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SEAMANSHIP

ENOUGH CHAIN OUT?

A better way to calculate your safety margin

NEW TECH TESTED

Check on your boat from home

+ FIND YOUR OWN ANCHORAGES

ESCAPE THE CROWDS WITH WILD CRUISING

PRACTICAL SKILLS

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Navigating locks

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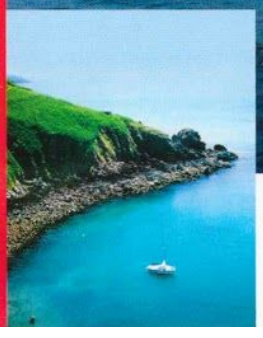

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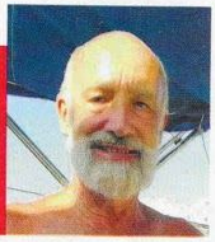


Christopher Smith has had a series of shared ownerships in Greece. He has now retired from an academic bioscience career

How much anchor chain?

When it comes to putting out anchor chain, most of us follow a basic ratio rule of thumb, but we should be taking wind and tide into account, argues Christopher Smith

Anchoring is a key part of the cruising sailor's arsenal – at least for those who don't intend to take refuge in a marina every time they wish to stop sailing. For such a vital aspect of our pastime, however, it can be difficult to get solid information on many aspects of the process. This is due, in no small part, to the complexities in working out issues such as chain length. What is needed in most circumstances is a handy rule of thumb, which can be used to ensure you are anchoring safely in most circumstances.

By its very nature, a rule of thumb calculation cannot take into account all aspects of the anchoring equation, but it is surprising how many miss out quite vital considerations simply because they can be hard to make fit a certain simplified formula.

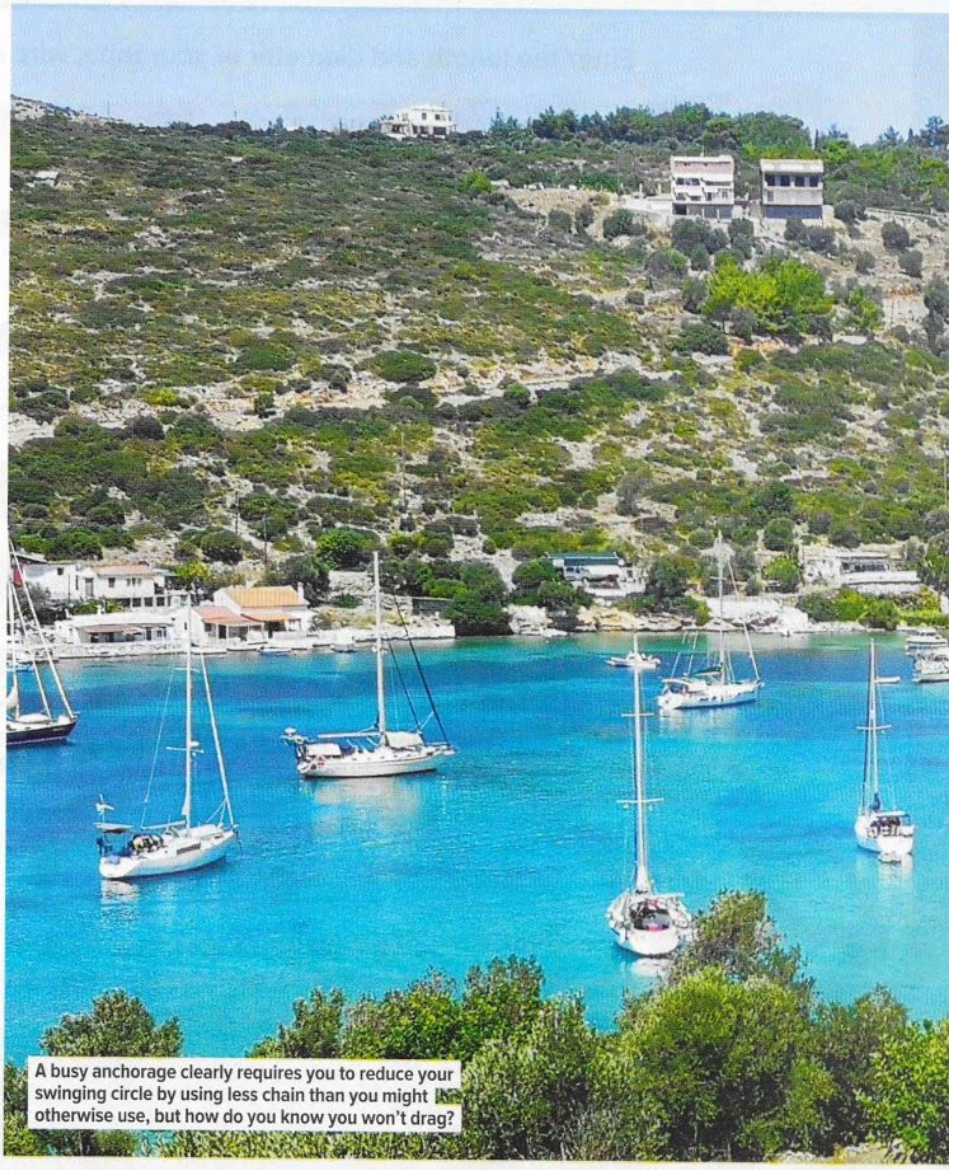
WIND

Everyone has their own idea of how much anchor chain to use. The simplest – and perhaps most often used method – why leave all of that chain you have stored in the locker? In reality this usually means using the maximum safe length – any anchorage has rocks, shallows and other boats at anchor either when you arrive or, often, turning up after your arrival.

So how do you decide what is safe before looking elsewhere to anchor? Traditionally you use the scope – a multiple of the water depth to determine the length of anchor chain you'll need to use. The RYA suggest a scope of at least 4:1, others say you need 7:1 but in crowded anchorages 3:1 is quite common.

A moment's thought, however, tells you that a static rule of thumb in an environment that can significantly change in different conditions will not sufficiently account for the main forces acting on your boat, namely the wind and the tidal stream. Often, wind is going to be the biggest concern, so you must take this into consideration and also be aware of, and prepared for, the maximum anticipated wind strength. And there's the problem; there are virtually no articles or text books on anchoring to tell you how to take into account the wind strength when setting your anchor.

So I've come up with a very simple guide to provide a rule of thumb calculation (above), which also takes wind and tide into account.



A busy anchorage clearly requires you to reduce your swinging circle by using less chain than you might otherwise use, but how do you know you won't drag?

WIND-ONLY FORMULA for shallow anchorages (4 to 8m)

Chain needed (m) = wind speed (knots) + boat length (m)

If you will not see anything greater than the top end of Force 4 (16 knots) and you are anchoring a 10m yacht in fairly shallow water, by which I mean anything under about 8m depth, you should be fine with 16m + 10m = 26m of chain. But if you think a Force 7 gale (33 knots) is coming, try setting 33m + 10m = 43m of chain.

This rule of thumb works in the majority of anchorages relatively close to the shore where the water is quite shallow, but for deeper anchorages (of around 10-15m) you obviously need more chain. The answer to this is simple: you just need to use a factor of 1.5 times the wind speed, which will deliver a better result.

CALCULATING LENGTH

A RULE OF THUMB

1 SIMPLE EQUATION

The most basic equation is: wind speed + boat length = chain length. This works for anchorages up to around 10m. Beyond that depth, calculate 1.5 times wind speed instead.

2 CALCULATING TIDE

Tide can also be taken into consideration, by converting the tidal force asserted to your boat into a relative wind speed.

Motoring into varying headwinds and noting the engine rpm and then seeing what boat speed the same revs provide in calm conditions can provide a surprisingly accurate wind speed to tidal flow conversion.

3 ADDING SOME MORE

It is wise to add roughly one additional boat length to our calculations to ensure there is enough slack to counter the yawing at anchor without a direct upward pull on the anchor.

4 PLAN AHEAD

Make sure you consider not just the conditions of the anchorage as you arrive but what they might become. Is the wind forecast to increase significantly? Is there a likelihood of the anchorage becoming significantly busier while you are there? How much tidal stream do you expect to flow through the anchorage when the tide changes?

Different types of anchor

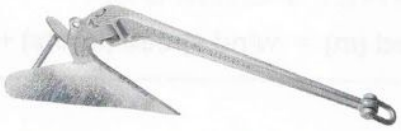
PROS AND CONS

1 FISHERMAN

Traditional fisherman anchors can be folded flat for easy strowage and hold well on rock and weed, but tiny flukes are likely to drag on any other bottom, ruling it out as a main anchor.

2 PLOUGH

CQR, Delta and Kobra II anchors may drag if pulled hard enough, tilling the seabed if it is soft sand or mud. Designes have evolved to increase their maximum holding power.



4 CLAW

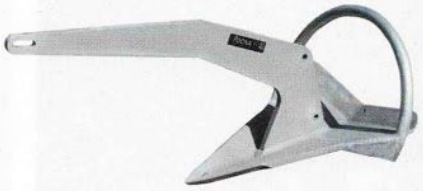
The genuine Bruce has not been made for very many years and many copies have been produced, often in low-grade, brittle and weak materials. The genuine item sets and holds well in soft-to-medium bottoms, is said to hold on rock, but its long leading edge struggles to cut through weed.

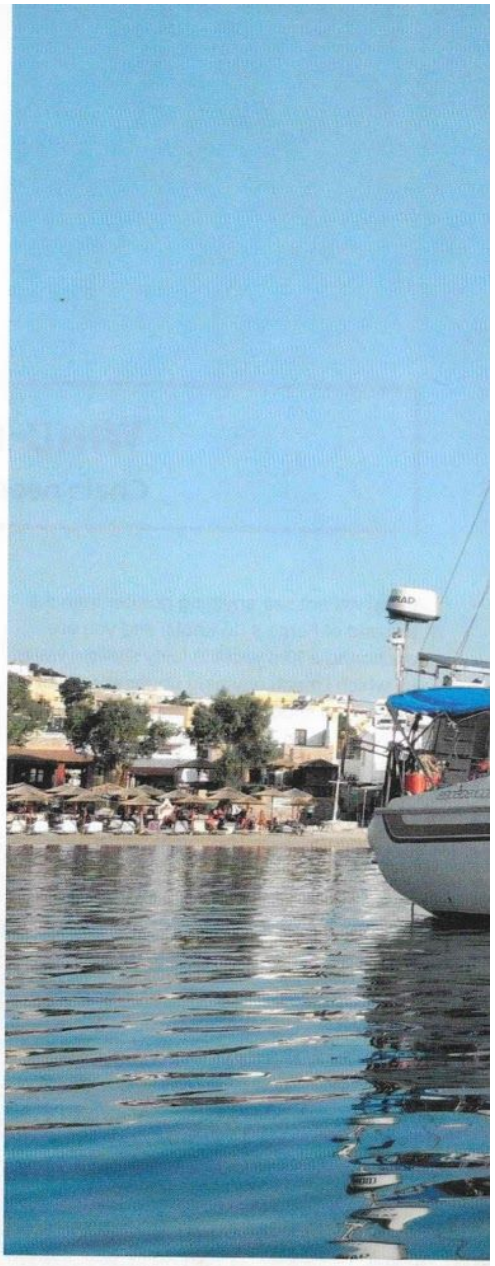
3 FLAT ANCHORS

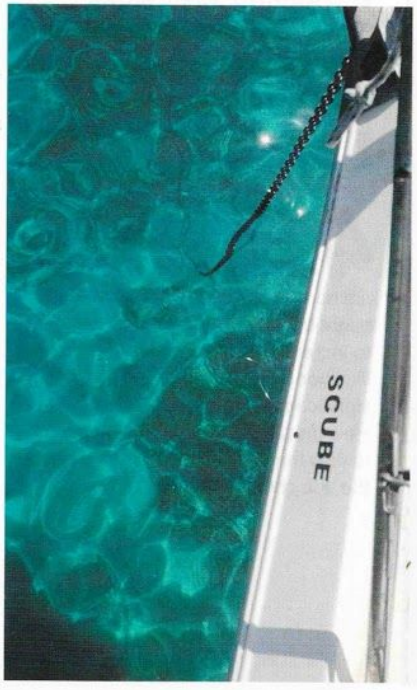
Danforth, Britany, FOB, Fortress and Guardian anchors have a large surface area for their weight, and hold well in soft-to-medium bottoms. On hard bottoms, such as packed sand and shingle, they can skid without setting and they tend not to reset when the tide or wind changes the direction of pull.

5 NEW GENERATION

This category includes the Bügel, Manson Supreme, Rocna, Sarca and Spade. Their designs aim to make them easier to set and reset if the tide changes, with increased holding power.







CATENARY CURVES

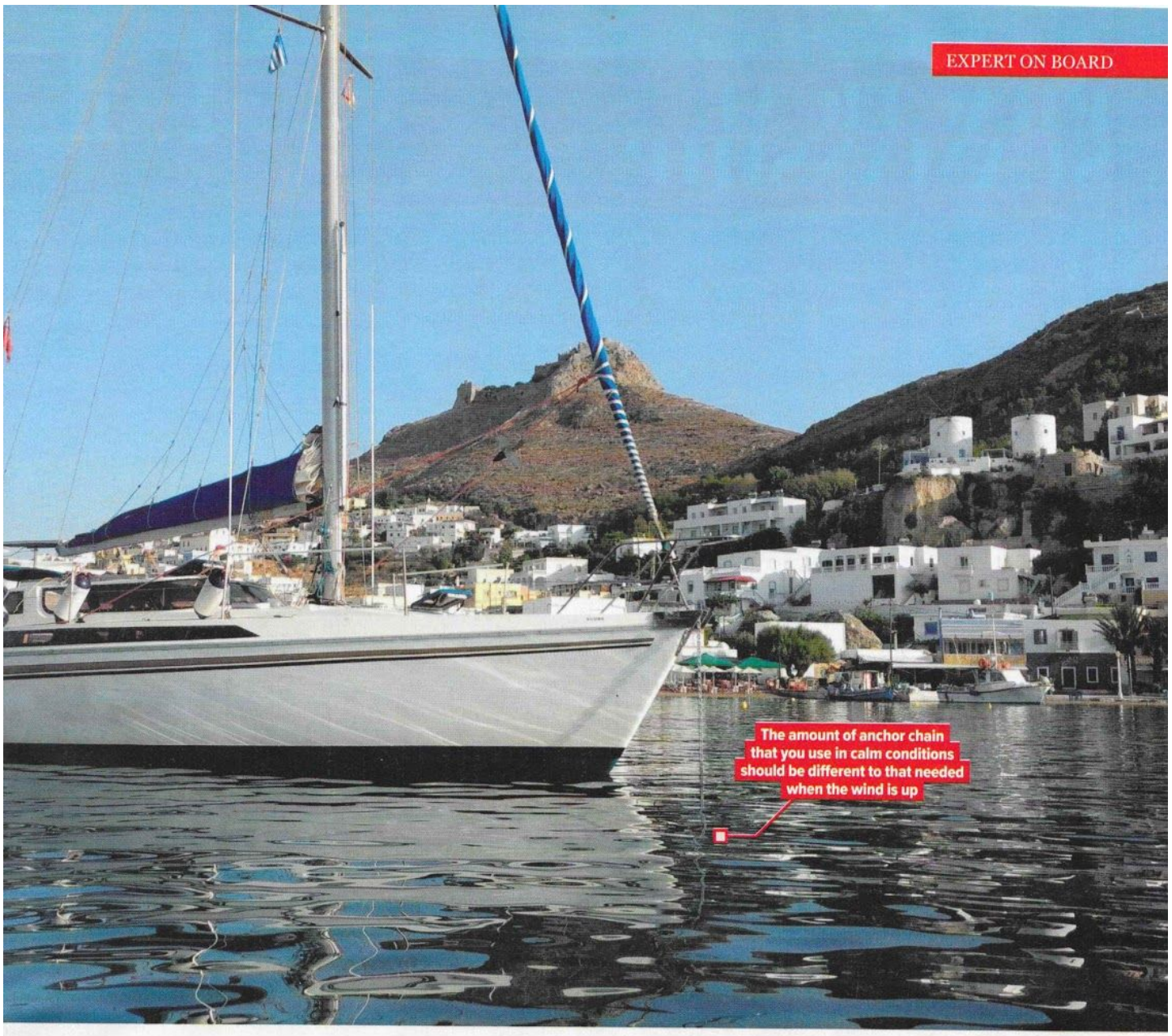
The starting point for these calculations is the curvature of the chain in the water, the catenary, which transfers the lateral force from boat to seabed. The maths isn't fun, but for typical anchoring conditions, the catenary length turns out to be closely linear with wind speed, but with a slope that increases only as the square root of the anchoring depth.

For shallow anchoring (5-8m) the slope is close to unity: catenary length (m) = wind speed (knots). With deeper anchorages (15m) the slope rises to 1.5 and onwards to 2 at 20m depths. The square root factor with depth makes clear that the concept of scope is flawed. For example, anchoring in 4m of water with a Force 5 wind either present or expected, you need 32m chain, a scope of almost 8:1. As Rod Heikell says (*Yachting Monthly*, Summer 2018) 'Forget the 3:1 scope usually touted: go for at least 5:1, and if you have swinging room, more.' What I say is forget the concept of scope entirely!

The force of the wind also depends on the shape (windage) of the boat. You can measure this for your own boat by measuring the amount of chain lifted at a given wind speed (V) and depth (D) with the formula: catenary = f.V.√D . My 'shallow anchorages' calculation is based on my boat (10.4 m Jeanneau Espace, 10mm chain) and a depth of 6m. Values will be reasonably similar for most production yachts, assuming the chain size increases according to the boat size.

CHAIN ON THE SEABED

We can calculate the length of the catenary – but is this the right amount of anchor chain to use? Years of swimming down to watch the anchor in warm Mediterranean waters has convinced me that an optimal chain length is the catenary plus a boat length. This gives a buffer to counter the yawing at anchor without a direct upward pull on the anchor. Also a length of chain bedded in the sand or mud substantially reduces the pull on the anchor. So my best guess is: total chain = catenary + boat length. Some people say that in order to drive the anchor into the



WIND & TIDE FORMULA for shallow anchorages (4 to 8m)

Chain needed (m) = wind speed (knots) + 4 x water speed + boat length (m)

seabed the chain needs to be angled upwards, i.e. a length slightly less than the catenary. However this is exactly why we use the motor in reverse after anchoring – to lift the chain angle and drive the anchor down.

No consideration is given here to the holding power of the anchor. That's essential and is discussed in many other articles.

TIDAL STREAMS

The second force acting on your boat is the drag of tidal streams. Surprisingly you can easily measure this yourself. On a windy day motor slowly into the wind, reduce revs, and find the engine revs that just balances the wind force. Then on a calm day note the boat speed produced by the same revs.

With my boat, a full Force 4 wind needed 1200 rpm to balance the wind force – and when calm 1200 rpm gave 4.2 knots speed over ground. Thus a 4.2 knot tidal current would correspond to a 16 knot wind force, which needs 16m chain to balance it, i.e. about 4m of chain per knot of current. So we now have a more complete formula.

Anchor chains are usually marked in 10m stages, so a practical approach is to round the calculations to the nearest 10m of chain. With 10m boat length added, this gives an easy to use table (right).

It seems extraordinary that for all the articles on anchoring and discussions on scope there is so little consideration of how to allow for wind strength. Yes, there are geek articles on catenary lengths, but little attempt to apply this into sailing practice. I hope here to at least reawaken your thought processes of how to choose an appropriate length of anchor chain. It's actually not so hard after all.

Maximum wind (Beaufort)	Shallow anchorage (4-8m)	Deep anchorage (10-15m)
F3	20m	30m
F4	30m	40m
F5	30m	40m
F6	40m	50m
F7	40m	60m
F8	50m	70m
F9	60m	80m