which brings us back to that "catch-22": *The same low drag that allows for steering control may allow the boat to broach, capsize and even pitchpole in a once-in-a-lifetime storm.*

The forces that pitchpole yachts are large enough to yank a small, low-pull drogue through the water as they are throwing the yacht end over end. The red-blooded sailors who have made up their minds that the active approach is the *only* way to go should take note of a number of mishaps associated with this strategy. Out of a total of 38 drogue files, about 20 involve the active approach. We find about 5 mishaps among these, some catastrophic. That's 25%. Food for thought.



Formula for Disaster - unfortunately a low-pull speed-limiting drogue has insufficient drag to prevent a pitchpole.

Destiny was pitchpoled with a Sea Squid in tow in File D/M-12. Granted, her speed was at the upper end of the bounding box. Granted, the 80-ft. "stacking" wave that she fell off of was a composite - sandwich - of three intersecting waves, the middle layer falling out, or "aerating," as Darryl Wheeler describes it in File D/C-5, allowing the yacht on the top layer to take a death-defying plunge into the green water in the trough. Granted, one may never run into this sort of wave phenomenon in a life-time of cruising. But forewarned is forearmed. Dana Dinius:

> *Three times during the morning hours,* Destiny*'s keel broke loose* [with drogue in tow] *and we slid down the wave face like dropping in an elevator. It was at this point we felt control had been lost and we issued our PAN PAN call. As the wind began to clock south and increase again, there developed a secondary wave direction which created a "stacking effect." Ultimately, we feel that's what killed* Destiny. *Two or three breaking waves stacking on top of one another produced a bottomless situation. Under those conditions we don't think any drogue could have held the boat from that fall. There comes a time in extreme conditions when your survival boils down to the luck of the draw. We feel this was one of those times.*

Some might argue that a drogue with more pull might have saved *Destiny*, but Dinius says, "Under those conditions we don't think any drogue could have held the boat from that fall."

Darryl Wheeler's experience on the catamaran *Heart Light* would seem to corroborate Dinius' statement. *Heart Light* was also towing a drogue in the Queen's Birthday Storm, but a *medium pull* one consisting of a 5-ft. diameter hybrid parachute of some sort. Even with the higher drag, and even though Wheeler was using the two inboard engines (propellers 18 feet apart) to try to keep the yacht aligned, *Heart Light*'s situation was touch and go as well. Darryl Wheeler (File D/C-5):

> *As the wind built to a steady 77 knots gusting to 90 knots it would drive the 50 foot waves on top of one another. The faces of these monsters were vertical on both sides. In some cases the waves would stack 3 high, with the center wave becoming aerated. When you came off one of these giants the middle wave would drop out and the cat would free fall through the gap until hitting the next wave below.*

In File D/M-5 we find the 37-ft. Tayana *Hudie* running off in a hurricane with warps and various items in tow, including buckets, tarp, sailbags and a submerged 8-ft. fiberglass dinghy. The combined drag was enough to slow *Hudie* down to an average speed of about 3 knots.

Her owner, Patton S. King, told Victor Shane that from 10 p.m. Saturday until 6 a.m. Sunday morning he could not have been happier with the way things were going. A little after 6 a.m., however, a rogue wave picked up *Hudie*, carried her sideways, broke and rolled her through 360° in about twelve seconds. Instantly cans, bottles, tables, utensils, floor boards and people were rolling around in total shambles inside - with broken glass everywhere. There was much evidence of roof damage, with extensive damage to the rigging, mast and spreaders. All the crew had sustained injuries, fortunately nothing major. *Hudie* had to be abandoned.

In File D/T-9 we find the 60-ft. trimaran *Great American* running off in a storm while lining up her approach to Cape Horn. Rich Wilson and Steve Pettengill kept adding on warps to keep her speed inside the bounding box - likely 8-9 knots on the crests and 4-5 knots in the troughs for this big boat. On Thanksgiving morning 1990, *Great American* was capsized with twelve warps in tow. The warps were each 300' long, knotted to generate more turbulence.

In File S/M-27 we find *Mai Miti Vavau* being knocked down while towing one of Para-Tech's 36" Delta Drogues in the Indian Ocean. BJ Caldwell:

> *It was blowing a sustained 40 knots the night I got rolled 180°. Because the reinforced trades weren't that strong I abstained from switching to sea anchor. With the wind just a few degrees above a dead run with the drogue out, nothing but the staysail up and the boat sealed up, I heard a deafening roar approaching around midnight. Then everything hit the ceiling, including me.*

> *When I finally made it back to the cockpit and looked at my mast I couldn't believe it was still standing. I know it hit me broadside, so I think this is what happened: just before the freak wave broke over the boat the windvane lost the apparent wind in the trough and corrected for the loss of wind. As the boat veered upwind the monster erupted across the hull, rolling the boat through 180°. Aside from the torn staysail, bent solar panels and a soaked single-sideband radio, the rollover caused no serious damage to the boat.*

The active approach seems to require a man at the helm. At the very least someone on watch. Leaving the helm for prolonged periods may leave the yacht vulnerable. Had Caldwell been in the cockpit he may have been able to round up or steer away from the monster in the nick of time. But singlehanders can't be in two places at the same time. In File D/M-19 we find *Adele* being knocked down while towing a Seabrake MK I around the North Cape of New Zealand. W.R. Allen:

> *At 2200 hrs on the 7th March at 33° 36' S, 169° 17' E, we were under bare poles and had set the Seabrake. Shortly thereafter we suffered a 90 degree knockdown, but apart from a few bruises there was no damage. However through this incident we were made very much aware of the confused nature of the seas and that we were catching the odd rogue cross sea.*
>
> *On the 8th, 9th and 10th March we proceeded in a SE direction following the Three Kings Trough, towing the Seabrake. During this period of heavy breaking seas with winds in excess of 60 knots the Seabrake was in continuous use, doing a marvelous job steadying our progress and giving us a strong feeling of security regardless of the conditions. At no stage did* Adele *show any tendency to broach and it was always possible to maintain a measure of control, despite the extreme conditions.*

Is there a pattern emerging from all this, telling us that vessels using the active approach may be at higher risk than those using passive approaches? We need many more files before we can answer this question. And even then, the answers are not going to be cut and dried. For example, if the helm can be manned around the clock the risk can be reduced significantly. Certainly, the above sailors seem to have derived great benefit from speed-limiting drogues. Each thinks that the active approach was the right one in the given circumstance, in spite of the odd mishap. *St. Leger* survived the Queen's Birthday Storm intact with a Galerider in tow. And Peter Blake is certain that the Seabrake saved the boat and their lives on a number of occasions (File D/T-1):

> *The worst case scenarios were on two different occasions. One was on the day we started the race* [8 August]*, and if I hadn't had the Seabrake I wouldn't be talking to you now, probably. And the other occasion was the day and a half before the finish, when I think if we hadn't had the Seabrake there was no way we could have slowed the boat and the lightweight racing trimaran would probably have self-destructed, again because the wind changed and we were being driven headlong into northerly seas by a 50-knot wind from the south. These were very big breaking seas,*

real breaking waves collapsing down their full fronts....

With a little luck, given enough searoom, and able to work the helm in shifts, expert sailors Peter Blake and his partner Mike Quilter could no doubt survive any situation using the active approach.

But one does not always have searoom. As the Pardeys say in *Storm Tactics*, "Running onto a storm-swept rocky shore or wave-pounded coral reef is not an option." Moreover one does not always have the skill of a Peter Blake or Mike Quilter to do the steering either. Volvo racers and legendary sailors aside, one gets the feeling that the active approach is not for everyone, even when there is plenty of searoom. Dana Dinius, (File D/M-12):

> *We feel our chances of surviving the storm were greatly increased by choosing an active role at the helm. This decision took into account exhaustion and exposure. Warm, tropical weather diminishes exposure problems, and as for exhaustion, we've learned in extreme conditions the pure adrenaline pump will keep you going many more hours than you think is humanly possible now. Had we been in a colder climate we may have decided differently. We also realize that an active technique is not for everyone. For those who do not wish an active part, a much larger drogue that would hold the boat at a snail pace, "perhaps" would give the resistance needed to stay stern-to with the aid of an autopilot. We are sure, however, the boat would take a terrible beating given the size and power of the seas we experienced. As it was, we lost most of our cockpit canvas and saw extensive damage to the supporting stainless steel long before the pitch-pole.*

Medium Pull and Series Drogue

So far we have only 13 files involving medium pull and series drogues - *the passive approach:* No steering required or possible. Unfortunately such small numbers do not allow us much in the way of analysis.

All of the vessels using this approach lay essentially dead in the water, their occupants below, their hulls aligned and their sterns snubbed directly into the wind and seas. In file D/M-4 we find Charles Kanter using a genoa sail off the stern, three corners tied together like a diaper. The contraption seems to have worked quite well, playing the part of a medium-pull drogue. No steering was involved or possible. The boat lay essentially dead and buoyant in the water, everything tightly battened down and the occupant resting safely below. The yacht was an Irwin 37 with a well-protected center cockpit.

A reminder that any genoa can play the part of a medium-pull drag device. A number of yachts tried to convert their sails into drag devices in the Queen's Birthday Storm, with varying results. If one looses a drogue due to chafe, for example, sails can be converted into drag devices.

In File D/M-6B we find Gary Danielson using a Galerider and a series drogue on his Ericson 25 in a number of Atlantic gales. In the first mid-Atlantic gale he used the Galerider and found that it greatly enhanced active steering control in 15-ft. seas. However, left to itself (while he was resting down below) it would allow the stern of the boat to yaw too much - 40° off to each side at times. In the second Force 8 gale he used the series drogue. It kept the stern of the boat snubbed into the seas and, in taking total control of the situation, allowed him to remain down below and get much needed rest.

Danielson sailed *Moon Boots* back across the Atlantic singlehanded in March 1991, using the series drogue in another gale:

> *At 25-30 knots* Moon Boots *can't sail upwind effectively any longer. Once the wind got to the low 30's I knew I'd have to put out a drogue. I decided to use the Jordan style series drogue rather than the Galerider because I didn't want to lose any of the ground I'd already gained and the Jordan is a much better "anchor" than the Galerider. In fact, that was pretty much how I decided which one to use on the prior trip also. In any event it did an outstanding job of keeping the stern into the waves and of limiting drift to almost nothing (10 miles in 36 hours, less any westerly drift from possible currents).*

Danielson had beefed up *Moon Boots*' transom area in anticipation of boarding seas. The boarding seas turned out to be a problem for other reasons:

> *The only problem was that the boat had been broken into in the Canaries and the inside lock for the main hatch had been damaged (the hatch fully closed, just couldn't be secured shut). As you probably know, the Jordan drogue exhibits a tremendous pull at all times. The transom of* Moon Boots *had been beefed up specially because of this, as had the hatch and the hatch boards. And a good thing too, because every so often a wave would completely go over* Moon Boots *(I could see solid water as I looked out the side ports).*
>
> *The problem was that at times these waves would slide the main hatch 2-3' forward. Note that the hatch top itself was custom made of wood, weighed almost 75 lbs., and slid very hard on its track as it did not sit on rollers or cars of any type (just slid on metal tracks). It always took an effort with both hands to slide it open or shut. But these waves would slam it open and at the same time 30-50 gallons of water would pour in, (this happened 9 times in 36 hours). Therefore anyone using this style drogue had better have prepared the stern of his boat properly.*

The five 14-inch plastic cones used by Jim Gilster in File D/M-8 almost amounted to a medium-pull drogue, reducing *Windsprint*'s motion through the water down to 1.5-2 knots in 70 knot winds. Jim Gilster:

> *The five plastic cones were spaced 18" apart; I rigged them up with 5/16" braided nylon, doubled,*

> *with a thimble at the bend, and figure eight knots at the holes in the cones. I attached all this to 20' of chain and 300' of 5/8" nylon line, led to the port stern cleat and port sheet winch. I felt confident it would all hold up. It did, in 70 knot winds and 20' seas. We slowed down to 1.5 to 2 knots from 7 knots on bare poles. I adjusted the wheel to allow us to quarter the waves, and we were "comfortable"....*
>
> *We were occasionally pooped, but with a bridge deck and tight hatch, little water entered the cabin. Although each of the five cones was cracked when we hauled them back in, we did not notice any diminished resistance while "at anchor." I am in the process of affixing two cones together to make five sets of two each, somehow each set of two cones sealed/glued together for strength.*

In File D/M-14 we find Professor Noël Dilly using a series drogue on his 28-ft. Twister, *Bits*. The drogue did exactly what it was designed to do, a testimonial to the ingenuity and hard work of its creator, Donald Jordan. Sailors leaning towards the series drogue should read and re-read D/M-14. Noël Dilly made the drogue himself, out of old spinnaker cloth, using a household sewing machine. Any sailor should be able to do the same, perhaps with a little help from a kind-hearted wife. Note how Noël Dilly prepares *Bits* in anticipation of boarding seas:

> *We have massively strong washboards. We seal the cockpit hatch joints with 2" duct tape, also the cockpit locker lids (we have discovered how leaky allegedly waterproof locker lids can be). Finally we move the life raft into its gale storage position, which is on the cockpit sole. It is secured in place by two straps that are jointed by a long pin, such that if you pull the pin the straps are released. This storage has two advantages. First it reduces the weight of water in the cockpit when you get pooped. And second, it is a much more secure place for the life raft than exposed on deck where a breaking storm sea might easily take it, just when it might be needed.*

Regarding the motion of the yacht, Noël Dilly says the following:

> *I think the series drogue ride is a stable affair. Once deployed, description of the new motion of the boat as "bungee jumping" is a good one. Be prepared to hang on, or better still retire to your berth* [Jordan recommends that everyone be strapped in by aircraft-types seat belts inside the boat]. *In the troughs, she feels loose. As you rise up the wave and the wind hits with full force she hardens up. Surprisingly this is the best time to do things below deck. Usually that's all there is to it, but if you get accelerated by a crest, you can feel it and hang on for the quite dramatic deceleration. Once the crest has passed these things stop, and you are back to the up and down thing. It is all very slow and undramatic, until there is the violent motion associated with the odd crest strike.*

In File D/M-15 we are fortunate to find a side by side comparison of a Jordan series drogue and a 2-ft. diameter parachute type drogue. Robert Burns deployed a series drogue of the stern of his 40-ft. center cockpit ketch *Peter Sanne* in a very nasty gale in the Gulf Stream. He lost it due to chafe. He then deployed a 2-ft. diameter single-element parachute drogue. Robert Burns, after deploying the series drogue:

> *The slowing effect was phenomenal. Deploying the drogue was like bungee jumping off a 30ft wave with a 40ft. yacht. The feeling of being elastically attached to the sea itself is hard imagine. After a minute or so we had slowed from 8 knots to 1.5 knots. The stern was pointed aggressively into the wind and sea. It was as if we had entered a calm harbor of refuge. The yacht held her position near the top of the waves' crests. When a wave approached and threatened to break on board, the drogue would pull us up and over the top of the breaking waves. There was no possibility of a breaking wave hitting us broadside, as we were always above the majority of the white water.*
>
> *We furled the remaining portion of the jib, tied off the helm, checked to make sure everything on deck was secured, and then went below. Inside the main cabin the noise of the gale was much less. With the reduction in the yacht's motion, our situation seemed not too bad. We were all exhausted and took the opportunity to try to get some sleep. The time was 2130. I got up several times to check the situation. Despite the roar of breaking seas as we were pulled over the tops of breaking waves, I slept surprisingly well....*

The series drogue was lost due to chafe. The motion of the yacht changed:

> *At about 0230 the sound of waves falling on deck seemed to increase and the motion of the yacht changed. Gone was the elastic "bungee effect." I was about to climb out of my bunk and put on harness to inspect the rig, when the boat heeled sharply to port under the force of a wave striking the starboard quarter. The sound of flowing water was everywhere. In the next instant the companionway doors shattered, and an angry stream of water rushed into the saloon.... I reached for the nearest overhead light... it came on to reveal the main saloon with 2-3ft of seawater sloshing above the cabin sole. Debris of the splintered hatch floated with charts, books, wet blankets and sleeping bags. The cockpit was full to the top of the coamings with frothing sea water. The night was dark, but I could still make out the towering peaks of white water around and* above *us. I glanced at the wind instruments; we were lying with the wind just aft of the beam, we had no headway. "So," I thought, "this is what it is like to lie a-hull." The priorities were to clear the boat of water, and try to repair the shattered companionway in case we were boarded by another sea. And to check what had happened to the drogue....*
>
> *I found the bridle dangling over the transom, severed on both sides. The 3/4" nylon bridle had been abraded by the self-steering mounting brackets. There was damage to the stern pulpit and deck fittings, evidence of the forces and motion exerted on the hull by the drogue before it parted the bridle.*

Burns deployed his backup drogue - a 2-ft. diameter conical parachute. Note the difference in the behavior of the yacht:

> *When all 300 ft of line was out and the chute was subject to some forward motion the line came taut. There was no bridle now, so the tow line was only attached to the starboard stern cleat. The yacht yawed to port, aligning the stern almost into the wind and sea. Our forward velocity was about 2 knots. Big waves would cause us to surge forward and down the waves faces, as the chute didn't have sufficient surface area to slow us down against the push of big seas....*
>
> *Gone was the feeling of "bungee jumping"* [associated with the series drogue]. *The forces exerted by the chute were sharper* [jerkier] *and nowhere near as powerful. However, the strategy of lying stern-to was still the most comfortable and safe. The little chute did well. We had no serious broadside wave strikes, even though there were still a lot of breaking seas around us. The chute was not able to pull us up and over the breaking waves, so the occasional wave dumped on the stern. As the yacht had a center cockpit, there was less danger of it being filled....*

There are a number of things to be said about this file, not the least of which is that *we have more to learn*. One can reasonably assume, for example, that if all this had happened in more severe conditions - such as those typified by the Queen's Birthday Storm - the difference between the performance of the series drogue and the little parachute would have been far more pronounced, even critical.

Also, in reading this file one can't help worrying about the integrity of the hatches and washboards on production boats - Victor Shane's persistent worry about the passive drogue approach. Granted, *Peter Sanne*'s companionway was shattered *after* the series drogue was lost. But note what Robert Burns says:

> *... the boat heeled sharply to port under the force of a wave striking the starboard quarter. The sound of flowing water was everywhere. In the next instant the companionway doors shattered, and an angry stream of water rushed into the saloon....*

If a wave striking from the *starboard quarter* can shatter the companionway doors of a center cockpit boat like *Peter Sanne*, what might it do to a production yacht with a stern cockpit? The implication is quite clear: *one should never take anything for granted about the integrity of the companionway on any yacht.* If one is going to opt for the passive approach, the hatch and washboards had better be massive, otherwise the sea will find a way of breaking through. The series drogue is a marvelous contraption.

Judging by Burns's description of the behavior of *Peter Sanne*, Donald Jordan's brainchild provides an ingenious method of keeping yachts aligned in storms, *providing one can keep the sea out.*

Your authors worry about the "people risk" as well. There is little to worry about as long as people stay out of the cockpit. But what if something needs to be tended to - a problem with chafe, for example? Since the yacht is more or less stationary in the water, any breaking wave striking the cockpit directly may severely injure someone in it. Being slammed into a steering pedestal or fiberglass bulkhead by tons of fast moving water isn't all that different from being slammed into a windshield during an automobile accident. Roger Olson, File S/M-22:

> *As the weather deteriorated I ran off with storm jib and storm trysail. I considered dropping the trysail but wanted it up in just case I decided to heave-to. Deployed two "MINI" tires* [makeshift drogue] *off the stern for better control. Wind and seas not too bad (40 to 50 knots) and it was going in my direction. A huge wave broke next to us, depositing ample amounts of water on me and filling the cockpit. It doesn't take a genius to realize that if the wave had been over the stern I would have been rammed against the flat aft side of the cabin. Also, I could easily imagine this wave carrying me to the end of my harness tether. If the tether didn't break it would surely break my ribs. So I decided to come about and heave-to.*

Xiphias was "going with it" - running and being steered. Even so, Roger Olson could see how that he might be seriously injured by a breaking wave. With a series drogue deployed a yacht is more or less dead in the water, hence the threat of bodily injury has to be taken very seriously. When working on a slippery bow, deploying a sea anchor, for example, one is usually in a crouched position, on one's knees, or even lying flat, hanging on for dear life, facing *forward*, reading the approaching waves and always anticipating trouble.

Standing in the cockpit one tends to be more at ease, likely to let one's guard down. In the cockpit one is usually standing up, with one's back to the boarding seas as well. Here also, one should be in a crouched position, *facing astern*, reading the approaching waves and always anticipating trouble.

In the Coast Guard report that he co-authored, Donald Jordan - the inventor of the series drogue - writes the following:

> **The cockpit may not be habitable and the crew should remain in the cabin with the companionway closed. In a severe wave strike the linear and angular acceleration of the boat may be high. Safety straps designed for a load of at least 4g should be provided for crew restraint.**

One should not venture out into the cockpit area with any sort of a medium-pull drogue deployed. If it is absolutely necessary to do so, one must wear a padded PFD (personal flotation device) with some sort of head gear, and one must have one's safety harness snapped on at all times.

Moreover one needs the assistance of someone standing in the companionway to warn of approaching

danger as well. When Dana Dinius was grappling with *Destiny*'s helm in the Queen's Birthday Storm, Paula Dinius was braced in the companionway with her head out of the hatch, helping him read the waves that he could not see behind him. When a great wave would approach she would give a shout and Dana would correct the helm ahead of time, without looking back.

This sort of teamwork may be called for if one ends up using the active approach in a life-threatening storm. It is absolutely called for when one is using the passive approach and someone has to go out into the cockpit area. *Any crew member venturing out into the cockpit must do so under the close supervision of a "Paula-watch"* - a new nautical term!

This Paula-watch must brace himself or herself in the companionway - washboards in place, head poking out of the hatch - wearing foul weather gear, a PFD, a safety harness.

Stout hand rails must be installed on both sides of the companionway in the interior of the yacht so that the Paula-watch can hold on with both hands while standing on the companionway steps and looking astern. The steps themselves must be surfaced with anti-skid compound - or tape.

He or she must wear safety goggles, ski goggles, or Uvex goggles so as to be able to look directly into the maelstrom. The watch must not look at the individual in the cockpit, but rather keep his or her gaze fixed astern, so as to be able to read the approaching waves and serve as eyes and ears for the person working in the exposed cockpit. The watch must give a loud shout - or blow a whistle - if he or she sees a dangerous sea coming, so that the individual in the cockpit can "hit the deck" and hang on for dear life. Methods of communication must be established among crew members to this end - voice signals or whistle blows that can be heard above the screech of the wind. Whistles must be the sort that will continue to sound when drenched with water.

Having said all that, maybe the risk of boarding seas, when static in the water using a Jordan Series Drogue, is not as high as one might expect. Typically the water cascading forward from a breaking wave falls onto something that is positioned on the *face* of the wave and is *sliding (surfing) down that wave.* As the wave breaks, the boat is carried with it, and thus stays positioned right under the crashing water. With the Jordan drogue in tow, the boat is static and, as Robert Burns said:

> *The yacht held her position near the top of the waves' crests. When a wave approached and threatened to break on board, the drogue would pull us up and over the top of the breaking waves. There was no possibility of a breaking wave hitting us broadside, as we were always above the majority of the white water.*

Instead of sliding down the wave under the force of tons of falling water, the boat stays static, and the wave, with its breaking crest, passes below.

Do we know for sure that this is what happens? Unfortunately not - we need many more reports of boats using Jordan drogues in *serious* weather before we can draw any firm conclusions. Comparative reports, such as Robert Burns' with and without the series drogue are particularly useful.

The series drogue was specifically designed for the passive approach. The "bungee jumping" alluded to by Noël Dilly and Robert Burns is a saving grace, not a danger. Bungee jumping to a series drogue is not to be confused with bungee jumping to a large sea anchor off the stern. The former would be analogous to jumping off a bridge with bungee cords attached. The latter would analogous to jumping off a bridge with ordinary rope attached.

Unlike a large sea anchor, the series drogue allows a great deal of precisely tailored yield in the event of a wave strike. With anything bigger off the stern the yacht will surge ahead, only to come up short against the pull of a large, *unyielding* device. Even if the device is a relatively small parachute, the yield signature is not the same as that of the series drogue.

In file D/T-2 we find delivery skipper Thomas Follett using a 5-ft. diameter Shewmon *sea anchor* off the stern of a 60-ft. trimaran in Force 9-10 conditions. No steering involved. The boat was brought to a grinding halt and stayed glued where it was for 36 hours. With only 100-150' of rode payed out Follett reported that there was unbearable strain on the everything, "too great to risk paying out any more line after we got the thing made fast."

Days later he used a 3-ft. diameter Shewmon low-pull drogue off the stern of the same boat. "Worked much better," he reported, "lots of shipping about and we could maneuver with the engine (drogue still out) whenever necessary. Didn't stop us but slowed us down a lot and was very comfortable."

In file D/C-1 we find Walter Greene deploying a 4-ft. diameter Shewmon *sea anchor* off the stern of the 50-ft. catamaran *Sebago*. No steering involved or possible, and great strains again. He said, "The sea anchor really beat the hell out of the boat - deck gear and waves crashing on the boat."

Victor Shane is of the opinion that medium-pull drogues require much longer rode lengths. This is in marked contrast to the use of low-pull devices where one can tailor the length to the conditions, and very short lengths can sometimes be optimal.

Had Walter Greene used 600' of rode instead of 250-300 feet he would no doubt have found the seas much more comfortable. Had the crew of *Rogue Wave* (File D/T-3) been able to let out 500' of rode instead of only 150', no doubt they too would have found the seas much more forgiving.

In File D/C-2 we find John Kettlewell deploying a BUORD para-anchor off the stern of his 31-ft. catamaran *Echo*. This ordnance parachute has a porous canopy with an inflated diameter of about 6 feet, making it a medium pull-drogue for some vessels. Kettlewell was wise enough to pay out 400' of tether and the crew was able to go down below and get some rest on the floor of the saloon area. John Kettlewell:

> *In general we were very pleased with the performance of the drogue. As I stated previously we could not lie bow into the wind with this size chute. I wonder if we had removed our roller furling jib we could have laid bow to.... In any case I'm sure I would now prefer to run before the seas on this boat. Our cockpit is well protected with a strong door and great drainage due to the motorwell for the outboard. I think it is useful to give with the punches of the waves. We even raised our rudders to take the strain off them from wave hits.... With a bridle to each stern the drogue held us straight on to the sea and we did not have to steer....*

> *Our rode consisted of 2 x 200' lengths of 1/2" nylon connected by a large shackle in the middle. I feel your length recommendations (i.e., LOA x 10) may be a bit short. I was certainly happy I had 400' of rode!*

Perhaps the rule should be changed to *LOA x 15* in association with medium-pull drogues. Had Kettlewell deployed only 200' of rode *Echo* would no doubt have taken a terrible beating. But such beatings can be expected when using any sort of medium-pull drogue in storms. Dana Dinius, File D/M-12:

> *For those who do not wish an active part, a much larger drogue that would hold the boat at a snail pace, "perhaps" would give the resistance needed to stay stern-to with the aid of an autopilot. We are sure, however, the boat would take a terrible beating given the size and power of the seas we experienced. As it was, we lost most of our cockpit canvas and saw extensive damage to the supporting stainless steel long before the pitch-pole.*

In File D/C-9 we find the 44-ft. catamaran *Anna Kay* taking a terrible beating in the Gulf of Tehuantepec. She was using a 9-ft. diameter Shewmon *sea anchor* off the stern with only 250' of 3/4" tether. Given the diameter of the drogue, and given that wind was blowing 120 knots, *Anna Kay* might have fared a lot better with 600', 800' or even 1000' of line out. One can't help thinking, though, that a series drogue might have been the salvation of this boat.

The sailor who leans towards the active approach will argue that he would prefer something that didn't stop the boat entirely. The sailor who leans towards the passive approach might argue that he would prefer a drogue that could take total control of the situation, allowing him and his crew to rest down below - out of harm's way. The former may have a yacht with a wide, vulnerable transom. The latter may have a double-ender with a well protected center cockpit. Or perhaps a multihull with lots of stern bouyancy. The former may be trying to inch his way out of the dangerous quadrant of tropical storm. The latter may be wanting to anchor his ship and allow a fast moving front to pass overhead.

Any number of other variables might come into play in the making of such decisions. Every situation is different, every crew is different, every boat is different, every gale is different. The decision as to which approach to use must take into consideration many factors.

Looking to the Future

One would hate to think that a method of investigation, hopefully well worked out in the pages of this book, might end up as a consumer device to push sea anchors or drogues as "magic bullets."

There are no magic bullets at sea.

Only human ingenuity, coupled with the obstinate tradition of seamanship will answer. Sea anchors and drogues are products of human ingenuity. Both belong in the inventory of a cruising yacht. Both have already saved life and property at sea. With their vices and virtues clearly understood, they stand to save much more in the future. Victor Shane himself would not think of putting out to sea without *several* drogues and *several* parachute-type sea anchors. We find many of the sailors featured in this publication expressing a similar sentiment. Jeremiah Nixon, File S/M-5:

> *These are some of the reasons why I consider this equipment the most important safety item on my boat.... I will never make an ocean passage without one on board. People must realize that ocean cruising can be safe if you go with the idea that you will go into a defensive position before the seas build too high. The flat-out philosophy of professional racers must be disregarded by the small crew cruising yachts.*

Captain Jerry Sidock (File S/M-9):

> *I would like to say that I don't think that common sense would permit me to leave shore without my sea anchor. It is just too difficult at times to continue on when short-handed, or rather single-handed, as I am most of the time. It is at that time that I look for assistance from other sources, such as a sea anchor.*

Solo circumnavigator Brian "BJ" Caldwell, File S/M-27:

> *I don't know how our family cruised for six years without this. There's no excuse for leaving on a long cruise without a sea anchor and a drogue....*

Delivery skipper Phil Herting, File S/T-9:

> *I hate to think of the situation if we had not had the para-anchor with us. It should be considered a vital piece of gear when making any substantial offshore passage.*

Delivery skipper Warren Hawkins, File D/M-9:

> *The very instant that the Galerider took hold it was as if you had pushed a button and calmed the gale. We made a quick jury-rig repair on the tiller (which lasted all the way to Honolulu) and the*

> *motion of the vessel was such that we could take normal steering watches on the tiller and the off watch could get some sleep.*

Sir Peter Blake, File D/T-1:

> *We just about lost the boat on two occasions at that point going down the mine, until we got the drogue out the back and then suddenly we could relax. That really was a matter of survival. It was an "if we don't get the drogue out we're not going to be alive" scenario. There was no maybe to it that time.*

Are we arguing towards an implicit hypothesis? Are we subjectively handling the data in such a way that our optimism undermines our objectivity? To date we have not compiled nearly enough files to do the subject the justice it deserves. And yet there is great promise in these initial studies. The subject, although complex, would seem to be tractable.

A foundation has been laid upon which one can make claims, not that certain things will *always* happen, but rather that certain things will *probably* happen. We hope thus to adhere to the spirit of the scientific method as we understand it and thereby to leave open the way to more learning. Certainly we have a lot more to learn on this vast subject. As more and more files are added to the DDDB, we will learn more about various classes of vessels, keel types, rigs, hull shapes, tethers and the many modes of deployment.

For this reason we implore you, if you have been through a survival storm, whether or not you used a drag device: please submit a report to us. The more reports we have, the better we can all learn. Likewise, if you know someone else who has been through such an experience, please encourage them to contact us.

There are at the same time limits to everything on this earth and we will never achieve the level of certainty that some seem to demand of life. By now, all the same, we can feel secure in a substantial practical knowledge of the ways in which drag devices can play an important part in safety - and even survival at sea.

Section 4: Appendices

Appendices

Appendix I - Books to Read

Adlard Coles' Heavy Weather Sailing, Sixth Edition **by Peter Bruce (May 19, 2008)**

See also previous editions: Third Revised Edition 1981, John de Graff, New York, London. Fourth Edition 1992, International Marine, Camden, Maine. «This book should be read and reread by every yachtsman.» (Peter Blake, from the foreword to the Fourth Edition).

Fastnet, Force 10: The Deadliest Storm in the History of Modern Sailing **by John Rousmaniere (Apr 17, 2000)**

The story of the great Fastnet storm of 1979, expertly documented and written by one of its participants. Older editions are also avaiable.

Rescue in the Pacific: A True Story of Disaster and Survival in a Force 12 Storm **by Tony Farrington (Mar 1, 1998)**

Blow by blow account of the Queen's Birthday Storm of 1994. «The human spirit... is the best survival tool there is. That is but one of the lessons of this valuable, enthralling book.» (John Rousmaniere, from the foreword).

Heavy Weather Tactics Using Sea Anchors and Drogues **by Earl Hinz (Jan 1, 2010)**

A highly detailed analysis of sea anchors and drogues - how they work, what they do, how and when to use them for different types of boats, and so much more.

Storm Tactics Handbook: Modern Methods of Heaving-to for Survival in Extreme Conditions, 3rd Edition **by Lin Pardey and Larry Pardey (Jul 1, 2008)**

A treasure trove of information on methods of heaving-to. Practical tips on how to read sea and sky for the approach of weather, how to avoid the dangerous quadrant of storms, how to rig storm sails, prevent chafe, etc. Case histories and checklists for storm management.

The sea anchor & drogue handbook **by Daniel C Shewmon (1998)**

A wealth of analytical information. Sea anchor and drogue construction techniques. Numbers, tables, charts and graphs relating to wind-loading, sea anchor loading, drogue loading, etc. Unfortunately now out of print, but used copies are still available.

Survivor **by Michael Greenwald (Oct 1, 1989)**

Every aspect of survival from life rafts to rubbing sticks together to make fire on a deserted island.

Oceanography and Seamanship **by William Van Dorn (Jan 1, 1993)**

This large book belongs on the shelf of every cruising yacht as it contains invaluable information about a host of related subjects, including weather, currents, stable and unstable wave formations, sea states, tactics and tools of seamanship.

The list of valuable books one could take along on a cruise is endless. From Royce's *Sailing Illustrated* to Rousmaniere's *The Annapolis Book of Seamanship* to Marchaj's *Seaworthiness, The Forgotten Factor*, to the marvelous writings of Voss, Slocum, Guzzwell, Dumas, Smeeton, Moitessier, Hiscock, Street, Callahan and many other renowned sailors, the bookshelf of the well-found cruising yacht will boast of many titles.

Appendix II - Weather Information

The best way to survive a storm is to avoid it. We are fortunate that these days that is much easier than it was in the days of old - or even in the days of the early editions of the DDDB.

The two most notable developments are GPS, which tell you exactly where you are at any moment, and satellite phones.

The satellite phone, if you interface it with your laptop, allows you to receive GRIB weather files, and other weather information, either on demand or on a schedule. That means you can have up to date weather forecasts even in the middle of an ocean!

This can also be done using HF/SSB and a suitable pactor modem. The catalogue function on Win Link 2000 has good weather information for just about anywhere you would want to sail.

Plus, of course, weather forecasting itself has come a long way.

Below we have listed some resources that may help you to plan your cruise, and keep updated during your passages. Don't wait until the day you depart on an ocean crossing to investigate these: test and make sure your weather information system is working reliably before you cast off!

National Hurricane Center – the horse's mouth for hurricane and storm forecasts and advisories for both Atlantic and Pacific. Also some useful graphic tools showing predicted wind strength probabilities. The **Tropical Weather Discussion** and **Offshore Waters Forecast** are perhaps the most important on a daily basis, and are available as low-bandwidth text files making them suitable for satellite downloads. They can be found in the 'Text' section of the NHC Marine Forecasts page. Note that these are **human generated forecasts**, not just computer models as are the GRIB files. As such they are invaluable and FREE.

Ocean Prediction Center – for cross Atlantic and Pacific weather charts and synopsis etc.

StormCarib: Caribbean Hurricane Network – Useful local reports from all the Caribbean Islands with and emphasis on forecasting and tracking tropical storms and hurricanes. Also has some very interesting archives on historical hurricane frequences and tracks.

Climatology of Global Ocean Winds – average historical winds for all the world's oceans. Good for cruise planning.

Saildocs – receive free GRIB files by email, and use their free GRIB viewer, Viewfax . This is the service to use if you want to receive weather info through your satellite phone.

Zygrib, available free from zygrib.org, is another GRIB viewer that will also automatically download GRIB files if you have an internet connection – or will read files you have downloaded separately or have received by email.

MailaSail offers a GRIB delivery service, and also provides good information on choosing a satellite phone and, most importantly, how to interface it with your laptop so as to receive emails (such as GRIB files) through your satellite connection. IMPORTANT: if you connect your laptop through a satellite connection you MUST turn off all the automated updates etc. that your laptop does in the background, otherwise your satellite connection will grind to a halt. Better still, use a dedicated laptop with a totally clean installation, just for your at-sea navigation etc.

Live Weather Reports. Another free service that will send you the latest weather and sea state reports from ships within 300 nm of your current position. Just send an email with your current position, and receive the weather report back.

PassageWeather.com also provides online grib display, plus wave heights and some other useful graphics.

Frank Singleton's Weather Pages – Very informative. Frank is an ex UK Met office meteorologist and now a live-aboard cruiser. His site has loads of information about weather, how to read weather reports, what makes the weather etc, and sources from which to get reports and forecasts.

NAVTEX: for frequencies and schedules see Frank's Navtex Schedules page and also WORLDWIDE LW Navtex Broadcasts

Weather Underground – whole host of global information: weather reports, storm watches, tutorials, etc

Cruisers Forum has a thread devoted to marine forecasting. Very interesting.

Weather Routing Services

If you want more individualized weather advice, there are several companies that will, for a fee, give you weather routing advice specifically tailored to your own personal circumstances. These services are frequently used by racing yachts, but are equally suitable for cruisers. They will want to know your intended route and departure dates, the type of boat you have, and your weather tolerances (e.g. how much 'rough' weather are you happy to tolerate).

The companies listed below are only a small selection, and have not been tested by the authors.

Commanders Weather

Weather Routing International

Rich Shema - The Weather Guy

Bob Jones - Ocean Marine Nav Inc

Bob Cook - Ocean-Pro Weather Services

WeatherWeb - UK based, but also provides bespoke forecasting for Atlantic crossings.

Chris Parker - Caribbean, Bahamas and East Coast of USA

NOTE: If you get yourself a satellite phone, pre-program into it the emergency phone numbers for the coast guard of your home country, and the countries nearest to you, plus any other emergency numbers that might be useful.

Appendix III - Drag Device Manufacturers & Suppliers

Below are listed the major manufactures and suppliers of various drag devices. All of these have put significant time, energy, and money into designing and developing their products.

There are also many chandlers around the world that stock and supply various types of sea-anchors (including, unbelievably, some of the old cone patterns), and drogues. When possible we recommend dealing directly with the manufacturers as from them you will get the best expert advice for your own personal situation.

The ones that support and contribute data to the DDB are shown in bold. This does not mean their devices are better - but it does indicate that they are open-minded and willing to share what they learn with the wider community for the overall improvement of safety at sea. We encourage you, where possible, to deal with these suppliers.

If you do chose to use a supplier that is not currently supporting the DDDB please use your influence as a customer to persuade them otherwise! The more freely we can share data, the better we can ALL learn. There are plenty enough seafarers to provide enough customers for ALL the manufacturers if they can work with a spirit of 'co-opetition' instead of pure competition.

And, once again, if you have occasion to use a drag device in a storm (or even in more moderate conditions but have some learning points to pass on) please contribute your experiences to the database!

Ace Sailmakers **(Dave Pelissier) - Jordan Series Drogues in complete or kit form.**

Para-Tech Engineering **(Don Whilden) - Para Anchors and Delta® drogues**

Coppins Sea Anchors - Para Anchors ranging from 3m (10') to 40m (130') in diameter

Fiorentino (Zack Smith) - Para Anchors and SHARK™ drogues

Hathaway, Reiser and Raymond - Galerider drogues

Para-Anchors Australia Pty. Ltd. (Alby McCracken) - Para Anchors 4 - 90' diameter and ring-slot style Para Drogues, also made in the UK by Ocean Safety

Seabrake (John Abernethy) - Seabrake drogues

Series Drogue Australia (Brian Glover) - kits and fully completed Jordan Series Drogues.

If you know of other manufacturers, please let us know!

Appendix IV - Hardware Ratings, Chain and Rope Strengths

A Basic Sampling. Refer to Manufacturer's Data Sheets for Actual Figures

SWL & BL Rating Methods

Most hardware, chain and rope manufacturers provide two different ratings: 1) **SWL** (safe working load) and 2) **BL** (ultimate breaking load). Safe working loads are given as guides only and most manufacturers warn that the **SWL** should not be exceeded. Ultimate breaking loads are usually at least four times the safe working load and sometimes as high as six times. Some manufacturers provide an intermediate rating known as the **PL** (proof load). The proof load (usually twice the **SWL**) is the load which the product withstood without deformation when new and under laboratory test conditions.

Screw Pin Anchor Shackles

These are usually the sort of shackles one ends up using for anchoring purposes. The SWL ratings are usually stamped on galvanized ones. Stainless steel screw pin anchor shackles have similar ratings. The following apply to galvanized ones made in Japan, for example:

SIZE	SWL	BL
1/4"	1,000 lb.	6,000 lb.
5/16"	1,500 lb.	9,000 lb.
3/8"	2,000 lb.	12,000 lb.
7/16"	3,000 lb.	18,000 lb.
1/2"	4,000 lb.	24,000 lb.
5/8"	6,500 lb.	39,000 lb.
3/4"	9,500 lb.	57,000 lb.

Swivels

Stainless steel swivels are preferable to galvanized ones, though strength ratings may be similar. The following apply to good quality galvanized ones made in Japan:

SIZE	SWL	BL
1/4"	850 lb.	4,250 lb.
5/16"	1,250 lb.	6,250 lb.
3/8"	2,250 lb.	11,250 lb.
1/2"	3,600 lb.	18,000 lb.
5/8"	5,200 lb.	26,000 lb.
3/4"	7,200 lb.	36,000 lb.

Chain Ratings

Three different types of galvanized chain can be incorporated into the anchor, sea anchor or drogue tether. 1) **Proof Coil**. 2) **BBB**. 3) **High Test**. The longer links found on proof coil are not compatible with most windlasses. BBB's shorter links are. High Test chain has the highest strength-to-weight ratio but the odd size link requires a windlass that will accept it.

Proof Coil & BBB

SIZE	SWL	BL
1/4"	1,250 lb.	3,000 lb.
5/16"	1,900 lb.	5,000 lb.
3/8"	2,600 lb.	10,600 lb.
1/2"	5,500 lb.	18,000 lb.
5/8"	6,900 lb.	27,600 lb.
3/4"	9,750 lb.	39,000 lb.

High Test

SIZE	SWL	BL
1/4"	2,600 lb.	7,750 lb.
5/16"	3,900 lb.	11,600 lb.
3/8"	5,400 lb.	16,200 lb.

Basic Nylon Rope Strengths

High quality treated ropes may be significantly stronger and up to 5 times more abrasion resistant than the cheaper, commercial-grade economy brands sold at ordinary hardware stores. As far as drag device tethers are concerned, braid may be preferable to three strand as it does not torque (try to unlay) under load. Most three strands will provide about 16% stretch at 15% of their breaking strengths, while most braids will provide about 7-10% stretch thereabouts.

Premium Three Strand

SIZE	Average Break Strength

1/4"	2,000 lb.
3/8"	4,400 lb.
1/2"	7,500 lb.
5/8"	12,200 lb.
3/4"	16,700 lb.

Single Braid (European "Multiplait" Equivalent)

SIZE	**Average Break Strength**
1/4"	2,000 lb.
3/8"	4,400 lb.
1/2"	7,500 lb.
5/8"	12,200 lb.
3/4"	16,700 lb.

Premium Double Braid

SIZE	**Average Break Strength**
1/4"	2,300 lb.
3/8"	4,900 lb.
1/2"	8,500 lb.
5/8"	15,300 lb.
3/4"	19,700 lb.

Appendix V - Meteorological Events by Month

METEOROLOGICAL EVENTS BY MONTH

EVENT	AREA	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NE MONSOON	S CHINA SEA												
SW MONSOON	S CHINA SEA												
SW MONSOON	ARABIAN SEA												
TROPICAL CYCLONE	BAY OF BENGAL												
TROPICAL CYCLONE	ARABIAN SEA												
TROPICAL CYCLONE	SW INDIAN OCEAN												
TROPICAL CYCLONE	WESTERN AUSTRALIA												
TROPICAL CYCLONE	ESTERN AUSTRALIA												
TYPHOON	SW NORTH PACIFIC												
HURRICANE	SE NORTH PACIFIC												
HURRICANE	SW NORTH ATLANTIC												
ICEBERGS	GRAND BANK												
PACK ICE (75% COVERAGE)	ESTERN CANADA												
PACK ICE (75% COVERAGE)	GULF OF BOTHNIA												
PACK ICE (75% COVERAGE)	KURILE BASIN												
SUPERSTRUCTURE ICING	N. PACIFIC, N. ATLANTIC												
EXTENSIV FOG	N. ATLANTIC												
EXTENSIV FOG	N. PACIFIC												
TEHUANTEPECAR	S. COAST MAXICO												
MISTRAL (GALE)	MEDITERRANEAN												
FREAK WAVES	S. AFRICA												

Period of likely Occurrence
Peak period

ref : Oilfield Seamenship Vol 8, page 694. (Oilfield Publications Limited)

Appendix VI - Offshore Checklist

Use this handy suggestion list before putting out to sea, revising and adapting it as necessary.

Peace of Mind

- Had the boat surveyed.
- Hauled out, hull inspected and bottom painted.
- Rudder checked.
- Rudder fittings checked.
- Steering cables & pulleys inspected.
- Zincs checked.
- Thru-hull fittings inspected.
- Engine shaft, prop etc. inspected.
- Batteries checked out.
- Masthead, spreaders & rigging thoroughly inspected.
- Ship's main compass checked and adjusted for deviation.

Offshore Necessities

- Certified life raft.
- Class A EPIRB (Emergency Position Indicating Radio Beacon).
- Immersion suit.
- Sea anchor & tether.
- Drogue & tether.
- GPS.
- Autopilot.
- Self steering - **don't put out to sea without a good windvane!**
- Cockpit dodger (a must for cruising).
- Emergency hand-pumped watermaker.
- VHF radio.
- SSB and/or Satellite phone (e.g. Iridium)
- WeatherFax (or set up and test receiving weather info by SSB or Satellite).
- Hydraulic wire cutters.
- Calamity pack.

Sail Inventory

- Heavy (6 oz. minimum) cruising mainsail near new.
- Heavy working jib.
- No. 1 & 2 Genoas.
- Storm jib, near new - "the cheapest sail in the inventory, but the one you'll be needing most in heavy weather!"

- Storm trysail on a separate track.
- Drifter/spinnaker.
- All sails - stitching, reef points & reefing systems checked by a sailmaker.
- All running rigging, blocks & winches inspected & refurbished if necessary.

Safety Items

- Hand-held VHF radio (better still, have two - one stored in the calamity pack).
- Life jackets for all.
- Safety harnesses for all.
- Installed jack lines.
- Whistles for the crew (make them wear it around their necks like dog tags).
- Man O'r board flag, life ring or horseshoe, ready for the heaving.
- Approved fire extinguishers **in working order.**
- Flare gun and assorted flares.
- Marker dye.
- Horn.
- Signal mirror.
- Hand held strobe/s.
- Running lights, spreader lights, navigation lights and masthead strobe checked.
- Cyalume light sticks.
- Assorted flashlights and spare batteries.
- Watch & clock batteries.
- Pumps, bailers, plastic and stainless steel buckets - "no better pump than a frightened sailor with a bucket in his hand!"
- Dinghy, tender and paddles.
- Boat hook.
- Heaving line.
- Boarding ladder.
- Wooden plugs for thru-hull fitting.

Ground Tackle: Oversize!

- Ship's reserve/storm anchor.
- Ship's working bow anchor.
- Ship's stern anchor.
- Lunch hook.
- Adequate lengths of anchor chain.
- All told at least 600' of new nylon anchor rode, for various anchoring applications (can be segmented).
- Related hardware.
- Oversize mooring swivels, shackles etc. - don't forget to wire **all** of your shackles!! (don't use cable ties, as they deteriorate in sunlight)

First Aid

Consult your personal physician for your particular needs, special prescriptions/medications etc.

- Bandages & bandaids.
- Antiseptic cream and spray.
- Eyewash.
- Compress.
- Inhalant.
- Antacids and laxatives.
- Codeine.
- Analgesic.
- Dramamine or other sea-sickness meds that WORK for you. Also consider taking them as suppositories (so you can take them even if you are throwing up). Scopolamine patches can also be applied *after* you are already seasick.
- Vaseline.
- Chapstick.
- Sunscreen lotion.
- Water purification tablets.
- Insect repellent.
- Nail clippers.
- Scissors.
- Tweezers.
- Dental floss.
- Oil of cloves.
- Emergency dental kit.
- Spare prescription glasses.

High Priority Items

- Wet suit & diving weights.
- Mask, snorkel & fins (need several pairs of spare straps for these).
- Alarm clocks - TWO OF THEM!
- Binoculars: be sure to purchase 7 x 50, or 10 x 50 optics as these have higher light gathering capacity.
- Thick wool sweaters.
- Foul weather gear.
- Sailing boots.
- Assorted parkas, jackets, gloves and items of clothing.
- Plenty of hammocks to keep clothes high and dry.
- Ski or Uvex storm goggles.

Navigation

- Ship's main compass.
- Ship's backup compass.
- Hand bearing compass.

- Sextant (and know how to use it!).
- Quartz watches.
- Short wave receiver (to set the watches by, - tune to **WWV, 5, 10, 15 and 20 Megahertz** for the time ticks and listen in at 7 and 48 minutes after the hour for Atlantic and Pacific weather warnings.
- Nautical almanac.
- Reduction tables, etc.
- Divider.
- Parallel rulers.
- Pens, pencils & erasers.
- Ship's Log, note books and jotting paper.
- Triangle.
- Protractor, etc.
- Coast Pilot (domestic).
- Sailing Directions (foreign).
- Charts.
- Pilot Charts - shipping lanes and a great deal of other very useful information on Pilot Charts - ask for "Pilot Charts" by name.
- Tide tables, etc.
- Spare GPS. Another spare GPS. Many handheld GPS units can be interfaced with your laptop (loaded with charts such as OpenCPN) to provide a backup to your main chartplotter.

Tools, Tools, Tools

- Assorted screwdrivers.
- Assorted pliers.
- Wrenches (both combination and socket).
- Large Vise-Grips (Vise-Grip's cam action will cut through ¼" wire in 5 tries)
- Small Vise-Grips.
- Wire cutters.
- Spanners.
- Sparkplug wrench & gapper.
- Allen wrenches.
- Scratch awl.
- Files.
- Chisels.
- Hammers.
- Axe.
- Crow bar.
- Wood saw.
- Hacksaw & blades.
- **Hand drill and bits - buy the very best.**
- Nicropress tool and assorted nicropress sleeves.
- SS Rope clamps - 2 rope clamps will do the job of one nicropress.
- Grommet kit & assorted fasteners (use hammer and board to install these on canvas & sails).
- One extra large C-clamp.

- Assorted nuts, bolts & nails.
- Glass cloth & resin.
- Epoxy resin.
- Assorted glues.
- Spare paints & thinner.
- Brushes.
- Scrapers.
- Lacquer thinner (best all around solvent).
- WD-40.
- Silicone caulk.
- Lot and lots of duct tape (you can repair sails with this stuff).
- Stainless Steel wool.
- Industrial razor blades.

Marine Items

- Depth sounder.
- Radio direction finder.
- Barometer - don't put out to sea without a good one.
- Anemometer.
- Radar reflector.
- Two masthead feathers (wind indicators) - keep one in reserve in case the other one gets blown off.
- Bosun's chair and mast steps.
- Cockpit awning for those hot days.
- Spare winch handles.
- Spare blocks.
- Spare turnbuckles.
- Assorted snaphooks, SS shackles & fasteners.
- SS cotter pins - never use cotter rings, use cotter pins instead
- SS Seizing wire.
- Hose clamps.
- Rigging knife & stone.
- Sail repair kit.
- Dacron scraps.
- Assorted lines, cables, webbing, shock-chord, velcro.
- Emergency underwater epoxy - **don't put out to sea without at least a quart of Z-SPAR SPLASHZONE** as this stuff can effect wet/dry repairs like nothing else can.
- Book of knots.
- Other marine books.

Engine

- Crankcase/2-cycle and gear oils.
- Grease.
- Spark Plugs.

- Spare filler cap wrenches.
- Sheerpins.
- Spare prop, shaft collars and related items.
- Spare parts.
- Filters, gaskets.Have enough oil and fuel filters for multiple changes at sea.
- Diesel additives etc.

Miscellaneous

- Rods, reels, hooks, lures, weights, gaff.
- Large, three-prong grappling hook (also good for retrieving lost anchor lines, etc.)
- Camera and lots of film.
- Hats & spare Polaroid sun glasses.
- Blankets, etc., including thermal "space blankets."
- Tarps & shades.
- Sandwich, zip-lock & garbage bags.
- Plastic wrap.
- Aluminum foil - wrap some around a fender, hoist it up on a halyard and you've got an emergency radar reflector.
- Drinking straws.
- Waterproof matches & Bic lighters.
- Candles & clothes pins.
- Towels.
- Paper towels.
- Toilet items.
- Toothpaste & brush.
- Sea soap - else use liquid detergents.
- Several Can openers.
- Assorted scissors, large and small.
- Propane, kerosene alcohol & other fuel for the stove.
- Several stainless steel Thermos jars.
- Mosquito netting & attire.
- Thermal underwear & socks.
- Hot water bottle & catalytic hand warmer.

Food & Sustenance

- Fresh water (allow at least one gallon per person per day to be on the safe side).
- Dehydrated and/or freeze-dried dinners, vegies, etc.
- Dried fruits.
- Tinned bread.
- Butter/margarine (in plastic containers).
- Cheese.
- Spreads.
- Peanut butter.
- Honey.

- Dried milk, oats, rice, potatoes, flour (sealed in **double** zip-lock bags).
- Sugar, salt, pepper & spices.
- Cookies.
- Nuts.
- Tea, coffee & cocoa.
- Tang.
- Canned goods (stew, beef, corned beef, chicken, spaghetti, sardines, soups etc.)
- Eggs (raw, coat the shells with salad oil).
- Bread (preservatives added).
- Olive oil.
- Potatoes & onions.
- Vinegar.
- Pickles.
- Lots of lemons/juice.
- Fresh fruits (lots of oranges) & vegetables.
- Vitamins.
- Mineral supplements.
- Energy bars.
- Chocolate - exceedingly good for the soul on a lonely watch at night.
- Lifesavers & chewing gum.

Spare Parts

Go through every item on your boat and ask yourself "if this fails in the middle of the ocean is that going to be a problem". If the answer is yes, stock a spare part.

Don't Forget

To file a FLOAT PLAN with friends or relatives, to take along valid registration, passport, visas & documents, along with phone numbers, addresses, credit cards & travelers checks...

Appendix VII - Multihull Capsize Protocol

As always, the hardest part is facing squarely the potential for calamity and* doing *the simple things ahead of time to make coping with capsize easier. In the unlikely event of disaster you will be prepared.

Chris White,
The Cruising Multihull

Required Reading

The most authoritative text on dealing with capsize is contained in Jim Brown's book,The Case for the Cruising Trimaran by Jim Brown (Jun 1, 2010). Also of great value is Chris White's excellent work,The Cruising Multihull (Sep 1, 1996).

Psychological Preparations

The vices of the unpredictable sea notwithstanding, the medium of the ocean beneath is supportive of life. An exuberant variety of fish thrive in it, even thousands of feet below the surface. Mammals like whales and dolphins call it home. We human mammals spend the first nine months of our lives fully immersed in the saltwater environment of the womb. We enjoy going to the beach and swimming in the ocean later on in our lives. No doubt in a generation or two we will be living beneath the sea, farming its bounty, mining its beds, and perhaps even learning how to communicate with whales and dolphins. There is no reason for us to fear such a medium. There is no reason for us to perish when we are accidentally immersed in it.

Multihull capsize need not be the end of the world. It may be an inconvenience, a discomfort and a temporary setback, but it is not the end of the world. With seamanship and the proper use of sea anchors and drogues the chances of multihull capsize can be greatly reduced. And even if a multihull *does* capsize, it need not result in loss of life. But unless the crew is *prepared* to deal with such an eventuality lives may be lost. Loss of life is by and large caused by two things: 1) Drowning. 2) Hypothermia.

Drowning

We humans need oxygen to survive. If our lungs become clogged with water we may expire from oxygen-deprivation. Those who die of drowning likely do so because they are not wearing a life jacket and can no longer keep their heads above water. Safety experts, the Coast Guard and the Navy will all tell you that those who wear life jackets consistently outlive those who don't. The slogan of the California Department of Boating and Waterways is very much germane to the present discussion:

Wear your life jacket,

It's your friend for life!

Wear your life jacket during and after deployment. Don't take it off after you have deployed the sea anchor or drogue. Keep it on for the duration of the storm. If you don't like bulky life jackets there are other PFDs (personal flotation devices) on the market that have the look and feel of an ordinary parka. Some even come with integral safety harness.

Most of those who die after falling into the cold sea die of hypothermia. Most cold water drownings are in reality caused by the hypothermia-related loss of gross bodily functions - the use of arms and legs to tread water and keep afloat - and loss of consciousness.

Hypothermia: The Real Killer

The medium of the ocean is supportive of life. Dolphins are happy to spend their whole lives in it. We humans have bodies that differ from those of dolphins in terms of thermal requirements, heat tolerance and cold threshold. We are geared to survive in a different temperature environment.

The mean *core temperature* of the human body is around about 37° C (98.6° Fahrenheit). *Thermoregulation* is the complex process by which the brain, the skin, the myriad thermal receptors, the arteries, the heart pump, the lungs and other organs regulate and maintain this temperature within a 1-2° C (1.8-3.6° F) margin. Even a 2 or 3° change in *core* temperature can have disastrous consequences. Every time the core temperature falls beyond 2 or 3° there is potential for a life-threatening breakdown. Muscle rigidity can be expected below 33°C (91° F). Loss of the use of limbs at 31°C (88° F). Unconsciousness and heart failure at 29°C (84°F). Certain death at 25°C (77°). *In cold waters all of the above can occur within a few minutes.*

The human body can quickly lose a great deal of heat in cold water. This hemorrhage of heat and energy results in reductions in core temperature. As we lose more and more heat, bodily systems work slower and slower until they are barely functioning.

Unless warmth can be retained/restored, our complex biological systems shut down, our cells begin to die and death from hypothermia will quickly ensue.

It is not within the scope of this publication to provide a detailed explanation of thermoregulation and the onset of hypothermia. Suffice it to say that in a physical sense we are creatures of temperature. Whether we live or die depends on whether we can maintain the core temperature of our bodies within narrow design limits. This is true of all creatures.

A dolphin's body is geared to function at a lower temperature than ours. Remove the dolphin from its element on a warm day and its core temperature will quickly rise. This is why stranded dolphins have to be rinsed down and provided with shade. Without constant rinsing and shade the creature will quickly expire from heat stroke, as quickly as a human expires from *heat loss* when immersed in cold water.

But this is where we humans have dolphins at a disadvantage. Delphinidae don't possess the technological wherewithal to construct artificial, thermoregulatory enclosures around their bodies. We humans do. That's why we have invented immersion suits. We *can* survive hypothermia in the artificial skin of an immersion suit.

Note that when the trimaran *Gonzo* capsized in File S/C-5 one of the first things that Walter Greene and crew did was to put on their immersion suits.

Note also that after deploying their para-anchor in a Force 11 storm in the Gulf of Alaska, one of the first things that Rick and Linda Kasprzak did was to put on their immersion suits. Wrote Rick Kasprzak, "...we were dressed in our survival suits and had the catamaran ready so that if we flipped, we could have access to our EPIRB, survival food and water," (File S/C-8).

On the way to Hawaii in his little open trimaran, Victor Shane was in his wetsuit for two days when he ran into gale force winds in the outer coastal waters of California. On the way back he was in his wetsuit again for a day and a half when he ran into a gale west of San Francisco.

A wetsuit can trap a great deal of heat. Divers can remain submerged in icy waters for many hours in a well-designed wetsuit.

But wetsuits are difficult to get into quickly. Immersion suits are easier. Unlike wetsuits, one can get into an immersion suit fully clothed, wet or dry. Like wetsuits, immersion suits function as full body flotation modules as well. One can survive for relatively long periods of time in cold water in the "survival pod" embodied by an immersion suit.

When the fishing vessel *Cloverleaf* rolled and sank off the Alaska Coast in 1980, Captain R.T. Laws survived 27 hours in 2.7°C (37° F) water in a Bayley Suit. "The Bayley Exposure Suit saved my life," said Laws, "without it I had no chance for survival." Without it he would have expired from hypothermia within a matter of minutes.

DON'T PUT OUT TO SEA WITHOUT IMMERSION SUITS. They are not that expensive. Bayley Suits (and similar) have been seen on sale for around the $300 mark. This suit has been approved by both US & Canadian Coast Guards and has the approval of many other international safety organizations, including SOLAS (Safety of Life at Sea Convention). A quick search online for "immersion survival suit" will produce many useful results. Three hundred dollars is not much to pay for a long and prosperous life after capsize.

There are other thermal enclosures on the market today. Mustang Suits, heat retaining storm jackets, etc. Again, a wetsuit is a likely substitute. Along with the mask, snorkel and fins, it is an absolute necessity on any long cruise. A lighter surfer's wetsuit is better than nothing. Snowmobile suits or waterproof skiing attire may keep a sailor warm. At the very least layers of clothing may ward off hypothermia in warmer climates.

When it comes to rapid heat loss the human head needs major attention. *In cold conditions an unprotected head is for all intents and purposes a heat drain valve left wide open!*

This is because skull and bone are much better conductors of heat than tissue and muscle. Huge arteries carry warm blood to the brain where the heat can be quickly conducted away into the environment.

In fact, hypothermia studies have shown that fully 50% of the heat that the body loses escapes from the head area. So in theory, at least, if the head can be protected from heat loss by wearing a thick neoprene diving cap one might be able to double one's survival time in cold water. A large diving mask would also help retain heat. At the very least, several woolen watch-caps worn under the hood of foul weather gear - or a storm parka - might extend survival time until rescue.

Multihull Classifications

Foremost among our "thermal enclosures" is the interior of the boat itself. In so far as multihulls go, capsize may invert that enclosure but in most cases it can't sink it outright. Depending on the basic *classification*, the enclosure may or may not remain the most viable and life-sustaining environment after capsize - the one that provides the easiest access to food and water stores as well. There are only two classifications:

1: Capsize habitable

2: Capsize non-habitable

Because of the air trapped in the outer floats, most trimarans are capsize habitable. In File S/T-7 we find John Glennie and crew surviving 118 days in the inverted hull of the trimaran *Rose Noëlle*, in all that time having access to water, food and shelter. A minimum dry interior height of 3-4 feet is required to make a capsized trimaran - or catamaran - habitable. Living comfortably inside such a tunnel area calls for creative ideas. Jim Brown's "capsize hammocks" would provide dry, comfortable places for an individual to sleep in, for example.

Catamarans present a different scenario. Because they float lower when inverted, and because the large main salon will usually be fully submerged, most catamarans are not capsize habitable. In File S/C-19, when the catamaran *Bayete* capsized the occupants seem to have been quickly forced outside, finding themselves on the slippery underwing deck area between the hulls. Without tethers and handholds they were quickly swept overboard and overcome by hypothermia.

YOU MUST FIND OUT WHAT CLASSIFICATION YOUR BOAT FALLS UNDER. Talk to the naval architect or the multihull designer. Make certain that your boat is in fact unsinkable - a few multihulls have been known to sink outright!

Ask the designer or builder about the level at which the vessel will float after capsize. Ask him about watertight bulkheads, air pockets and potentially habitable areas. Find out if there will be enough interior space to survive in after inversion, and if so, exactly where. One of the big challenges is finding a horizontal surface that will be above water level and on which one can lie when capsized.

Designer Chris White has solved this problem in his catamarans by building a habitation module into the

bows of his larger cats. These provide a seal-able pod into which one can retreat in the event of a capsize.

If you are having the multihull built, find out if certain areas can be filled with foam to provide additional buoyancy. There are many nooks and crannies on modern catamarans. Filling them with solid foam will make the yacht more seaworthy and increase odds of survival in case of collision with a ship, for example. It will also allow the boat to float higher when inverted.

Capsize Habitable

If you know for certain that your boat is capsize habitable, try to imagine what it will look and feel like moments after capsize. A short while ago the boat was upright and its motion was quite lively. Now that she has overturned she has settled lower in the water and has the more heavy, stable feel of a submarine. Try to imagine what you will do as cold water begins to rise around your ankles. Did you have a serious chat with the crew or family beforehand, about capsize not being the end of the world? Did you remember to give a reassuring shout of "DON'T PANIC" shortly after the boat rolled over?

The first few minutes will be critical. Remain calm. Remember, seawater is a life-supporting medium - fish live in it. Don't rush to blindly swim out from under the inverted hull - there may be a tangle of sheets, lines, stays, sails, broken mast parts, boom and other debris dangling under the boat. THINK FIRST. ACT SECOND.

If you must make your exit from under an inverted hull, plan on a safe route ahead of time. In daylight, diving goggles will enable you to pick your way.

NOTE: if you are wearing flotation gear, or an immersion suit, or a wetsuit without diving weights, the positive buoyancy of what you are wearing will tend to float you up and make you "stick" to the underside of the inverted multihull. You can still make your way out, but you may have to do it on your back, pushing off with your hands.

What will the interior look like when upside down? Will everything fall out of its place, or did you make a point of securing everything before you put out to sea? Will the cabinet doors and drawers open and disgorge their contents, or did you install positive latches on these? Will the floor boards tumble down and turn the interior into an obstacle course? Will the wet, heavy carpet float down onto your head like a death shroud? Will the unsecured foam cushions float about and try to smother your children? Will wet blankets twist around your ankles like thick seaweed? What does it take to secure such items? What does it take to plan ahead for such things? Not much.

The bilges will now be the roof over your head. Did you devise a way of removing and storing the floor boards in an orderly fashion? **Did you secure a diving light and Cyalume light sticks in the bilges?** If capsize occurs after dark you will need immediate access to emergency lighting. Remember, all the overhead cabin lights will now be underwater, and the electrics will probably have failed in any case.

Do crew members have easy access to their immersion suits? Do they know where the EPIRB is located and how to activate it?

As far as a capsized multihull is concerned the experts generally agree that it is better to stay with the boat. In coastal situations the EPIRB should bring help before too long.

In long, drawn out survival situations offshore, a man-size hole may have to be cut in the roof (bilge) of a capsize-habitable multihull. You will need tools - axe & keyhole saw.

Experts all agree that this "hatch" should be cut as high as possible. Don't cut it low or every wave will dump more water into the inverted hull. The hole that you cut out should be like a submarine hatch, high out of the water, a place of relatively dry ingress & egress, the all-important perch from which crew members can take turn standing watch, shooting distress flares, waving flags, hoisting radar reflectors on the ends of poles, etc.

Cutting out this hatch may mean violating an airlock, after which the boat will settle a little lower. Talk to your multihull designer or naval architect about this. Ask specific questions - "Where should I cut the hatch? How much lower might the hull be expected to settle afterwards?" Work together with your designer or naval architect. These talented individuals have emotional ties to their brainchilds. They care a great deal about the lives of those who venture offshore on their boats. They have vested interests in your safety. They don't want you to come to harm on one of their creations.

Capsize Non-Habitable

If you are absolutely certain that your boat is not capsize habitable then you must invest in a good life raft. Storage position of the raft canister is critical. THE CANISTER SHOULD BE EASILY ACCESSIBLE WHETHER THE CATAMARAN IS UPRIGHT OR INVERTED.

Storage location will differ from boat to boat. Some experts suggest that the canister be secured to the trampoline and its hardware topsides, where it will be accessible from both top and bottom - one would need a knife to cut the trampoline after capsize. Some life rafts, notably those designed for aircraft and commercial vessels, have an auto-inflation feature. Such a feature is not desirable as the raft may auto-inflate beneath the multihull after capsize.

Some catamarans may need a factory-installed escape hatch in the topside of one hull to allow safe exit after capsize (many already do).

Of course once outside, the best life raft in the world won't do you any good if you are instantly washed out to sea. The underwing of an inverted multihull is a very slippery place to be in heavy weather. Some sort of lifeline is imperative. You must devise tether systems, handholds and restraints that will (a) keep you from being swept off the inverted hull, and (b) allow you to make your way to the life raft. **At the very least, a length of knotted rope secured on deck and running longitudinally beneath the wing can serve as a lifeline after capsize.** A dozen or so stainless steel padeyes must be thru-bolted to the hulls close to the waterline. These can then be used to hook tethers and harnesses to.

Most safety experts agree that after successful life raft inflation the best course is to keep it tethered to the still floating mothership. For search and rescue purposes an inverted multihull is much easier to spot from

the air than a small life raft.

The use of red bottom paint on the hulls will make spotting easier as well, as will the use of orange paint on the under wing. Paint sections of the underwing with an orange checkerboard motif, an "SOS," or a large "V."

Staying with the mothership will also mean access to life-sustaining food, water, clothing, tools etc. You will need mask, snorkel and fins for diving into the hull to retrieve food and water. At least part of the total fresh water carried by the mother-ship should be in plastic jugs with screw on caps (as opposed to lift-off caps) so that it can be carried to the raft.

Tethering a life raft to an inverted multihull is not as easy as it sounds and may require much pre-planning. In heavy weather a tether might rip a single attachment point right off the rubber raft. MULTIHULL LIFE RAFTS MUST BE EQUIPPED WITH MULTIPLE ATTACHMENT POINTS.

Raft manufacturers can easily install additional attachment points. No harm in asking them to install a dozen large, specially reinforced ones on your raft. One could also rig some sort of collar that would go all the way around the raft, perhaps from trampoline netting material, or a sail. A working jib, properly rigged, might make an excellent "diaper" around a raft. Look alive and be creative. Don't just sit in the raft and watch it fall apart. For example, you may be able to "spiderweb" the raft between the inverted hulls (to use a term coined by Jim Brown himself).

Check all raft attachment points regularly for chafe and wear. In a worst-case scenario a raft may have to be temporarily hand-tethered (someone inside the raft physically holding the tether by hand), while someone else is trying rig another tethering scheme.

Safety Harnesses

CAUTION: SAFETY HARNESSES MUST BE RELEASABLE UNDER LOAD. Make certain the tether portion of the harness has two clip-type attachment - one for clipping onto the boat, the other for clipping onto the harness worn around your chest. ***The chest attachment must be releasable under load in case you get trapped under the boat after capsize.***

Fuel and Water Tanks

All tank installations should be carefully examined to see if they might leak after capsize. Any gasoline leaking into the interior will make habitation impossible, contaminating everything else as well. Fuel and water tanks should have shut-off valves. The normal filler cap on deck and outboard vent pipe affair should not pose any problems. The water in tanks may not be accessible after capsize. Adequate water should be stored in gallon bottles with screw-on caps. These and other plastic water containers should have an air gap so that they will float. Make sure that the lockers in which they are stored will not open by themselves when inverted.

Batteries

CAUTION: Conventional batteries can emit poisonous chlorine gas when immersed. The gas is produced mostly by the lead battery terminals, so one should avoid having them come in contact with saltwater. Think about capsize when deciding on where to install batteries. Ideally they should be installed away from living quarters and positioned so that they will be above the waterline in the event of capsize.

Best idea: *Replace conventional batteries with sealed gel batteries or, better still, modern Lithium ($LiFePO_4$) batteries.* Always keep the battery terminals well-greased as this will waterproof them and result in less chlorine emission.

Calamity Pack

No yacht should put out to sea without a calamity pack. A calamity pack is a container or rugged bag containing the essentials of survival. It is secured in an accessible place so that it can be one of the first things to go into the life raft in the case of a sinking monohull or capsized multihull.

The following is a suggestion list of some of the items that might go into the calamity pack. Note that unless the ship's budget allows for duplicate purchases, some of the expensive items on the following list will have to do for both boat and life raft.

- EPIRB
- FLARES
- LIGHTS
- RADAR REFLECTOR
- HAND-HELD VHF
- WATERMAKER (hand pumped)
- PROVISIONS
- CLOTHING
- MEDICINES
- TOOLS

406 MHz EPIRB (Emergency Position Indicating Radio Beacon): Your surest bet for a quick rescue. In this day and age an EPIRB can summon help from almost anywhere on the planet via satellites. The most modern ones transmit a GPS position, which means the rescue services know *exactly* where you are. Most EPIRBs will continue to broadcast for a few days, after which the battery will have to be replaced. CHECK THE BATTERY'S EXPIRATION DATE and test once a year according to the instructions.

LIGHTS: At least one good, expensive diving light. Several smaller utility flashlights. Two hand-held

strobe lights. The above will require adequate supplies of new alkaline batteries. Cyalume sticks. Candle lantern, candles & waterproof matches.

FLARES: Main parachute flares should be the bigger, rocket-propelled ones (not the ones fired from a pistol) as these are your best bet for attracting attention. In addition you will need a good assortment of smaller pistol-fired flares, Roman candles, etc. Shooting off flares carelessly has been known to cause face burns and raft damage. Practice firing one of each kind on land. *Face away from the wind when firing*. Use gloves or wrap your hands in some protective material as you do.

RADAR REFLECTOR: Hoisted up on a spinnaker pole or fishing rod, this inexpensive item can be an important search and rescue aid. All search aircraft and rescue ships use search radars. When purchasing a radar reflector for the mast, purchase another one for the calamity pack. At the very least a very effective radar reflector can be made by stuffing loosely crumpled aluminum foil into a net shopping bag and then raising it up on a fishing pole.

HAND-HELD VHF (waterproof): An absolute necessity for summoning assistance from passing ships, and for providing information about injured persons, or information about other critical considerations prior to and during rescue by ship or helicopter. After the EPIRB pin-points your location, the hand-held VHF will be your main channel of communication with those who are coordinating rescue operation. If possible, get one with DSC capability as that allows you to transmit a Mayday alarm with just one button. This alarm will sound on the bridge of nearby ships, waking them up to your voice transmission.

WATERMAKER: This technological marvel uses a hand pump to force salt water through hi-tech membranes to produce fresh drinking water. In prolonged survival situations is may very well turn out to be the single most important piece of equipment in the calamity pack.

PROVISIONS: Refer to *Offshore Checklist* (Appendix VI) for suggestions. The list of things to put into the calamity pack could include anything and everything, or just the bare necessities. At the very least it would be easy for one to collect a few canned goods, seeds, nuts, cereals, some bottled water, a can opener, a spoon, a flashlight, a signal mirror, some batteries, a candle lantern with candles, waterproof matches, Bic lighters and Polaroid glasses and place them in a waterproof plastic container.

CLOTHING: Emphasis should be on items that retain heat. The list should include neoprene diving caps, woolen hats and hoods to keep the head area warm. It should also include a few thermal blankets. These lightweight, waterproof "space blankets" have an aluminized lining that reflects heat back to the body.

MEDICINES: As necessary (consult your personal physician). You will need spare prescription glasses if you wear them. You will need some antiseptic cream, bandages and bandaids for cuts, bruises and salt water sores. Chapstick, aspirin, laxative, antacid tablets, sea sickness pills, etc.

TOOLS, ETC: Mask, snorkel and fins are absolute necessities. The ones that go into the calamity pack need not take up too much room. The fins can be the smaller, recreational ones. Miniature diving goggles can substitute for a large mask. Don't forego the snorkel as this item will allow you to swim in relative comfort for longer periods on the surface, without having to constantly gasp for breath.

You will need a telescoping fishing pole, line, hooks and lures. Hooks and lures must have steel leaders as the sort of fish you will be catching may bite through nylon line. A small spear gun or diving spear will help bring in the tasty fish that hang around but never bite. *Keep all sharp hooks and spear tips away from the raft.*

A utility knife and small sharpening stone should be in the calamity pack, along with one high quality - stainless steel - survival tool (pliers, knife, screw driver, scissors, etc. rolled into one). A roll of duct tape should be included, along with lengths of rope and string.

Waterproof Containers

Many of the items listed above must be stored in waterproof containers, sealed plastic jars or several layers of waterproofing material, or they will be useless in short order. Flares and batteries are especially susceptible to salt water degradation. The hand-held VHF can be housed in a specially designed waterproof bag. Other types of waterproof pouches are now available from marine outlets. Indeed, the whole calamity pack could be stored in a 'dry-bag', which will also float.

Wrist Lanyards

ATTACH WRIST LANYARDS TO ANYTHING AND EVERYTHING THAT DOESN'T FLOAT. The best survival tool on earth will disappear if it falls overboard. The calamity pack itself should be equipped with a stout lanyard for attaching it to the mothership or to the life raft.

Capsize Preparation Checklist

Vessel Description:_____

Vessel Name:_____-

Designer:_____-

Designer's Address:_____-

_____-

Tel/Fax:_____-

Classification determined to be:

CAPSIZE HABITABLE

CAPSIZE NON-HABITABLE

Immersion Suit/s

Emergency Hatch Cutting Tools

Life Raft (Attachment Points).

Safety Harnesses (Releasable Under Load)

Tethering Systems (Lifeline Padeyes)

Fuel & Water Tanks (Shutoffs)

Batteries (Sealed Gel)

Calamity Pack:

EPIRB (Battery Date _____)

FLARES

LIGHTS

RADAR REFLECTOR

HAND-HELD VHF

WATERMAKER

PROVISIONS

CLOTHING

MEDICINES

TOOLS, ETC.

Jim Brown: **"In all probability, your capsize preparations will never be put to the test. But once made, adequate preparations yield perpetual benefits in peace of mind."** (*The Case for the Cruising Trimaran*, courtesy of International Marine Publishing Company).

Appendix VIII - Beaufort Wind and Douglas Sea Scales

Beaufort Wind Scale

		Wind speed				Waves height	
		km/h	m/s	kt	mph	m	ft
0 Bf	calm	< 1	0-0.2	< 1	< 1	-	-
1 Bf	light air	1-5	0.3-1.5	1-3	1-3	0.1	0.25
2 Bf	light breeze	6-11	1.6-3.3	4-6	4-7	0.2-0.3	0.5-1
3 Bf	gentle breeze	12-19	3.4-5.4	7-10	8-12	0.6-1	2-3
4 Bf	moderate breeze	20-28	5.5-7.9	11-16	13-18	1-1.5	3.5-5
5 Bf	fresh breeze	29-38	8.0-10.7	17-21	19-24	2-2.5	6-8.5
6 Bf	strong breeze	39-49	10.8-13.8	22-27	25-31	3-4	9.5-13
7 Bf	near gale	50-61	13.9-17.1	28-33	32-38	4-5.5	13.5-19
8 Bf	gale	62-74	17.2-20.7	34-40	39-46	5.5-7.5	18-25
9 Bf	strong gale	75-88	20.8-24.4	41-47	47-54	7-10	23-32
10 Bf	storm	89-102	24.5-28.4	48-55	55-63	9-12.5	29-41
11 Bf	violent storm	103-117	28.5-32.6	56-63	64-72	11.5-16	37-52
12 Bf	hurricane	>=118	>=32.7	>=64	>=73	14+	45+

Douglas Sea Scale

This actually has two scales; one for the wind generated waves, and the other for the background swell.

State of the sea (wind sea)

Degree	Height (m)	Description
0	no wave	Calm (Glassy)
1	0 - 0.10	Calm (Rippled)
2	0.10 - 0.50	Smooth
3	0.50 - 1.25	Slight
4	1.25 - 2.50	Moderate

5	2.50 - 4.00	Rough
6	4.00 - 6.00	Very Rough
7	6.00 - 9.00	High
8	9.00 - 14.00	Very High
9	14.00+	Phenomenal

Swell

Degrees	Description
0	No Swell
1	Very Low (short and low wave)
2	Low (long and low wave)
3	Light (short and moderate wave)
4	Moderate (average and moderate wave)
5	Moderate rough (long and moderate wave)
6	Rough (short and heavy wave)
7	High (average and heavy wave)
8	Very high (long and heavy wave)
9	Confused (wavelength and height indefinable)

Wave length and height classification

Wave length

- Short wave 100 m -
- Average wave 100 – 200 m
- Long wave 201 m +

Wave height

- Low wave 2 m -
- Moderate wave 2 – 4 m
- High wave 4.01 m +

Submit Your Own Case Report

Have you been in a storm? If so, others can learn from your experience. Please help to contribute to safety at sea by submitting your own report.

You can do this either online or offline:

1. Enter your details and upload your images, weather files and further information through the online form.
2. Download the form as a Word document, fill it in, and upload it.
3. Download the form as a PDF document, print it out, fill it in by hand, then take a photo or scan of it and upload it.
4. Write the report in longhand or just use your log entries, take a photo or scan of it and upload it using the upload form, or send them to us by snail mail at:

DDDB
Xanavive Health Corp.
PO Box 20036 RPO Shoppers North
Vernon, BC V1T 9L4
Canada

Full instructions can be found on the website.

Please, in all cases make sure you include a completed submission form, including your signature at the bottom, and your contact details so that we can verify information with you.

We look forward to hearing from you!

May you have only fair winds and following gentle seas