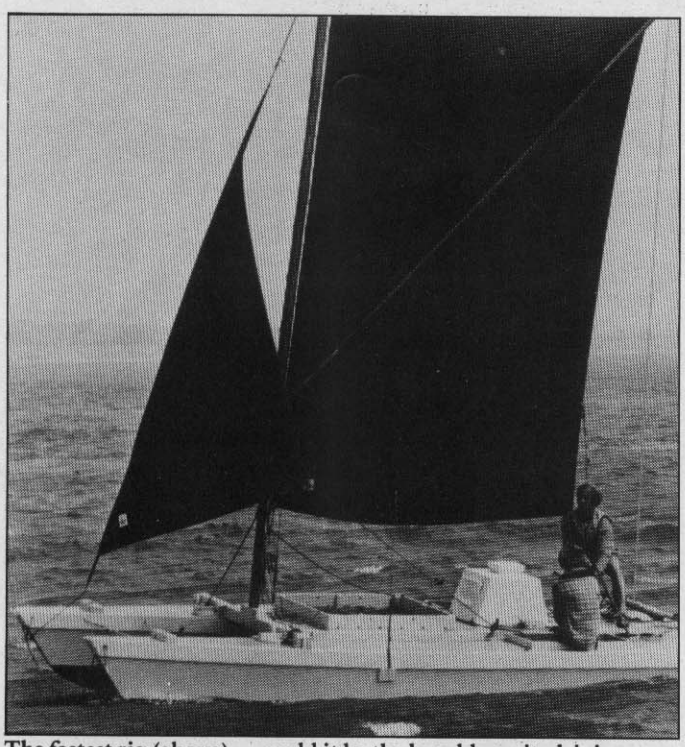
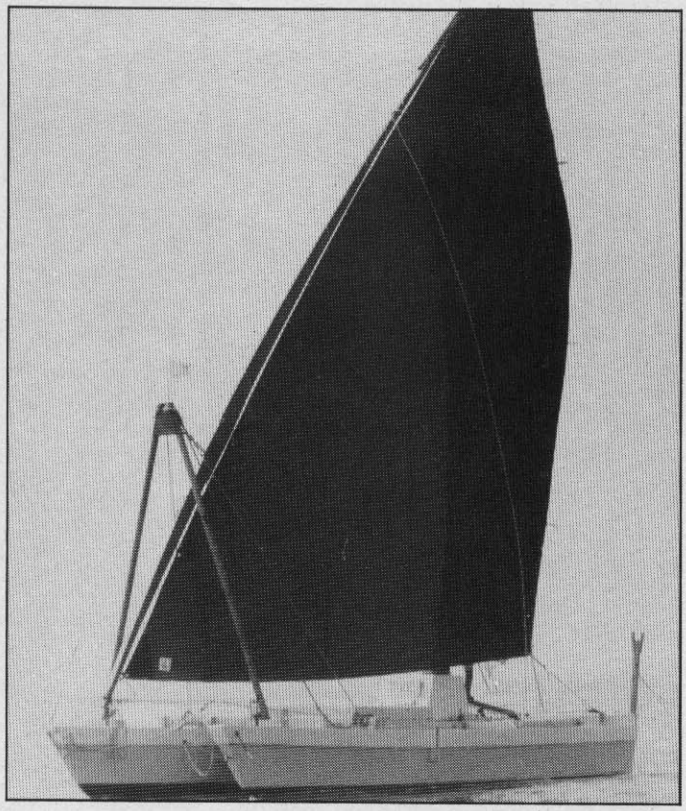




The fastest rig (above) — could it be the humble sprit, driving force of the Thames barge? Trials indicate it is not the lateen (right), sail for Egypt's dhows

The Fastest

JUDGING BY the vast majority of modern yachts, be they racing or cruising designs, the bermudian rig must be the best rig available. To be sure there is some dissension from those who lay claim to improved offwind performance and ease of handling to justify their picturesque 'old gaffers', but their voice is small and they are somehow seen as traditionalists who do not want to change. Any modern, forward-thinking yachtsman knows that the bermudian rig is the one to go for. After all, racing rules in recent times have encouraged its development.

But why? What is the basis for this assumed superiority? Look more carefully and you find that the comparisons are not made on a like-for-like basis. Bermudian rigs are generally fitted to sleek hulled boats, whereas the traditional rigs tend to appear on more solid boats. It is impossible to draw valid conclusions about the rigs alone.

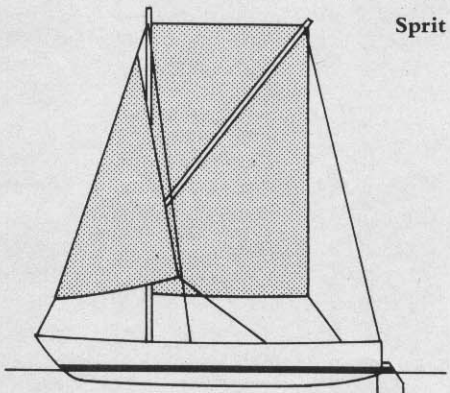
Many thousands of third world fishermen still rely on the use of sail power to make their daily living and there are many development projects going on to assist them. A feature often targeted for improvement is the traditional rig they use. It should be modernised, it is said, and this is frequently thought to mean a change to a bermudian rig, so following the lead of the developed world.

To make the most useful recommendations some facts must be established about the relative merits of different rigs. The only way to do this is to make comparisons under fair and controlled conditions. Take two identical boats, fit one with a bermudian rig and the other with an alternative. Sail them against each other and measure the difference in speed. This seems obvious but, surprisingly, it appears never to have been done before. Opinion on the superiority of one rig over another is based mostly on hearsay and results of very subjective comparisons.

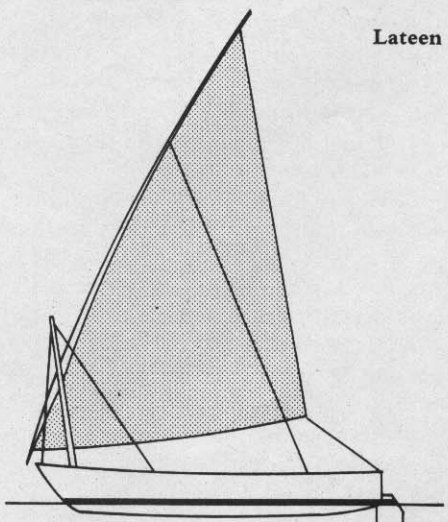
As part of a study of energy saving measures in third world artisan fisheries funded by the CEC, Gifford Technology of Southampton conducted what are probably the first ever truly comparative trials. Using two identical catamarans, we fitted one with a stock bermudian rig and sailed it against the other boat, fitted in turn with lateen, sprit and gaff rigs.

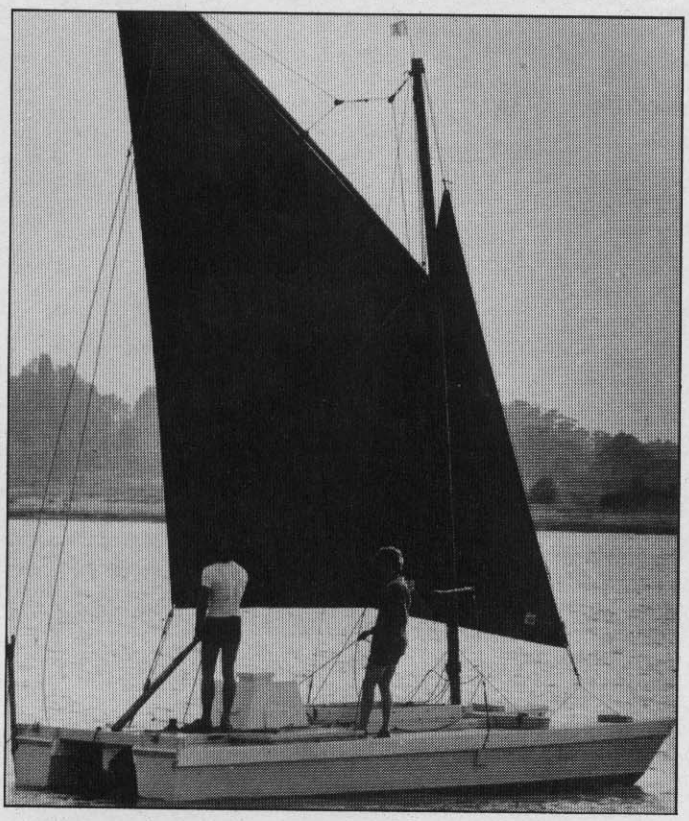
The results came as a surprise and overturn the common assumptions about the bermudian rig. The best rig, on all points of sailing, was the sprit sail. Its superiority was especially marked when sailing to windward.

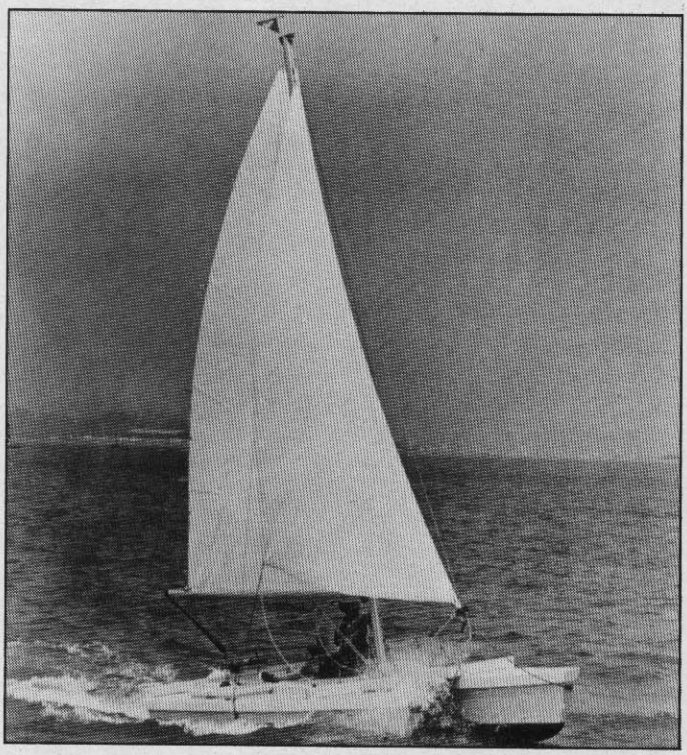
Sprit



Lateen







The out-of-favour gaff (left) showed up well against the Bermudian plan (above) which came third of the four contenders

Rig?

Recent research to evaluate different sailing rigs for use on small fishing craft in third world countries has produced some suprising results, writes COLIN PALMER of Gifford Technology

The gaff sail ranked second best, followed by the bermudian and the lateen.

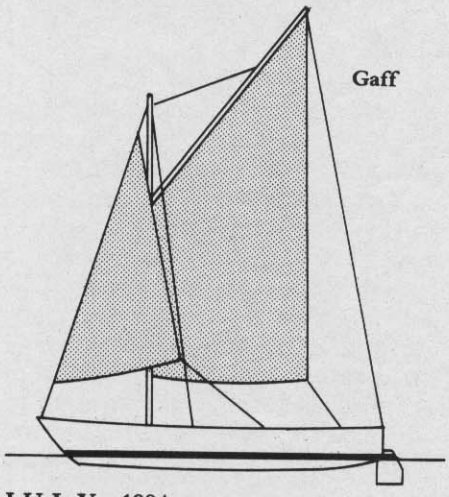
At first sight these results are almost unbelievable. The sprit sail better to windward than the bermudian? How could this be? In searching for reasons we must look to basic aerodynamics.

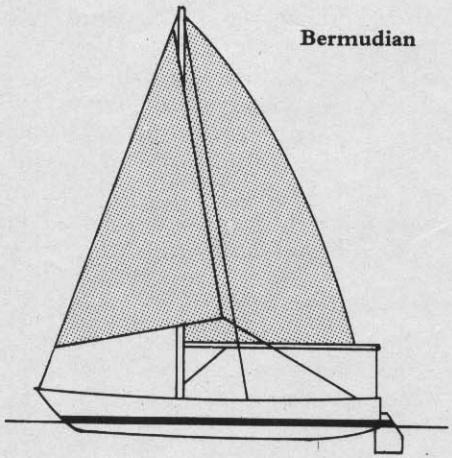
It has long been recognised that aerodynamically the triangle is a very poor plan form. Rigs should tend towards the classic ellipse, though in practice the rectangle is very nearly as good; much better than the triangle. So what is needed is a rectangular sail, and the sprit sail fits the bill.

In our trials it was used with a small jib to smooth the flow around the mast and give the extra drive that comes from slot effect. Since total sail area was the restriction, a large mainsail/small jib combination was chosen. This may seem strange in the light of racing yachts with huge overlapping genoas, but it's the rule and not aerodynamics which calls the racing tune.

Overlapping area in the genoa is 'free' area for racing boats, so the more the better. The commercial sailor has to make every square metre pay. He is ill-advised to put it into large overlapping sails for, area for area, they are less efficient.

For those who wish to pursue this reasoning further, there is a great deal of relevant information in C A Marchaj's excellent book *Aero-Hydrodynamics of Sailing*. Indeed he devotes some thirty-four pages of Section 2D to a lucid discussion of the effect of rig plan form, and concludes by lamenting the restrictive effects of the racing rules on the development of unorthodox and potentially superior rigs. This was all written long before our trials and based on a free-thinking review of known rig performance and aerodynamic theory. Now we have trials results which support his line of reasoning.





The rigs used in the comparative trials were selected as being appropriate to working boats. Thus the bermudian rig is not of extremely high aspect ratio, and it did not bristle with controls for squeezing out the last little bit of drive. Instead it was a simple masthead rig, as you might find on a modern, fast cruising boat. Grooved aluminium spars, stainless steel rigging and Terylene sails were used.

The other rigs were rather simpler in concept, using wooden spars and lashings for sail attachment. The sails were, however, also made of Terylene.

For the trials we used two identical six metre catamaran hulls. They were

chosen since the catamaran is less sensitive to heeling forces and so less demanding of the helmsman's skill; the purpose of the trials was to compare the rigs and not the helmsmen. In addition the virtual elimination of heeling gave a more stable air flow over the sail, therefore making direct comparison easier.

Another advantage of the catamaran is that, whilst being stable, it is also light in weight. This results in a relatively gentle rise of resistance with speed (as compared to a heavier displacement boat) which means that speed varies more rapidly with sail thrust, giving a more sensitive measure of differences in rig performance.

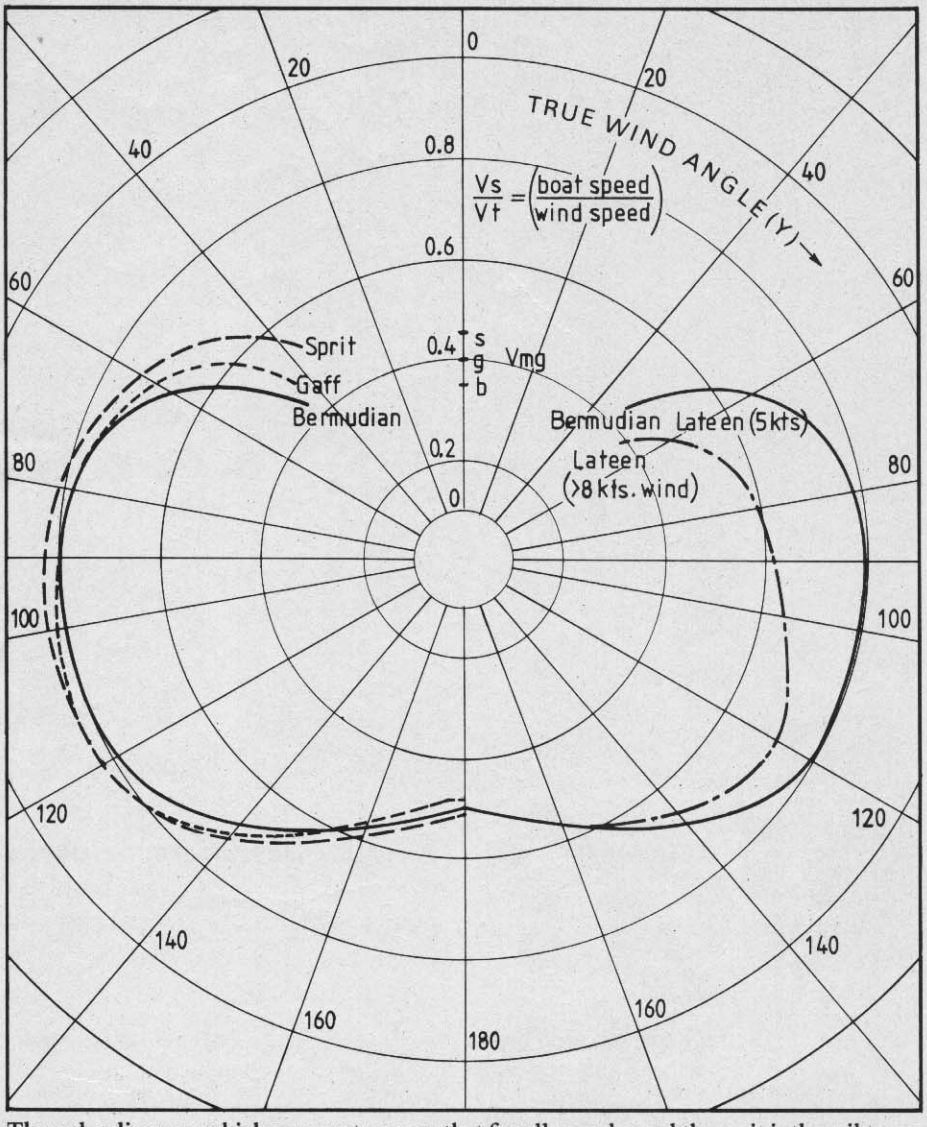
Two different approaches were adopted during the trials. In the first the bermudian boat and the lateen boat were sailed individually on short courses past a moored boat which recorded wind speed and direction on magnetic tape. The speeds of the boats were measured from the shore by triangulation with theodolites. A computer was used to record and analyse the data and, after a large number of runs, a plot of boat speed against heading was obtained.

The results showed considerable scatter, and it was difficult to deduce from them the true pattern of difference between the rigs.

As an alternative, another set of trials was conducted in which the boats were sailed against each other over predetermined courses. The large number of fixed piles and navigation marks around the trials area (Calshot near Southampton) gave a wide choice of headings to suit all wind conditions.

In *America*'s Cup fashion the boats were match-raced against each other. As with the *America*'s Cup, the crews were encouraged to get the best from their boats by experiments with sheeting positions and sailing techniques, but this was an *America*'s Cup with a difference. Instead of tacking to cover, they tacked to keep clear of each other. If a boat was overtaking on a downwind leg this was made as easy as possible. It was a co-operative competition, each boat to be sailed at its best; a difficult discipline for competitive sailors, but they soon became used to it and ensured a true measure of the relative speed of the boats.

A wide range of courses was selected from a dead beat through reaching to running before the wind. On each course the two boats were timed between the fixed marks. Since they sailed in company as far as possible, the effects of tide and wind were experienced equally by each boat. The trials



The polar diagram which appears to prove that for all round speed the sprit is the sail to use

were conducted in winds of between 5 and 10 knots, in an area of sheltered water.

Unlike the direct measurements these comparative trials gave very consistent and repeatable results. By using the bermudian rigged boat as a trial horse for each of the other rigs, a reliable picture of the relative performance was established. The measurements of time taken to cover known distances allowed the speed differences to be measured.

The sprit sail rig proved to have the best overall performance. Beating it was closer winded and sailed faster, giving a speed made good to windward some 30 per cent faster than the bermudian rig. When reaching the margin was smaller, the sprit being on average 5-10 per cent faster. Directly downwind the two rigs gave very similar speeds.

The gaff rig was also superior to the bermudian rig to windward, but by a smaller margin of around 15 per cent. Close reaching, it was no faster than the bermudian, but off the wind it was 5-10 per cent faster. Downwind, again, there was little difference between the two.

In very light winds the lateen rig performed very similarly to the bermudian, but as the wind strength increased to 8 knots or more, its performance dropped off on all but broad reaching and running courses. When close-hauled or close-reaching it was up to 30 per cent slower than the bermudian rig.

The precise margins measured obviously apply only to the particular rigs tested but they no doubt reflect general trends which are valid for the relatively light winds commonly found in tropical countries.

They also apply only to sprit sail, gaff and lateen rigs sailed with vangs — lines attached to the yards and used to hold them up to windward. This reduces sail twist which has a dramatic effect on windward and close-reaching performance. The poor performance of our lateen can be attributed partly to difficulties found in controlling its yard.