

The split-junk rig: a junk with jiblets

One owner's development points to untapped potential in the junk rig, as David Harding reports

If you were sailing in one of the lower-rated ISC classes in the Round-the-Island Race in 2008, 2009 or 2010 you might have noticed a rather unusual-looking boat.

This particular boat has a junk rig, which is not exactly common in racing circles. What made many people do a double-take, though, is that the rig on *Poppy* – a 9.4m (31ft), fin-keeled Westerly Longbow – is split either side of the mast, the area forward being in the form of mini jibs between each batten. It looks like a hybrid between a conventional junk and an Aerorig (the cruising-yacht development of the sort of rig widely seen on model yachts, whereby the jib is tacked to what's effectively an extension of the boom forward of the mast).

Downwind is when *Poppy* gets into the overtaking lane

The Round-the-Island Race is not the only time *Poppy* has been sighted in and around the Solent, because her owner and the rig's inventor, Slieve McGalliard, also cruises from his mooring on the Hamble. Racing, however, is by far the best way to see how a boat goes against a wide variety of others, and that's why Slieve competed.

For various reasons unrelated to the rig he didn't do as well as he had hoped on any of the three occasions despite impressive boat-speed at times, but *Poppy's* performance both during the races and while cruising has given him encouragement to develop the concept further.

Making a good thing better

Enthusiasts point out many benefits of the junk rig compared with a conventional Bermudan alternative. Among them are that it's controlled entirely from the cockpit and is easy to hoist, lower and reef at any angle to the wind. It's self-tacking, it doesn't flog and it comes into its own downwind when its full area is projected. Needing no standing

rigging, it's relatively lightly stressed and easy to repair.

The problem with junk-rigged boats has been getting them to go upwind, largely because the sails have traditionally been flat. In previous PBO articles we have looked at ways of putting shape into the sails, including jointed battens and cambered panels. While these have made a significant difference to performance upwind and in light airs there's undoubtedly more to come, and that's why Slieve felt moved to do some experimenting.

As a recent Research and Development Secretary of the Junk Rig Association, he admits that he has been fortunate enough to learn a little about what makes junks tick.

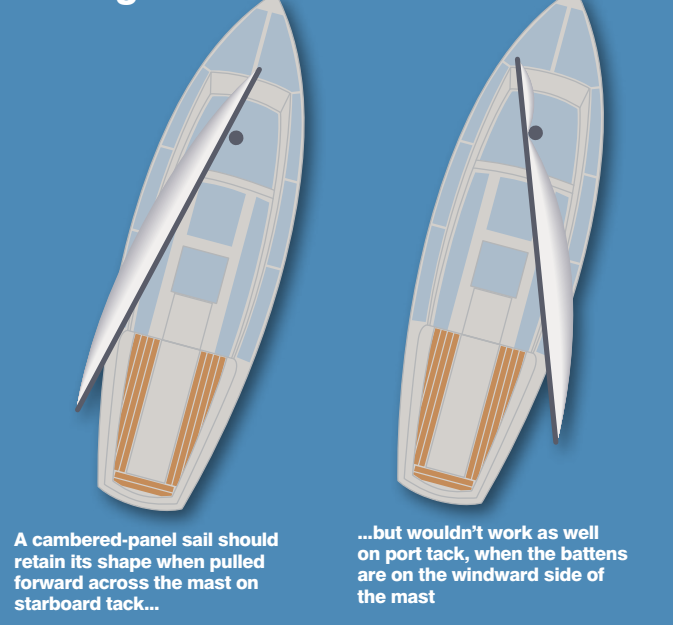
A retired airline pilot, he also has more than a passing knowledge of aerodynamics. Flat sails, he

explains, perform poorly for a number of reasons. The main one is that the luff area of a cambered sail has a 'forward-facing' surface that produces



Poppy beating across Osborne Bay, nearing the finish of the 2008 Round-the-Island Race

Sliding sails



A cambered-panel sail should retain its shape when pulled forward across the mast on starboard tack...

...but wouldn't work as well on port tack, when the battens are on the windward side of the mast

forward drive in a way a flat sail simply can't. With a flat sail, the airflow also tends to break away from the sail just abaft the luff rather than staying attached to the leeward side. It may re-attach towards the leech, but the centre of pressure moves a long way aft. Most of the pressure is on the windward side and the lift/drag ratio is poor. Weather helm is one result, and that's why junk rigs are sometimes slid forward across the mast to help redress the balance, especially downwind.

Slieve is a firm believer in cambered panels as a way of building shape into a junk sail, having been inspired by the work of Arne Kverneland in Norway. Sails with Bermudan and most other forms of rig are cambered as a matter of course, because that's the way they work best. After all, how many aeroplanes have flat wings? The problem is that it's difficult to



Downwind is when the rig really comes into its own, partly because of the projected area and partly because laminar flow is maintained at greater apparent wind angles than with most other rigs

maintain camber all the way forward in a conventional junk configuration with the sail largely abaft the mast. Another problem is that the mast creates a good deal of turbulence, so again the centre of pressure starts creeping aft, inducing more drag and weather helm. Further compounding the situation is the fact that, on many boats converted from Bermudan to junk rigs, structural constraints such as the position of bulkheads make it impossible to step the mast far enough forward.

Sliding sails

Sliding the sail forward over the mast has been tried with both flat and cambered-panel sails, though both are normally moved aft again for sailing upwind.

Sliding a sail with cambered panels forward results in the sail being divided in two on port tack

when the battens are on the windward side of the mast, and aerodynamically that's highly inefficient. A flat-panel sail is less affected when slid forward and, in fact, seems to work better on port tack because on starboard it's disturbed by turbulence from the mast.

Minimising the effects of the mast's turbulence was one of Slieve's objectives. His solution was to move the sail forward permanently and split it at the mast so the area forward would be in the form of separate mini-jibs (or jiblets, as seems the natural name for them). This allows the forward-facing cambered section to work in clear uninterrupted air and increase the lift/drag ratio. The mainsail's camber can also remain constant on each tack, unaffected by the mast. Any benefit from the 'slot' effect of the jiblets is a secondary consideration.

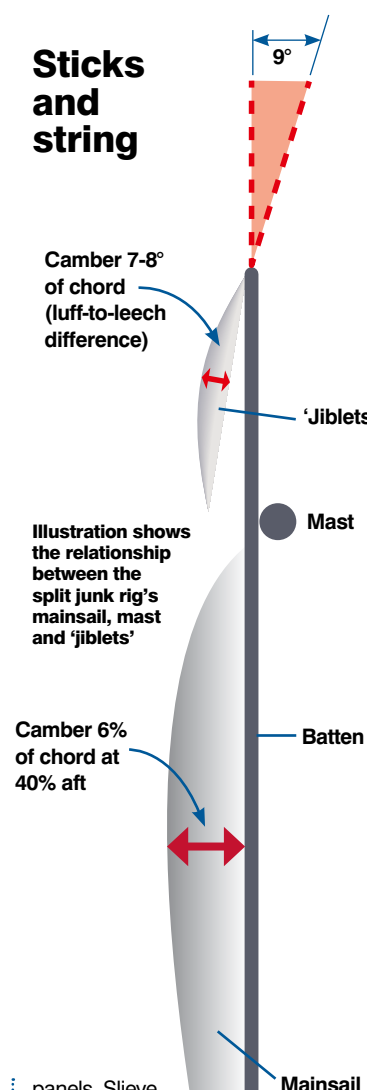
Sticks and string

Being of a practical bent and able to do the necessary number-crunching, Slieve designed and built his own sail in his living room with the help of a spreadsheet and a sewing machine.

He made the jibs at an angle to the mainsail of 9° and with a camber of 7–8%. The panels in the main body of the sail have 6% camber at 40% aft from the luff, the shape being built in by broadseaming in the vertical panels (whereby they're cut with curved edges before being sewn together).

Initially the area of the jiblets was calculated at around 25% of the total but, knowing what he has learned since, Slieve would increase it if starting again. In model yachting a jib area of 33% in a balanced rig has been found to work and to remain stable.

Despite having a sail with seven



panels, Slieve only has jiblets in the lower five. He considers the top two to be his storm canvas and decided to leave them alone until he learns more. In other respects the rig is based on the tried and tested in junk circles: the aluminium mast is from Needlespar and the 6m (20ft) battens are in 16-gauge aluminium tubes of 50mm (2in) diameter. Controls are conventional too, though Slieve has simplified them over the past couple of years and now simply has a halyard, a hard-hauling parrel (a line controlling the yard's position on the mast), three batten parrels that double as downhauls, and a three-part mainsheet.



Jon Stone Photography

This shot shows how much more sail *Poppy* presents to the wind than the non-spinnakering Bermudan-rigged boats around her

Ironing out the wrinkles

When I went for a sail we had a brisk north-westerly gusting to around 20 knots, so we hoisted five of the rig's seven panels. The full rig can be flown in those conditions if you're just concentrating on sailing

and not trying to talk and take photographs at the same time. With all seven panels set, the area is around 46sq m (500sq ft). That's the same as on a conventionally-rigged Longbow with a mainsail and 135° genoa.

Few junk sails set as smoothly as a Bermudan equivalent and

Poppy's didn't look desperately pretty from every angle either – but it clearly worked, even if accurate measurement of our tacking angle was impossible in the shifty offshore breeze. All we could gauge with any certainty was that it was less than 90° and occasionally closer to 80°, while our boat-speed

hovered in the mid-5s.

Given that we were sailing a 30-year-old Westerly with a three-bladed fixed prop, the performance seemed highly creditable. It's hard to imagine that a normal Westerly Longbow would have done any better, though it's difficult to judge a boat's performance without something comparable to sail against – hence Slieve's Round-the-Island entries.

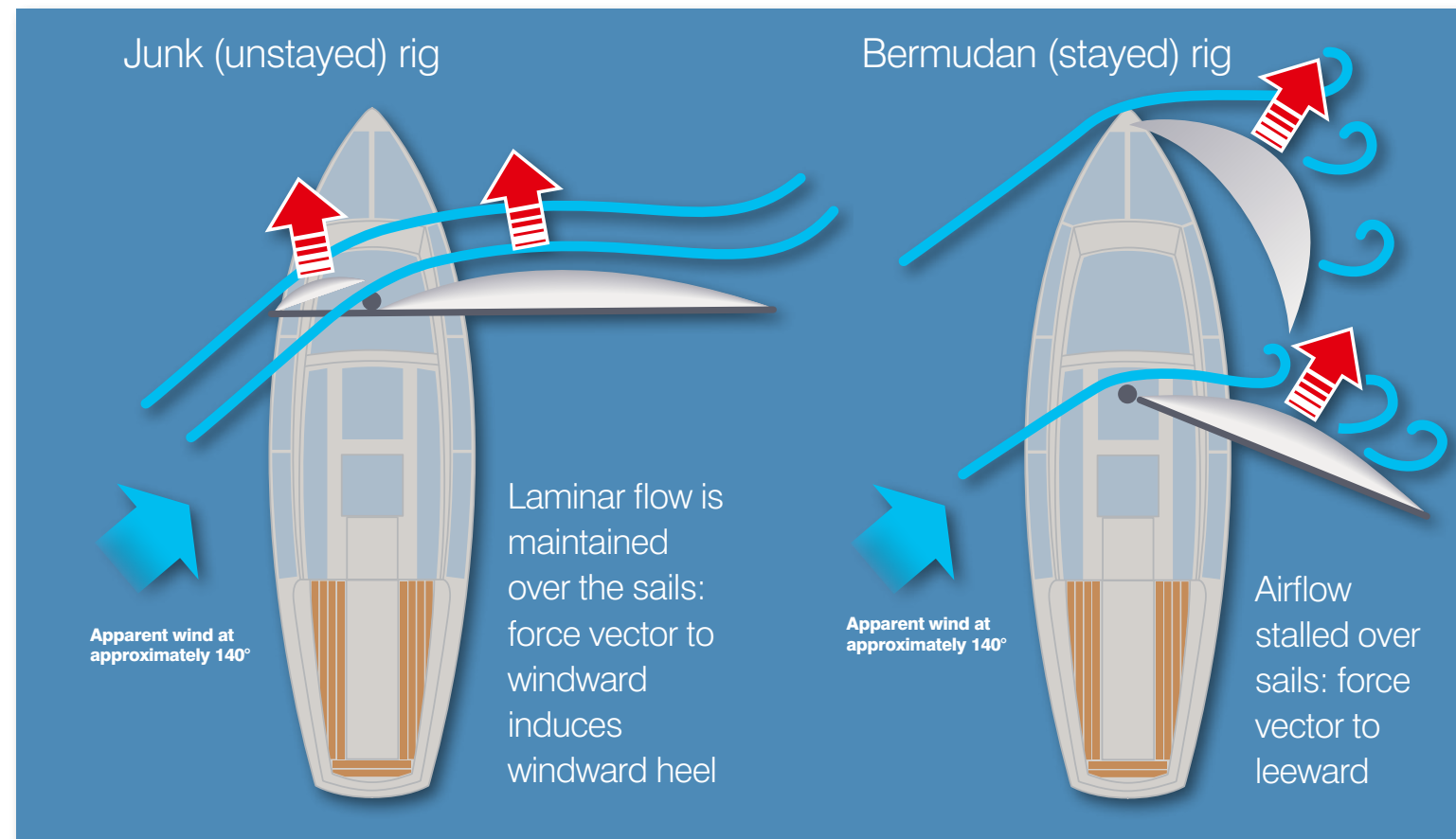
One thing he hadn't taken into account in his design is the downward component of the mainsheet, which pulls the battens closer together, induces some creases and increases the vertical camber. The trick is not to apply too much sheet tension.

Slieve is keen to differentiate between creases and wrinkles in a sail. 'There are two things in a junk rig', he says. 'One's called creases and one's called wrinkles. Wrinkles you can tolerate; creases you can't.' He maintains that wrinkles from the surplus cloth in cambered panels are sometimes evident and nothing to worry about, whereas creases can spoil the camber and the performance.

When it came to handling, *Poppy* was as simple as a sailing boat can be. Short-tacking is a doddle and gybing is gentle because of the balancing sail area forward of the mast. Downwind you simply ease



Splitting the rig: the jiblets at work forward of the mast in the lower five panels of the seven-panel sail



the sheet and sail as deep as you like – even well by the lee if necessary, knowing that if the sail swings across it will happen gently. One thought I had at the time was that a separate sheeting span to the upper battens would be worth having, to induce some more twist into the sail. Without telltales in the top panels it was hard to be sure, but I suspect the upper leech was stalling at times.

Relative performances

The simplicity of Slieve's rig is one of the factors he likes most about it, partly because it relieves so much of the physical effort normally involved in sailing. During the 2008 Round-the-Island he noted that he tacked 36 times and gybed twice, all without touching the sheet. He adjusted the halyard, downhaul and yard parrel twice, once for shaking out the first reef and once for putting it back in. The sheet itself was adjusted four times and left cleated for the rest of the race.

Slieve reckons that a little-recognised characteristic of junk rigs is the reduced pitching moment: the mast flexes forward when the bow meets a wave, leading to more comfort and greater speed. During the breezy 2008 Round-the-Island he

observed: 'I did get my glasses wet with spray twice, which I thought was very inconvenient.'

In terms of performance against other boats, his observations from three years of sailing have shown *Poppy* to match or sail faster than comparable boats upwind in both flat and choppy water and to be far handier in confined spaces.

Reaching is efficient as well, because a conventional headsail becomes less effective and starts to stall when eased beyond a critical point. As the wind comes further aft and most boats find the headsail blanketed by the mainsail, *Poppy* continues to project her full rig to the wind and maintain laminar flow across the sails until the apparent wind angle reaches about 140°.

It was when broad-reaching in a breeze that Slieve discovered one characteristic of the rig he wasn't expecting. Sailing along one day with the apparent wind over the quarter and the sail at 90° to the centreline, he found that an increase in wind strength made the boat heel to windward. This behaviour will be familiar to sailors of Lasers, Finns and other single-handers with unstayed rigs, but it wasn't expected on a Westerly Longbow. It happens because the force generated by laminar flow over a rig squared off like this is directed to windward, whereas that

doesn't happen with a mainsail whose angle to the centreline is limited by the rigging. The solution is simply to reduce sail or sheet in slightly.

Downwind is when *Poppy* really gets into the overtaking lane, leaving spinnaker-less boats behind and generally keeping pace with those flying spinnakers but without her crew needing to do anything other than sit back, enjoy the ride and, occasionally, watch

others struggle. Performance cruisers aren't included in the comparisons, which have to be made against boats of a suitably cruisy nature: Westerlys, Moodys and others of a similar size and vintage.

One more point Slieve is keen to make is that he uses no winches – just a pair of gloves when hoisting the sail and letting the halyard run through his hands during a fast drop.

Split-rig junk: what next?

Slieve believes there's plenty of scope to develop the 'split junk' further. He has not devoted full-time effort to the project by any means and, when out sailing, is often with his grandchildren rather than rig tweaking.

He's currently writing a set of notes on how to build the rig and is interested to see how others who are in the throes of building one get on. It seems unlikely that junk rigs will ever attract a mass following but, if they can evolve to the point where they match Bermudan rigs in all-round performance for less cost and a fraction of the effort on the part of the crew, they surely deserve to win a few more converts.

It's only fair to say that many of the attributes of the split junk are shared by other forms of junk rig, though the jiblets add a new dimension and, as Slieve's observations about *Poppy's* performance would appear to suggest, a step up in performance.

While developments are continuing on several other fronts as well, it seems that the split junk makes sense in theory and also seems to work pretty well in practice. If someone could be persuaded to try it on a slightly sportier boat, we would have a chance to see what it can really do.