Poppy

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Back in 2002, I wrote down my thoughts on the modern junk rig, looking for a way to improve its one weak point, the windward performance. These notes were printed in JRA Newsletter 40 and AYRS *Catalyst* no. 11, and received some response from readers, but mostly advocating soft wingsails. The conclusion of my thoughts was that camber is needed right to the luff of the sail, a feature that is difficult to achieve with the standard rig, which is normally pulled aft. One possible idea was to build a cambered rig with a lot of sail balance forward of the mast and split the sail in way of the mast so that the camber would be the same on both tacks and not distorted by the mast.

The initial idea was to try the rig on a Mirror dinghy, but when a rather neglected 31ft Westerly Longbow with tired rig became available the project grew bigger. Needlespar made the basic mast and step. I made all the rest of the rig after getting 50mm dia by 1.5mm wall tube welded to make 6 metre length for the battens. The split sail was home made in 3 sections of 6oz Terylene, and is 515 sq.ft (47.5 sq.m), the same area as the Bermudan rig mainsail and 135% genoa. This, along with some other major work took more time than planned before we could try it out.

It would be nice to report that the boat, *Poppy,* was fully set up and running by now, but the truth is that I've enjoyed sailing her so much that I still have some modifications to make which should improve the appearance and possibly even the performance. When I modelled the rig I did not allow for the downward pull of the sheets when close-hauled so the result is there is some diagonal creasing in the upper panels when the sheets are pulled tight. This creasing affects the camber and seems to have a significant effect on the performance, but fortunately the sheets only have to be eased a little and the creases reduce a lot.

How to Test

As most experimenters find out, it is very difficult to evaluate the performance of a boat. With seemingly unlimited finances the Americas Cup boats simply build two identical boats to use one as a yardstick, but lesser mortals have to find another way.

With *Poppy* the decision was to enter *Poppy* into the 2008 Round the Island Race in the Island Sailing Club handicap fleet. The ISC provide a Rating for each boat involved. Armed with the list of ratings it is possible to sail alongside a wide variety of boats and by comparing their ratings make an assessment of how the boat is performing. The ISC initially placed *Poppy* in the 'too difficult to rate' category as there is no similar rig in existence, but they finally settled on rating her as a standard Longbow with a typical cruising rig with short battened mainsail and roller reefed headsail. As this is probably the most common cruising rig, then comparing the performance with other boats with known ratings should give an indication of performance compared with the standard cruising Longbow.

Apart from sailing in the 2008 and 2009 Round the Island Races, armed with the rating information on hundreds of boats has made it possible to form an opinion on the performance of the split junk rig over the last couple of year's general sailing.

Notes on Performance

Starting with **Close-hauled in smooth seas,** *Poppy* should sail at about the same speed as her Bermudan sister, or not more than 2% slower, but in practice we have not met smooth water when beating. In our local sailing area in the Solent passage making is always done with the tide, so that beating is always done in a wind over tide situation giving **Close-hauled in Choppy seas**. Under these conditions the unstayed mast has an effect that tends to reduce the pitching moment of the boat. Where a Bermudan boat with fore and back stays will dig its bows into the chop helped by the inertia of the mast, the unstayed mast will flex and let the bow rise and ease its way over the chop giving a smoother ride with less spray. In these conditions *Poppy* would appear to be 1 or 2% faster than her sister boat.

When **Tacking from Close-hauled to close-hauled** the split junk rig is very good. On a Bermudan boat the long leech of the headsail will flap as the boat heads above close-hauled and will slow the boat until the sails are filled on the other tack. With the split junk the short leeches of the 'jibs' do not have the same drag and do not significantly slow the boat as it heads up so that it is possible to take you time during the manoeuvre. As

the rig is self-tacking there is no risk of being taken aback and forced onto either tack, and when the boat reaches the new close-hauled heading for the sheet setting the rig immediately develops full drive. There is no need to bear away to accelerate before luffing back up onto the new course. In practice this means that in a tacking dual the split junk will gain ground on each tack over the Bermudan sister, and all with no more effort than pushing the tiller over. Beating up a narrow river is practical and fun as it is only necessary to sail about one length after a tack before comfortably starting the next one, and it is possible to immediately tack back only a couple of metres after the completion of a tack.

The whole point of the 'Some Thoughts' article was to try and analyse the reasons for the poor windward performance of the westernised junk rig, and Poppy's performance, even in the early stage of development suggests that a solution has been found. It is quite common for skippers of other boats to go out of their way to comment on how good the windward performance is, probably because they were left behind when they thought they should have arrived first.

Looking at the **Close Reach to Beam Reach** performance, the split junk simply gets faster while the Bermudan performance deteriorates. As the headsail sheets of a Bermudan boat are eased the sail takes on a greater camber and although the flow can be maintained over the luff, the area towards the leech starts to stall and the drag increases, resulting in increased heeling force and reduced driving force. When the split rig is eased out the 'jib' and mainsail maintain their relative individual sheet settings with the 'jib' tell-tales streaming horizontally, and the total force vector simply rotates further forward, driving the boat faster. This continues until the rig is approaching right angles to the hull and the relative wind is about 110° from the bow. *Poppy* sails faster than her rating would suggest on these points of sail.

With the wind about **120 to 140° from the bow** the split junk has to be handled very carefully in certain conditions. The first time we became aware of this we had just left Cowes bound for Bembridge in company with a 38-41 foot Moody who wanted to see how the rig would perform. The wind was from the NW, Force 4-ish in gusty cold sector air, so we simply went "7-up" (all seven panels or full sail) as we turned on course while the Moody turned into wind and raised main and unrolled the genoa. After a few minutes we were well ahead while the Moody eventually dropped his main to let his big genoa set without being blanketed. We lost sight of him astern in very few minutes. Shortly after we were slowly overhauling a group of 36 to 40 foot sailing school boats, also under full sail, but we were aware that they were luffing a little on every gust suggesting that a strong gust might cause them to broach.

At this time the relative wind was 120 to 140° from the bow on the port side and our sail was squared of at 90° on the starboard side. We noticed that the Bermudan boats were all heeling about 10° to starboard, and with each little gust the heal would increase to about 15 °. *Poppy*, on the other hand was healing 10° to port, i.e. upwind, and on the gusts this would increase to about 15° to port. My wife was sitting in the cockpit with her back to the wind and steering with her hand on the tiller and not using the extension.

Then we received a fairly strong gust and the Bermudan boats heeled some 20° to starboard and started to swing up to port. *Poppy* increased to 20° heel to windward, to port, and started to swing to starboard. Because of the increased heel my wife was thrown back and was not able to push the helm up enough to straighten up the boat without my help from the other side of the cockpit. Despite having sailed most of my life I have never seen this happen to a displacement keelboat before. We promptly dropped two panels to 5-up, and sailed on with no further problem, nor any drop in speed.

My explanation for the windward heel is very straightforward. In the article 'Some Thoughts' I made the point that to get better windward performance we had to have a rig that had the total force vector as far forward as possible, with respect to the rig. This is another way of saying that we needed a good lift/drag ratio. The split junk rig seems to have achieved this to the extent that when the rig is at right angles to the hull the total force vector is towards the windward side and therefore makes the boat heel in that direction. The increase force from the gust then makes the boat heel more to windward. This is not a problem with Bermudan boats as they cannot ease their sail out far enough, and lose a lot of the rig efficiency as the sheets are eased and their lift/ drag ratio decreases. Having experienced it once, this is now not a problem as it is clear we must not over-press the boat when the wind is in this direction, or we must simply sheet in a few degrees to bring the total force direction to dead ahead. We have to be aware that the total force vector is so far forward with respect to the rig, and sheet accordingly.

When on a **Broad Reach** with the relative wind aft of 140° from the bow the rig begins to stall and the drag increase, however the boat does not slow significantly as the luff camber and the slot still seem to encourage some flow across the lee side of the sail. The sail area is fully spread by the battens when on this point of sail, whereas the Bermudan boats cannot spread their sail area and need to fly a chute to maintain speed. We do not have enough experience of sailing against similar performance spinnaker boats to be able to say with confidence how well *Poppy* performs, but it would appear that there is very little difference. In other words, by easing the sheet from the cockpit to square the rig across the boat we are getting performance similar to a boat where all the deck work has been done and the chute set and trimmed.

On the **Dead Run** the performance is similar to the broad reach. In light winds *Poppy* will run at half wind speed so 8 kts true will produce 4 kts boat speed and 4 kts relative wind over the deck. 10 kt wind gives 5 kts boat speed and as the LWL is 25 ft the maximum displacement speed is 1.34*LWL^0.5 = 6.7 kts. This then seems to be quite good performance, particularly as there is a large 3 bladed propeller being dragged through the water.

Most Bermudan sailors try to keep away from the dead run as they are worried about the accidental gybe. I am happy for my 4-year-old grandson to take the helm on a dead run. This is not a problem with the junk rig as the rig can be squared off and is stable across the boat. As the main sheet is attached to nearly all the battens the sail does not oscillate so rhythmic rolling is not such a major problem. *Poppy* can be sailed comfortably **by the lee**, and on one occasion when a smaller Bermudan boat overtook us I suddenly realised that our helmsman had followed the bend in the river and we were sailing 70° by the lee! I told him to turn 20° further and we all ducked to let the sheet fly across in a so-called crash gybe, but with the balanced junk the rig swings relatively slowly and ends up feathered before the sheets fully take the load. Then it only took a 20° turn back on track to quickly overtake the Bermudan boat again.

Conclusions

Poppy seems to support the points made in the 'Some Thoughts' article. The windward performance seems to be as good or better than the Bermudan equivalent, and on all other points of sail the performance seems to be superior. The rig is very powerful, and when the sails fill the instantaneous surge of power is very noticeable. Throwing into the equation the advantages of easier handling and a more comfortable ride suggests that the rig is well worth further development. Cost has not been looked at in detail, but it is essentially a very simple rig with no expensive hardware to buy or maintain so is significantly less expensive that the Bermudan equivalent.

Probably the only way to confirm my observations is to consider the comments of those who have sailed against *Poppy*. Virtually every time we sail, people who have seen our performance go out of their way to complement us on how fast *Poppy* sails. The day after the 2008 Round the Island Race, I met three of the hard men of sail in the sailing club car park pushing an empty trolley. You know the type – designer stubble, and dressed in the most expensive ocean breathable gear with their expensive sunglasses pushed up in their sun (?) bleached hair. Dressed in my 'too tatty for gardening clothes', I was looking for a trolley so approached them and asked if they had sailed the race the day before. They exploded that 'it had been blowing a gale', 'thrashing

to windward', 'spray flying everywhere', 'soaked to the skin', 'absolutely exhausted' and waving their arms around to emphasise just how tough it had been. When they paused for breath I quietly commented –'I went round as well, (paused for effect) in a junk rigged boat'. All three stepped back together and in unison exclaimed 'POPPY!' I replied, 'Yes, do you know her?' One of them replied with a fast wave of his arm, 'You went past us as if were standing still!' Praise indeed, particularly as the average age on *Poppy* was probably twice the average age on their boat. I hope they didn't notice me smile as I walked away with their trolley.

So why did we not win the RTI race if *Poppy* is so fast? In the 2008 race with two crew members who had only one day's experience of sailing a junk rigged boat, we got three quarters of the way round overtaking boat after boat, all rated as faster and most having started before us. After passing the fort we suddenly discovered that the bilge water was up to the cabin sole, so we pulled out of the race into the foul tide to pump out and find the problem. We lost 40 minutes before deciding to rejoin the race. Even with this we were 236 out of 883 entered on corrected time, and if we subtract the conservative 40 minutes when out of the race we would have been about 60/ 883 and easily within the top 10%. In 2009 I was exhausted for my activities of the previous week and probably sailed the worst tactical race of my life. We watched slower boats overtake us in the distance while we sailed the wrong track on most legs, yet when we did sail near other boats we always had the speed advantage. I make no claims to be a good tactician as most of my racing has been in tideless waters and ended over 25 years ago.

After the 2008 Round the Island Race, I noted that –

1. An own design and homemade Junk rig can compete on equal or better terms with a Bermudan rig on a similar cruising hull.

2. The demands on the crew are relatively light as the combined age of the three of us was over 190 years, and we were not overly tired after 9hrs 30 min racing over 50 miles in boisterous conditions. All sailing was done from the cockpit.

3. No special skill is needed to get good performance out of the rig as the two crew members who actually sailed the boat had only about 4 hours Junk experience before the event.

4. The halyard, downhaul and yard hauling parrel were adjusted twice during the race when the reef was shaken out after the first beat and put in again for the second beat.

5. The main sheet (the only sheet) was adjusted only four times in the race and was cleated for the rest of the time. Set for close hauled before the start, it was eased to squared off when round the Needles, and further eased to squared off when the reef was shaken out. It was reset once when we rounded Bembridge unto the close reach and again as we came to close hauled and one reef down at the Fort for the last beat. Despite the apparently many pieces of string the rig is easy to sail.

6. We tacked 36 times and gybed twice all without touching the sheet.

7. Despite having the spray hood down and the typical Solent chop we had very little spray over the top due to the soft ride of the un-stayed mast. I did get my glasses wet with spray twice which I thought was very inconvenient. It is doubtful if any of the Bermudan boats could say the same thing.

Unfortunately winning the Round the Island Race takes more than boat speed; but it would make the public sit up and take notice! If only…

To summarise –

The list of advantages of the junk rig over the Bermudan rig is long, but this rig has the added advantage of equal or better performance to add to that list.

The disadvantages are that it is not fully developed yet, and cannot be bought 'off the peg'. There is still work to do.

Overall it is great fun to sail, but I do wish sailors on other boats would close their mouths as they stare at us when we sail past them.

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Notes on the Photos

The opening photo was taken by a friend on a Moody 31 on a trip from Hamble to Osborne Bay and shows *Poppy* with the relative wind just forward of the beam. My friend will not accept that the engine was not running as we steamed past him. The wind continued to free as we sailed away from him so that we arrived reefing panel by panel to slow down at a crowded Osborne bay on a dead run, and than sailed in among the boats to anchor. We kept the two panels up after the hook was down so that

the Moody could find us, and through the binoculars watched him approach the anchorage to round up and drop the mainsail. There is no question that we would be quicker around a triangular course despite his 'faster' boat. Later that day we met a Freedom 30 with the latest Sunbird 90 ketch junk rig. When he was sailing close-hauled we literally sailed 360° round him and then sailed away 20° higher to windward.

The photo shows that the 'jib' panels are tightly stretched which would indicate that there is a significant pressure differential across the panel, and the 'main' panels are slightly creased showing the pressure differential in much across the material. This is what I expected in the 'Some Thoughts' article and I believe is what is needed for good close-hauled performance.

The photo below was taken by Jon Stone during the 2008 RTI Race. Jon sent me the photo and wrote – *" Normally I sail a junk rigged 28' Sunbird and find it an excellent rig. In this year's race however I was crewing on a Bermudan rigged Westerly Konsort. I was amazed at how tiring the sailing was. Every tack took three people's full effort (there were only 3 of us), and even when not tacking we had to post one crew member on lookout to peer out under the Genoa and call to the helmsman whether to stand on or give way. Quite terrifying under the windy and very busy circumstances.*

However my favourite memory of the day was when we were between Needles and St. Catherine's point - enjoying a fast beam reach. I looked behind and saw Poppy with her beautiful white Junk rig just coming around the Needles. She flew through the pack and within 20 minutes had overtaken us, and everyone else it seemed. 20 minutes later she had disappeared into the distance ahead. It seemed that no one could touch her for speed on that leg. We caught up with her much later in the day - and now I know why- (because we stopped to pump out and look for the problem) *but she still crossed the line well ahead of us."*

Jon also wrote "*As you can see Poppy is the only vessel's sail presenting any kind of useful profile to the wind."*

Jon's words left me worried that the Konsort was ahead of *Poppy* at the Needles, so I checked the details. For the race, their rating was based on them being a faster boat and using a spinnaker, and this placed them in an earlier start group, and started 10 minutes ahead of *Poppy*. It would appear that we matched them for speed during the first beat, and as mentioned overtook them quickly on the first reach, only for them to pass us when we pulled out with our bilge water problem. When we started racing again well into the last beat against the tide we again quickly overtook them and finished 17 minutes ahead in an elapsed time of 9:28:10 to their 9:45:50.

I also heard that the crew members on the Bermudan Konsort were so tired after the race that they motored the last leg to their overnight berth. We, on the other hand, sailed Poppy all the way back, including 3 miles up the river before going out for a meal and before the (60+ year old) boys drove 70 miles home. I know which boat I would rather be in - the one where a push on the tiller was all that was required to tack!