Could it happen again?

Have we forgotten the lessons so harshly learnt in the 1979 Fastnet Race? If 300 modern yachts were out in the same conditions today, would the outcome be any better? asks Bill Anderson

On 11 August 1979, 303 yachts set out on the Fastnet Race. The opening stages of the race were sailed in light to moderate WNW winds which backed and increased as a rapidly deepening depression moved across the Fastnet area on the night of 13/14 August.

The winds generated by this depression reached storm force – 70 per cent of the fleet reported winds of, or in excess of, Force 11. One hundred and twelve yachts reported being knocked down to horizontal and 77 experienced knockdowns to substantially beyond horizontal, including total inversions or 360° rolls. One hundred and ninety four of the competing yachts retired from the race, 24 were abandoned and 15 lives were lost.

After the tragic race, the RYA and RORC conducted an inquiry into the factors which contributed to the loss of life. That inquiry drew numerous conclusions and made a number of recommendations.

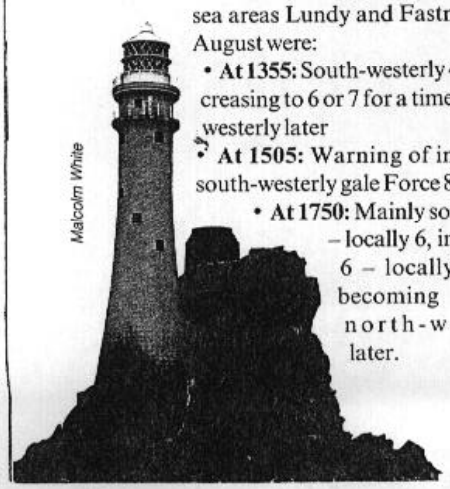
WEATHER

Did the 1979 Fastnet fleet encounter weather conditions of unprecedented severity? The inquiry thought not. The weather was certainly very severe for the sea areas around the British Isles in August, but meteorological records showed that storms of similar severity occurred in August 1917, 1923, 1931, 1957 and 1975.

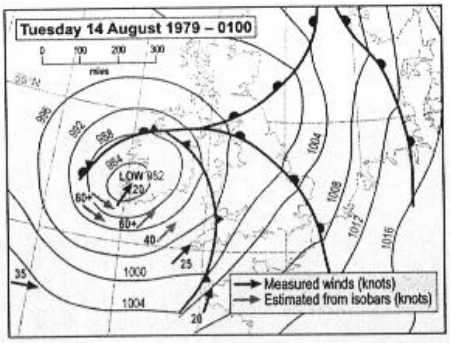
It is therefore reasonable to assume that, at some time in the future, yachts will encounter conditions similar to those of the 1979 Fastnet.

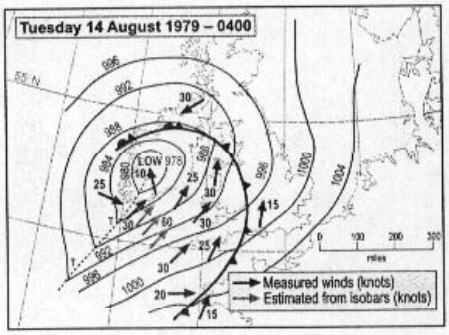
The fleet received very little advance warning of the weather conditions about to confront them. The shipping forecasts for sea areas Lundy and Fastnet on 13 August were:

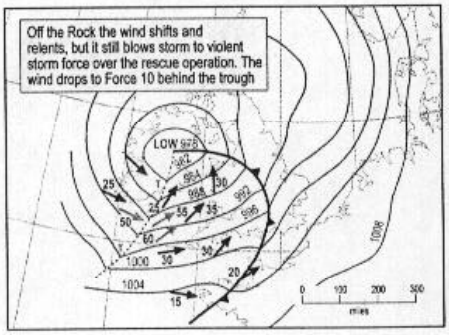
- **At 1355:** South-westerly 4 or 5, increasing to 6 or 7 for a time, veering westerly later
- **At 1505:** Warning of imminent south-westerly gale Force 8.
- **At 1750:** Mainly southerly 4 – locally 6, increasing 6 – locally gale 8, becoming mainly north-westerly later.



Malcolm White







- **At 1830 and 1905:** Warning broadcast of south-westerly gale Force 8, increasing severe gale Force 9 imminent.
- **At 2300:** Warning broadcast of south-westerly severe gale Force 9, increasing storm Force 10 imminent.
- **At 0015 on 14 August:** South to south-west veering westerly 7 to severe gale Force 9, locally Storm 10.

Longer range forecasts issued on 12 August had indicated gales or possibly severe gales for area Fastnet on the night of 13 and 14, but these forecasts were not available to yachts at sea. Most of the fleet reported experiencing Force 11 or more by 0200 on 14 August.

Would forecasters today be able to give longer or more accurate warnings of very severe weather conditions? Subjective opinion generally holds that the accuracy of weather forecasting has improved significantly in the last decade, but the exceptionally severe storms of October 1987 were certainly not forecast with any great accuracy.

What has improved over the intervening years is the means of disseminating weather information to yachts at sea. In 1979 most skippers would have been listening to the shipping forecasts, but few were monitoring Radio 4 in case a gale warning was broadcast.

Hence very few were aware, until the 0015 shipping forecast, that they were about to encounter anything worse than a summer gale, although the forecasters knew by 1800 that the winds were likely to be severe gale and by 2300 storm force.

Today the warnings of very severe weather would have been available, by Navtex or weatherfax, several hours earlier.

By the evening of 13 August, the fleet was already strung out between Land's End and the Fastnet Rock, with no ports of refuge available within six hours' sail. While we may now have access to slightly earlier warning of very severe weather conditions, it is doubtful if that extra warning would be of much practical value.

SKIPPER AND CREW SKILL AND EXPERIENCE

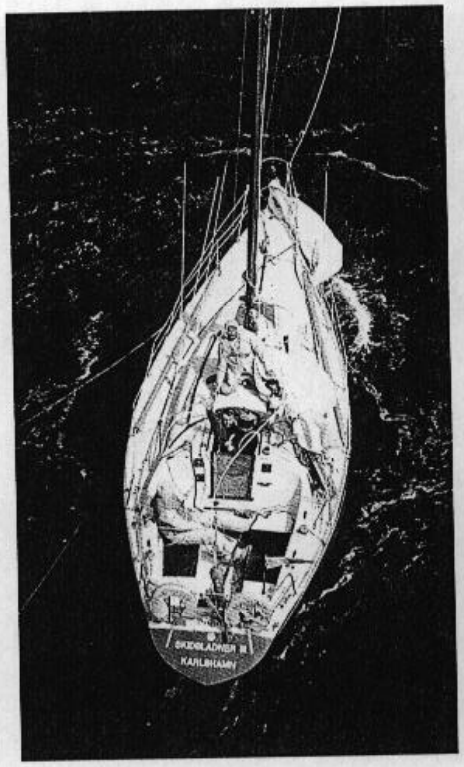
Just over half the fleet reported that the Fastnet storm was the worst weather they had ever experienced at sea. Many very experienced competitors said that the wind strength was not unusual, but the sea conditions were the most dangerous that they had ever encountered, possibly because of the rapid wind veer at the height of the storm.

Survival tactics adopted included lying ahull (86), running under bare poles (57), ▷

The eight-man crew of the 34ft *Camargue* had to take to the water to be picked up by helicopter. The yacht was later towed to Milford Haven by a French trawler. Inset, rescue at hand, from RNAS Culdrose


AT RISK?
Fastnet '79
William Payne
CANARGUE
B.Y.C

Right, the OOD 34 fleet was particularly badly hit, caught in the area with the worst seas. Below right, 77 yachts experienced knockdowns to substantially beyond the horizontal, including 360° rolls



Photos: RNAS Culdrose

streaming warps (46), heaving-to (26) and carrying on under storm sails (26). Most competitors said that, if faced with similar conditions again, they would adopt the same tactics.

However, of the boats which suffered heavy knockdowns, the majority had no sail up at the time and the sea was either on the beam or quarter. The boats which fared best seemed to be those which managed to keep sailing to windward, under trysail and/or storm jib.

The general implication drawn from analysing the success or failure of the survival tactics adopted was that the boats which managed to set small enough sails to keep going to windward (but enough sail to maintain good control) were the ones which fared best.

Survival depended on a really strong crew who could set storm sails efficiently in atrocious conditions, and first-rate helmsmen who could keep their boats moving in savage seas.

Passive survival tactics, which have worked well in previous generations of heavier boats, did not seem so effective in light displacement yachts with small underwater lateral profiles.

Today, with even lighter boats racing offshore, the premium placed on crew strength and helmsman skill must be even higher.

STABILITY

The propensity of the boats to turn upside-down was one of the alarming features of that Fastnet storm. For the last 30 or so years, racing yachts have depended, to some extent, on the weight of the crew on the weather rail to help with righting moment needed to carry sail.

This has allowed designers to opt for lighter keels and therefore lighter displacement. Increased beam has helped to improve the effectiveness of crew weight in keeping the boat on her feet.

Could we reasonably expect the boats racing in the '79 Fastnet, or those which we race today, to withstand beam-on collisions with several hundred tons of water, moving at some 20 knots, in the crest of a breaking wave?

It is doubtful if any yacht under about 40ft in length can be designed to withstand a really large breaking wave and remain the right way up. Light displacement boats (ie, racing boats) will always be particularly at risk.

Since 1979, the RORC has introduced stability screens for racing yachts, and Marine Safety Agency stability rules are applied to all yachts used for sail training and charter. A number of owners of small charter yachts have been dismayed to find that their boats do not get a totally clean bill of health from the charter yacht stability rules.

'I've weathered gales in her without a moment's anxiety,' is a typical outraged reaction to the news that the stability screen only allows charter within 20 miles of a safe harbour. No doubt the aggrieved owner is telling the truth, but what he has never, very sensibly, experienced is storm force winds and confused breaking seas.

Only boats with good stability characteristics should be available for charter outside the area in which it should be possible to seek shelter.

LIFERAFTS

The lives of 14 people were saved when they took to liferafts from sinking yachts. On the other hand, seven people died after taking to liferafts from yachts later found afloat.

Subsequent research into liferaft design, by the National Maritime Institute using scale models in a wind/wave tank and by the Iceland Coastguard at sea with full size rafts, resulted in considerable improvements to the design of the water ballast pockets (from which liferafts derive their stability), and design of drogues

Above, winchman returns to helicopter after transfer of last remaining crew from the stricken *Grimalkin*

(which also have a considerable influence o stability).

However, it is hardly reasonable to expect 6ft diameter rubber boat to provide a saf refuge in conditions which have overwhelme a 35ft yacht: it will always be preferable to t to save the yacht and only to take to the lifera as absolutely the last resort.

MAN OVERBOARD

Six lives were lost when crewmen were swe overboard. Five of them were wearing ha nesses and were clipped on. Two of the harne lines failed, two were washed out of their ha nesses (one of them probably came undon one was clipped to guardrails, which parted.

It is perhaps surprising that there were n more people lost overboard. Since 1979, RN

Safety is a state of mind

Matthew Sheahan is well-placed to appreciate dangers aboard, following his own experience in the '79 Fastnet– an event that ended in personal tragedy

I remember thinking at the time that, after the ordeal of the previous night, to be trapped with my chin under the gunwale and held down by my life harness was the cruellest way to end it all.

As the upturned hull of our half-tonner lurched over the crests of the mountainous seas, I was momentarily released and had but a second to grab some air before the upturned deck bore down on my face again.

It was as if someone was teasing me and probably the only time during the whole saga that I had felt anger bordering on panic.

During the long, terrifying night, each crew member had frequently been towed along behind the boat after she had righted herself, following the numerous knockdowns and pitchpoles.

Accelerating down the face of waves behind a surfing boat under bare poles, being towed by your harness and not knowing, or even caring, which way up you are, is a simple way to go. ▷

...istics show that 51 people have been lost ... auxiliary yachts to which lifeboats were launched, of these 31 were men overboard.

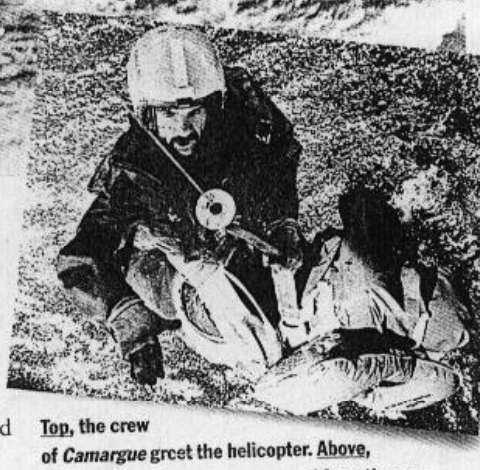
CONCLUSIONS?

For most of the 2,000-odd people who took part in the 1979 Fastnet race, the experience was no doubt a very steep learning curve. The events of 13 August were widely reported and ... tens of thousands of yachtsmen proba... took careful note and worked out their own solutions to the dangers highlighted by the experience of others.

I suspect that, given the same circumstances today, conditions which occurred in the '79 Fastnet would take a heavy toll and we would have to re-learn many harsh lessons.

Biff Anderson has been Training Manager for the RYA ... 1982. From 1972 to 1982 he was Cruising Secretary ... responsible for the introduction of today's Yachtmaster schemes

Photos: Press Association



Top, the crew of *Camargue* greet the helicopter. Above, drowned crewmen were recovered from the sea

'But what I've seen aboard boats since 14 August 1979 has frightened me more'

Simple, because you have absolutely no real idea as to what is going on. No time to panic, no time to shout out. You are totally at the mercy of the elements – and you know it. Nothing you do or say in these moments will make the slightest difference.

But here, trapped between the sea and the sky, was the worst of all, as I struggled to get free, only to be dragged under again, time after agonising time.

Because my harness only had a carbine hook at one end, and this was attached to the cockpit padeyes, I could not easily free myself unless I took my harness off. To do this meant taking my inflated lifejacket off first.

Although it was a struggle, I managed it and looped my right arm through the floating jacket as my left hand attempted to unfasten the harness attachment. Success! The buckle undid with the flick of a finger and, as the shoulder straps slackened, I floated a few centimetres higher, enough to let me breathe more freely.

I paused for breath, panting as much in relief as necessity. The upturned hull was an eerie sight and my mind started to play tricks. I began to hallucinate, drifting in and out of vivid images.

In the same way that, when you nod off, you think you've been asleep for longer than you really have, my mind behaved in a similar manner: I'm sure the timescale was merely a matter of seconds. And then, it all changed.

Suddenly, I could see part of the deck, as if the whole boat was precariously balanced on the edge of a wall. The view opened up and just as I twigged what was happening, I was wrenched out of the water by my harness, fortunately still over my shoulders, and launched across the full width of the cockpit as the boat suddenly righted herself.

On this, our final knockdown, the mast had finally broken and, without the damping effect of 12m of alloy tube and rigging, the boat had righted in an instant.

Picking myself up off the windward deck, I looked around.

I might not be drowning now, but things were still not good at all. Two people unconscious (or possibly worse) in the cockpit, another (my father), floating face down in the water upwind of me and drifting away, and two conscious crewmembers scrambling to get back on board.

I was 17 when it happened, and for the past 17 years the most frequently asked question has been: "You must have been absolutely terrified. How on earth did you cope?"

For the first few years after the event I had no real answer. I don't really know what I felt then and, as anybody who has come close to the end of their days in a similar situation may tell you, when your predicament is that serious your mind is paralysed.

AT RISK?
Fastnet '79

The word overwhelmed seems too simple to express my reaction to the conditions, and yet by definition that is precisely how I felt.

But what I've seen since 14 August 1979 has frightened me more:

- Owners who pay scant regard to safety regulations or the serviceability of the safety equipment aboard their boats.
- Cocky crew who shin up a spinnaker sheet at night without a harness or lifejacket.
- So-called macho crews who deliberately avoid even sizing up a life-harness or lifejacket before a long offshore race, let alone wearing one when the going gets tough.
- People who tell you that racing boat design has learnt the lessons of '79.
- People who suggest that stability requirements have improved for all as a result of the Fastnet inquiry report.
- Worst of all, those who believe it's unlikely to happen again.

You may think this is a cynical view to take, but I've read reports, waded through books, sat on committees and frequently been looked at as if I've arrived from another planet when I air my views on heavy weather survival.

Safety, in my book, is a state of mind. There is no definitive check-list of items and procedures because safety afloat is a personal thing. It will depend on your experience, capabilities, type of boat and where you wish to sail.

But one thing is certain: safety does not come in a shrink-wrapped box. Safety is not yellow with a set of Duracell batteries in the bottom and a big panic button on the side. And it is certainly not relying on the Coastguard.

Safety is thinking about the possible problems you might encounter and ensuring that you have considered what your options could be in different situations.

At this stage, many people will immediately jump to a worst case scenario and think of liferafts and EPIRBs – and perhaps that is one of the reasons why the issue of safety is frequently ignored completely.

To my mind, safety starts by considering how you are going to handle your boat should the conditions deteriorate. Reefing, changing headsails, the provision of an emergency forestay (and the method of attachment to the foredeck) and the hoisting of a storm trysail, are a few of the areas to consider.

These last two are particularly good examples as, almost by definition, conditions may have become pretty bad if you are considering setting these sails. At this stage, you will want to spend as little time on the foredeck as possible, so quick, simple and reliable sail handling systems will not only improve the ride, but boost your confidence tremendously.

Personal safety in any conditions is naturally high on the list of considerations – like ensuring that your safety harness attachments are not only substantial enough, but allow you to move about the entire boat with the minimum of unfastening. All too often I have come across boats which have jackstays that either don't run all the way to the bow or require you to unclip and refasten your line to get past the shrouds – just the time when you need your safety line to be attached.

***Grimalkin*, the Sheahan family's Nicholson half tonner at the start of the fatal Fastnet**

Beken of Cowes

Climbing in and out of the companionway is another occasion when you need to attach your safety line before you attempt to move. It is ironic that we will sit for hours on end, attached in the cockpit in a secure position and yet unhook completely to move below decks.

There are dangers below decks which are frequently ignored as well, and had it not been for my own experiences in 1979, I could be as guilty as any of underestimating the potential hazards of loose gear in the cabin.

During the height of the storm in '79, one of our biggest problems was keeping tins of food and other heavy objects from flying around the saloon each time we were knocked down (a factor which I believe contributed to my father's death), despite the fact that they were all stowed in their correct places.

Never underestimate the ability of objects to break loose. After our storm-damaged boat was recovered some weeks later, one of the lead acid batteries that had been fastened down under the companionway steps was found wedged in the bow of the boat, having taken part of the main bulkhead with it during one of our pitchpoles. The harm this could inflict on a crewmember doesn't bear thinking about.

In the many articles and books that were written on the race, our boat has been referred to as the organised boat in the disorganised storm. My father was a meticulous man who left nothing to chance. Everything was labelled, panic bags were clearly marked and every member of the crew briefed on the location of all the safety gear.

And yet, despite this organisation, in the space of less than 24 hours, I witnessed a competent boat and crew become overwhelmed by a series of events that ended in tragedy.

Perhaps the most important point of all is that our story is not about an instant crisis. We were not holed or run down. We did not lose our keel or rig (until the end) and there was no fire or explosion aboard the boat.

Instead, we were faced with a series of events that escalated beyond our control. Looking back on our situation with the benefit of hindsight, I appreciate more than ever the importance of keeping your boat under control. Never let conditions overwhelm you.

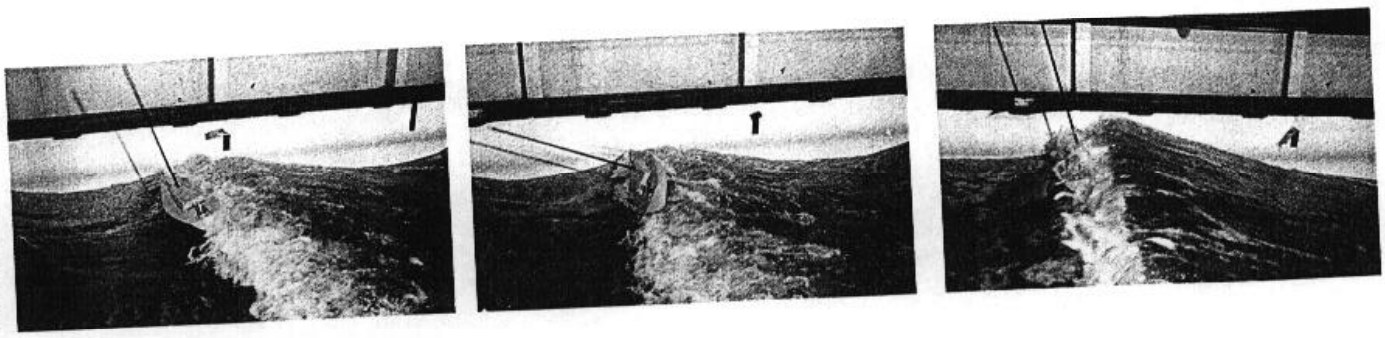
Safety is anticipating events both before and during your voyage. Safety begins well before you put on your lifejacket. ❑

'We were faced with a series of events that escalated beyond our control'

Matthew Sheahan, Yachting World's Technical Editor, was sailing on board his father's Nicholson half tonner, Grimalkin, in the 1979 Fastnet Race. Four of the six-man crew survived. Matt's father, David, and Gerry Winks died

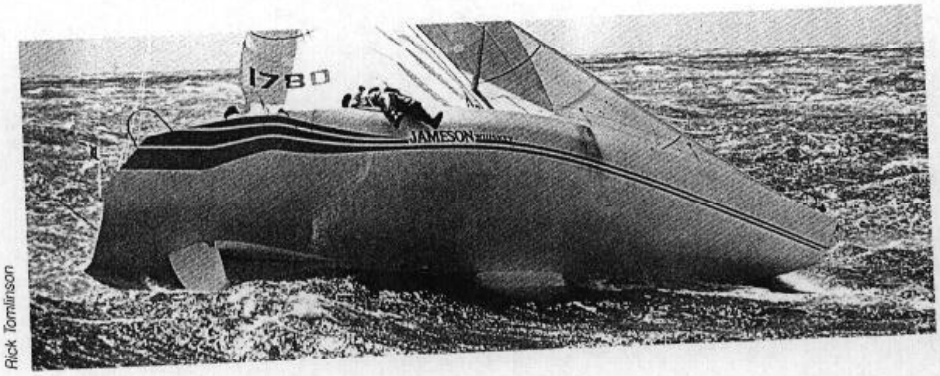
The **Fastnet rescue team from RNAS Culdrose**

RNAS Culdrose



Wolfson Unit

Risk of capsize



Rick Tomlinson

Barry Deakin of Southampton University suggests modern yachts are as prone to capsize as those in the '79 Fastnet. Andrew Bray describes how multiple drogues can be lifesavers in heavy weather

The subject of stability has been discussed at length in the yachting press during recent years, and much of what has been said has been based around data on just two yachts which sailed in the 1979 Fastnet race.

The stability curves of the Contessa 32 and a Nicholson half tonner which were presented in the race inquiry report, have been used many times to illustrate the difference between a traditional cruising yacht and a contemporary racing yacht.

The yachts were of similar size with a length of just under 10m. The Contessa, with a reputation as a seaworthy yacht, had a range of stability of 156°, while the half tonner, which capsized during the race, and remained upside-down for some time, had a range of 117°.

Modern trends for lighter displacement, higher aspect ratio keels and wider beam have resulted in a tendency towards reduced ranges of stability. Research has shown that, although narrow beam helps to reduce the probability somewhat, yachts of all types can be rolled over by breaking waves.

It is important for a yacht to have a large range of stability to ensure that it does not settle upside-down after such an incident.

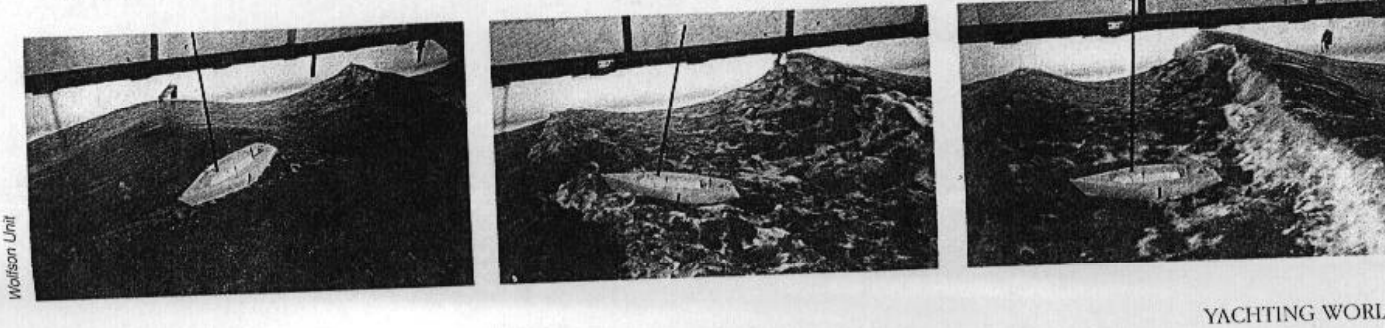
When the Department of Transport's Code of Practice was developed in 1989, requirements for stability for sail training yachts were recommended by the Wolfson Unit, using these and a number of other examples as a basis. At that time there were few well-documented casualties for which stability data was available, since full range stability calculations were rarely conducted.

Diagram 1 illustrates the data on file at the Wolfson Unit at that time. Some of the yachts were recognisable as traditional cruising yachts with narrow beam, a long keel with ballast located low down and hence a low centre of gravity. Small yachts of this type exhibit a large range of stability. The Contessa 32, and a number of recent cruising designs, fell within the envelope of data provided by these examples.

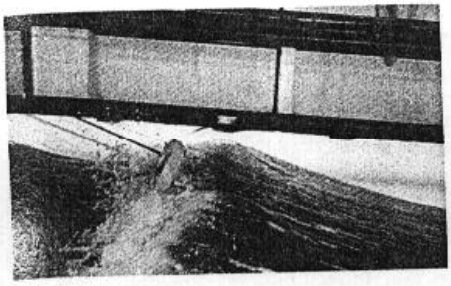
Contemporary cruiser-racers, influenced to a significant extent by rating rules, and concentrated around the popular 10m length, exhibit a generally lower range of stability. Some of these had earned poor reputations as a result of their performance in the Fastnet race, apparently being susceptible to capsize, though they did not remain inverted for prolonged periods.

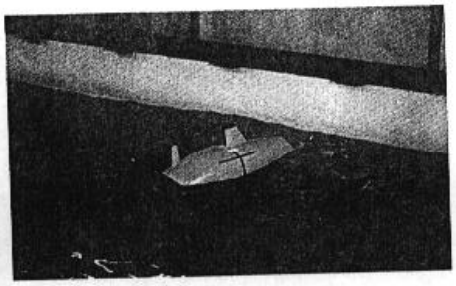
Two such 10m yachts are identified in Diagram 1 with circles round the data points. Five

The series of photographs at the top and bottom of the page show drogue research tests carried out at Wolfson. Top, without drogues, the model capsizes. Below, the same model with twin drogues deployed



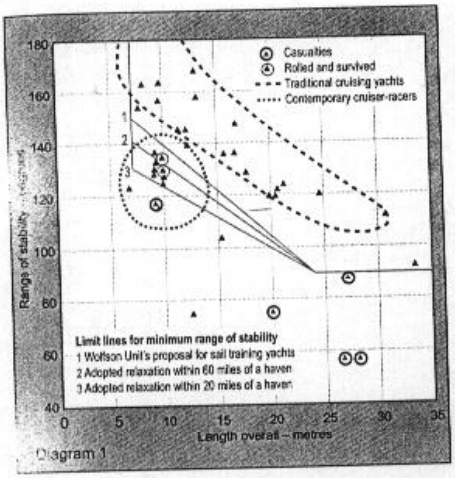
Wolfson Unit

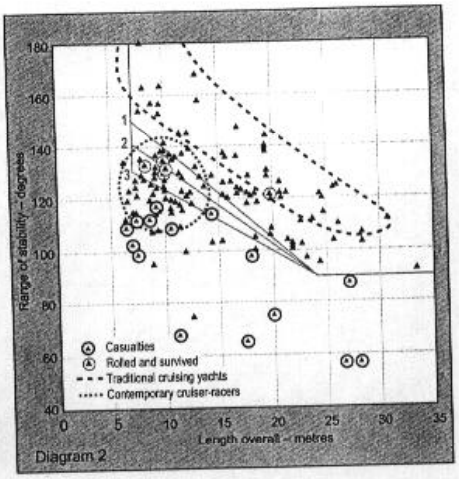




AT RISK?

Stability





These diagrams show stability data from Wolfson Unit files in 1989 (left) and from various sources in 1996

casualties are identified with bolder circles, one of these being the half-tonner *Grimalkin*; the others were larger vessels which were capsized by the wind. On the basis of these, data limits for a minimum range of stability were derived.

Since that time further data has become available from studies by the Wolfson Unit and others and for yachts submitted for approval as sailing school or charter yachts.

Diagam 2 illustrates the currently available data. Most importantly, though unfortunately, many new casualties have been documented. These all appear outside the limits required for sail training or charter yachts, apart from one which would have been eligible for operation within 20 miles of a safe haven.

Three new cases of yachts being rolled and returning upright, albeit with some damage, have been added. These all had a range of stability between 120° and 140°.

Some new data has been added within the envelope drawn previously for traditional cruising yachts, but by far the majority lie below that region, some within the region in which the casualties appear.

There is, therefore, no doubt that there are many yachts which are vulnerable to being rolled by breaking waves, some of them unlikely to return to upright despite being in storm conditions where further large waves will be encountered.

It would not be fair, however, to deduce from this data that the majority of yachts on the market today are of the latter type, since some of them have been studied specifically because they are known to be marginal cases.

The casualty data appears to validate the standards developed, and suggests that the lessons of the 1979 Fastnet race may not have been taken to heart by the industry.

Buyers of sailing yachts should be provided with information to indicate realistically the type of operation for which they are suitable. It would be irresponsible to market yachts for ocean cruising if they are vulnerable in terms of stability, or indeed any other aspect of safety.

Every individual is entitled to take measured risks, but one should not be misled by marketing strategies into underestimating ▷

STABILITY ON TEST – A clearer picture

Malcolm White

PEOPLE'S perception of what constitutes a stiff or tender boat can vary considerably, depending on the type of sailing you do.

Stability for racing crews will have as much to do with straight line directional stability at speed, as it does about angles of heel. For others, the lateral stability is the most important factor. What is her normal heel angle upwind? At what point will she invert?

Such diverse requirements will always be difficult, if not impossible to express by simple formulae alone.

In an increasing number of cases, there is a trade-off between stability and performance that is not always made clear to buyers.

In these cases we feel it is important to be fully aware of the characteristics of a choice before she becomes your property.

Over the next few issues, *Yachting World* will be introducing a means of categorising the stability of all vessels, aimed at clarifying this vital aspect of a boat's performance.

Watch out for details.

DROGUE MANUFACTURERS

UK

The Attenborough Drogue Co, Fallowfield House, Puttenham, Guildford, Surrey GU 1AH

USA

Blue Harbor Inc, 1142 Trailwood North, Hopkins, MN 55343.

Cal-June Inc, PO Box 9551, North Hollywood, CA 91609.

Hathaway, Reiser & Raymond, 184 Selleck Street, Stamford. CT 06902.

Para-Anchors International, PO Box 19, Summerland, CA 93067.

Para-Tech Engineering Co, 10770 Rockville, Santee, CA 92071.

Seabrake America, 11911 IS Highway One, Suite 201, North Palm Beach, FL 33408.

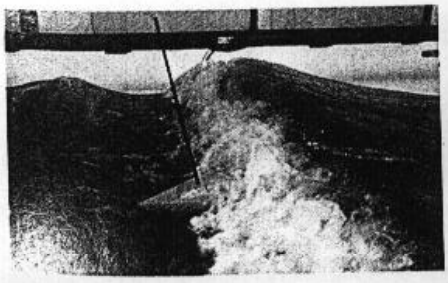
Shewmon Inc, 1000 Harbor Lake Dr, Safety Harbor, FL 33572.

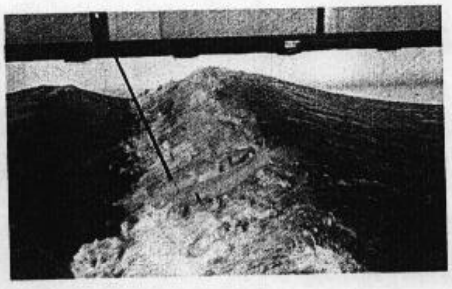
Australia

R.D. Mengler, 10 Hesperia Ave, City Beach 6015.

Para-Anchors Australia Pty Ltd, 18 S Gippsland Highway, Sale, VIC 2850.

Seabrake International Pty Ltd, 156 Queen Street, Wollahra, NSW 2025.





Stability

Using drogues in anger

Nick Gales

DR NICK GALES left New Zealand in August 1995, the height of the stormy Southern Hemisphere winter, sailing his 25-ton cruiser, *Kela* to join the Mururoa protest flotilla. He encountered severe weather.

'We found ourselves sailing under storm jib only in a steady 45-knot south-westerly gale, with gusts up to 60 knots. The sea was becoming dangerous with 10m breaking crests and steering was difficult. Our trusty TMQ autopilot was not able to cope with the conditions and we were taking turns on the helm. It was time to drop the storm jib and deploy our new series drogue.

'I had read much of the effectiveness of series drogues which utilise multiple small cones of 6in opening diameter strung along a weighted, heavy double braid nylon line. Our 100m line was 32mm in diameter and had 175 of the cones and a 15kg weight. We keep it ready for deployment in a teak chest on the after deck.

'Once deployed, our speed through the water dropped from six knots to a steady two to three knots. The elasticity of the line meant that there was no snatch as we took up on the drogue, but rather a comfortable uptake on our 25 tons.

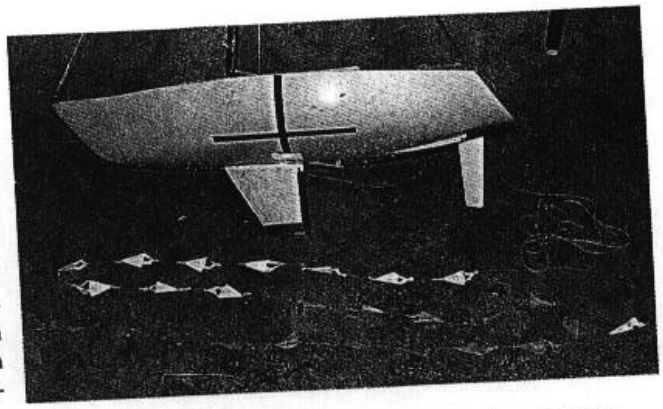
'I was initially concerned to find that we did not lie stern-to the sea, but rather lay at 30°-60° off the wind. I considered re-hoisting our storm jib, but as the wind had continued to build to a steady 50-60-knots, I thought I would sit tight and see how we rode.

'I soon relaxed as I noted the way that each large wave would accelerate us slightly through the water, while the drogue gently hauled our stern up into the wave.

'At no time did we take green water on deck and indeed our watch position in the cockpit remained delightfully dry. I was a convert to the series drogue and thankful we had made the substantial investment.'

those risks. This is the principle behind the EC directive on small craft which is being developed.

Boats will be assigned a category based on wind speed and wave height to indicate the conditions for which they are considered suitable. At present, however, difficulty has arisen in reaching agreement on the stability standard required for each category.



Model used in tank tests with scale series drogue

It appears likely that the resulting standard will be more complicated than that illustrated in Diagram 1, and that commercial pressures will force agreement on low requirements. These may yet mislead the buyer into believing his new coastal cruising yacht will carry him safely through ocean storms.

Barry Deakin is responsible for the Wolfson Unit's Bureau Service for stability calculations and the preparation of stability booklets. He is responsible for the stability research undertaken for the Marine Directorate, and assisted with the preparation of the Code of Practice for Sail Training Vessels.

Parachuting to safety

HEAVY WEATHER tactics to maximise chances of survival have in the past been anecdotal, discussed far and wide in books and bar rooms, but most techniques have developed through the dangerous principle of trial and error in real storm conditions.

As Robin Knox-Johnston's article illustrates (page 62), different tactics are needed not just for different types of yacht, but also for different storms and sea conditions.

However, in recent years Southampton University's Wolfson Unit has carried out valuable work, both on stability (see above) and on ways of reducing the chances of capsize, in particular on the use of drogues. The following is based on that research and the resulting paper, prepared by Andrew Claughton and entitled *The Use of Drogues to Prevent Yacht Capsize in Breaking Waves.*

Lifeboats have used trailing drogues for many years to hold rescue boats straight and control their speed when going through breaking waves. Also drogues play a vital role in helping prevent liferaft capsize.

The paper identifies that: 'in terms of avoiding wave capsize, correct orientation of the boat to the seas is the most important factor, much more than the beam or roll inertia. A wave that completely rolls the boat when lying ahull can easily be ridden if the boat is kept stern-on to the sea.'

A series of tests was carried out using one-thirteenth scale models in the Unit's test tank and breaking seas and 40 knot winds simulated. After free drifting trials showing how a wide, fin-keeled yacht capsizes in breaking seas (see pictures on previous page), trials were first carried out with drogues deployed from the bow, then amidships and finally the stern.

Four devices were tried: drogue, parachute, twin drogue and multiple or series drogue, the latter having been previously extensively tested by Donald Jordan in the USA. It consists of 90 x 5in diameter cones set at 20in intervals on a ¼in braided nylon line.

'The potential benefits of this type of drogue are its durability and ease of handling, and also the ability to "tune" its drag by altering the number of drogue elements deployed.'

The results of these tests showed that 'using any of the drogue configurations, there was a marked improvement in the ability of the yacht to hold, with a fixed rudder, a course directly downwind and wave and thereby resist capsize.'

On using multiple element drogues, the report notes: 'maintaining drogue line tension at all times was soon identified as a desirable feature of a drogue system. The use of a twin element drogue proved most effective in accomplishing this and consequently was the system which minimised the yawing motion of the yacht in steep, regular waves, and ensured stern-on presentation to the breaking waves.

'The drogue line slack was minimised because the aft drogue prevented the forward drogue being pushed down wave by the passing of a breaking wave, and if the aft drogue was disturbed, then the forward drogue was effective in holding the yacht on course.'

The problem with single drogues or parachutes was because 'under the cyclic loading drogues and small parachutes can collapse and start to tumble so that they either cause themselves structural damage or tangle so badly to be rendered ineffective.'

Another advantage of the multiple drogue highlighted is that as well as being steadier, drag is lower and less prone to shock-loading.

On deployment, the report recommends scope of between 60m and 100m, weighted to 30kg) ahead of the first drogue so they 10-15m below the surface. For attachment recommends a bridle to the sheet winches also points out the possibile vulnerability yacht's aft-facing structure, particularly companionway and the likely untenability cockpit being swept by large seas.