Catalyst

Journal of the Amateur Yacht Research Society

NUMBER 51 JANUARY 2017

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As examples, the polar diagram p16 of *Catalyst 28* was re-created from a second generation photocopy, photos of shunting in the Champion article in *Catalyst 27* (pp 19-21) were screen grabs from a video supplied on DVD. The rest of the images in that article were scanned from photographs, and the text was OCRed (Optical Character Recognition software) or keyboarded.

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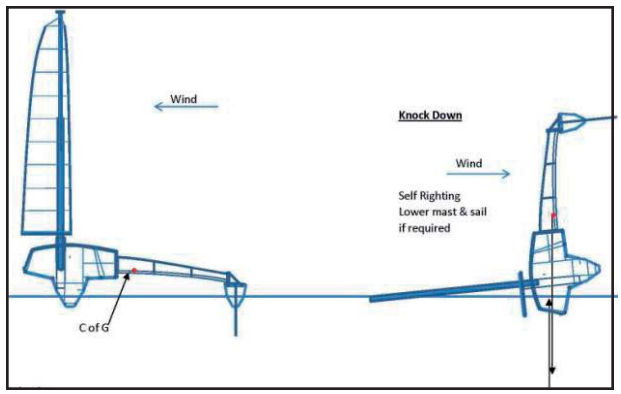

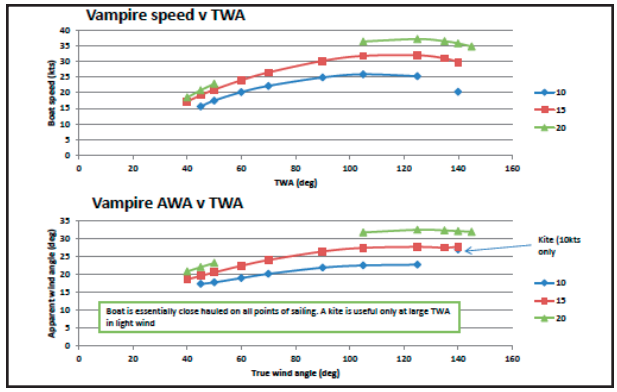

Cover photo: - Bill Sunnucks
Vampire *in flight*

(Photographer not known to AYRS)

Catalyst

Journal of the
Amateur Yacht Research Society

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Catalyst is an irregular journal of yacht research, design, and technology published by the Amateur Yacht Research Society, BCM AYRS, London WC1N 3XX, UK. Opinions expressed are the author's, and not those of AYRS. AYRS also publishes related booklets.

Contributions are welcome from all. Email them to **Catalyst@ayrs.org**, or send (at your risk) disks or typed copy with illustrations to the Society's office. AYRS can take no responsibility for loss or damage in the mail.

AYRS subscribers receive both *Catalyst* and any new booklets. Subscription is UK£20 per annum for paper copies, £10/$15/€15 for download copies. Concessions available in UK. Subscription requests and all other queries to be sent to the AYRS Office, BCM AYRS, London WC1N 3XX UK, email: **office@ayrs.org**

AYRS is a UK Registered Educational Charity (No 234081) for the furthering of yacht science.

Website: http://.ayrs.org

Online forum: http://ayrs.org/phpbb

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ISSN 1469-6754

Another year, another *Catalyst*

I had hoped that this year I would manage to produce two *Catalysts*. I'm sorry; I failed. I haven't had enough spare time and energy (this edition is being produced over the Christmas/New Year holidays) and I have not really got the material. There is some I am holding over for a future issue, but not much.

Your Society needs another volunteer with desktop publishing skills (Pagemaker, InDesign or Quark) to produce one or two issues a year. Typically, if articles arrive in good shape, it should take no more than a couple of busy weekends to put an issue together, less if your skills and computer are up to it (but it's not suited to someone trying to run a business 6-7 days a week). If you can and have the tools available, please step forward.

We also need more articles

Later on in this issue you will find a short introduction to the new AYRS website. It actually has been there since early last year, but we've been slowly reshaping it and getting the details sorted. If you're reading this on a computer screen then you will already know all about it; but if you're reading it on paper then you may not have seen it. If so you might like to have a look: direct a computer to look at http://www.ayrs.org and you'll find us.

Boat Shows

London-area members may have noticed that AYRS was not at the London Boat Show (Excel) last year – for the first time since 1955. We were not at the London Boat Show again this year. It's too expensive for the number of members we recruit there, and the general public attendance is falling, not growing.

Instead you will find us at: the London Dinghy Show in March, the Beale Park Boat Show in early-June and the Northern Boat Show at Liverpool in late-June. Details are in the Calendar in this issue, and on our website, where you will also find further events. See you there!

AYRS North West UK Local Group - Record of Winter Meeting held on Saturday 10th December 2016

As is now the custom at our Winter Meeting, members arrived just after noon for a 12.30 pm start. There were seven members and four of their wives present. Three apologies for absence were received from Roy Anderson, Steve McKenna and Colin Weir. After a short introduction, a Buffet Lunch was served which was enjoyed by everyone (thanks Col). Amply fed and watered, the Ladies retired to the conservatory leaving the Gents in the lounge to have their 'official' meeting.

Mike Howard informed the meeting that the North West Local Group would be hosting a stand and pontoon at the 2017 Northern Boat Show, which was being held on the 23rd, 24th and 25th of June, to coincide with the Merseyside International River Festival. Mike asked for comments and ideas from the floor.

John Shuttleworth suggested that if we intended to concentrate on recruitment, we should take time to try and analyse who is our target audience. Another suggestion was that Colin McCowen's Water Feature be used again as it proved to be a good 'crowd puller'. Mike suggested the pump be turned ninety degrees to make it easier for small children to operate it, which Colin acknowledged. Another idea was that we build a simple CORREX boat on the stand and then demonstrate it in the water.

With a pontoon berth to fill, Adrian Denye offered his Post Boat. Adrian stated that his boat had several alternative mast positions and if anyone had a Wing Sail he would gladly offer his hull for trials. Colin said he was developing a Wing Sail but wanted to mount it on his outrigger canoe. Mike said he had three CORREX boats and was hoping to build a couple more early next year. Mike suggested that if members send him their thoughts on e-mail. He would call a special 'Boat Show' meeting to discuss ideas and formulate a plan of action.

Mike then made a short presentation on TRANSONIC HULLS. Alberto Calderon, the Inventor had had a distinguished career in Aeronautical Engineering, being involved in the design of the F1-11B fighter, the Concorde and with Airbus. He spent two years working as the Chief Designer for Dennis Connors in two successive America's Cup Challenges. He was tasked with investigating how to mitigate shock loads from wave impact.

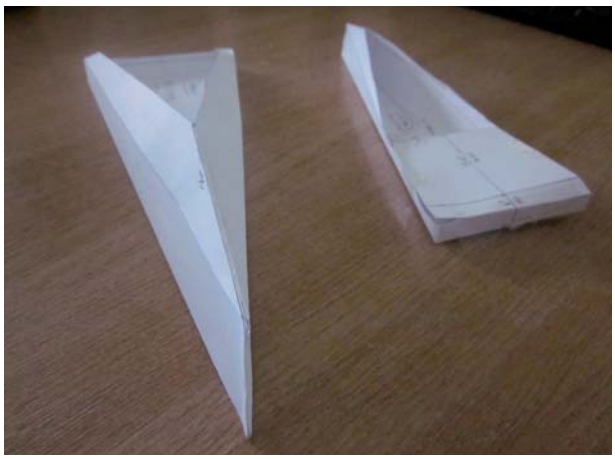
Members attending NWLG Winter Meeting

This led him to prove that maximum hull speed in displacement hulls only conforms to Froude's Theory if the hulls were of 'conventional form'. He then investigated unconventional hull forms which did not generate bow, stern or quarter waves and were therefore not restricted to the speed limitations as defined by Froude. Using his extensive aeronautical knowledge he developed the Transonic Hull. He holds several US Patents for his designs. However, the hull shape he developed fell outside the parameters of the America's Cup Rules.

Mike passed around two card models that he had made. He explained that Calderon saw the future of his design in the Stealth Incursion Boat (US Navy Seals) and the Fast Crew/Supply Boat market. Mike explained that the latter craft operated at around twenty-five to thirty knots and were used to transport crews to and from offshore oil and gas installations, principally offshore USA/Gulf of Mexico and in the Middle and Far East.

Calderon's design has a wave piercing bow and maximum beam at the transom. It has a deeply immersed bow with the transom just touching the water. The tapers of both the sides and the keel are critical in producing the Transonic Hull. Calderon has stated that his Transonic Hull shows 17% less fuel consumption for the same speed and could operate in significantly higher waves at maximum speed, compared with conventionally hulled Fast Crew Boats. Mike directed his audience to look on the Internet for more detailed information (transonic hull).

There was some scepticism about the Transonic Hull's ability to not make waves when operating at



Models of Transonic Hulls

high speed. James pointed out that the hull shape of the Transonic Hull was reminiscent of the Ocean 60's and Ocean 72's sailing yachts which raced around the World. Mike stated that Calderon had carried out water borne trials with a two metre long radio controlled model and a 5 metre long manned demonstrator boat. He had also carried out independent comparative trials of a Transonic hulled 56 metre Crew Boat versus the Axe Bow and Very Slim Vessel (VSV) of a similar size and displacement in the Test Tank belonging to The National Research Council of Canada's Institute of Ocean Technology.

Mike then went on to explain that Beale Park Boat and Leisure Show was being held on the 2nd, 3rd and 4th June and as it did not clash with the Northern Boat Show, was anyone interested in attending. Mike also suggested that the NWLG might enter the Cordless Canoe Challenge. He also pointed out there was a good video of the 2015 Cordless Canoe Challenge, featuring John Alldred's FLIPPER on YouTube (Cordless Canoe Challenge 2015 - YouTube).

John Alldred said that due to personal circumstances he would be 'out of action' for at least three months and could not make any commitment to such a project at this time. Mike suggested that he might build a CORREX Transonic Hull as a possible challenger. John Shuttleworth thought that such a hull would have too much drag and John Alldred stated that the flat bottom would not be an ideal feature in Correx. Mike pointed out that a three metre long hull would have a beam at the transom of 0.75 metres and would probably require outriggers to create stability. The bottom could be creased to provide bottom panels having a smaller flat area.

Three separate areas of discussion emanated from this one subject. The point was made that good publicity could be gained from putting a video onto YouTube, but did anyone know how to do this? James stated that he could take a digital video and put it onto YouTube. There was a visible sigh of relief from the less computer literate members present.

Adrian suggested that the NWLG investigate 'long forgotten' hull shapes in the 5 to 10 metre length range to see if, using modern materials, they could be resurrected. The meeting absorbed the idea without further comment.

This led onto a discussion about using a local canal as a test tank for hull shapes. Adrian suggested a simple trailer equipped with a telescopic boom and a calibrated winch fitted with 'electronic gadgetry' to measure speed and resistance. James was encouraged to participate but he said he had no electronics experience. John Alldred stated he had experimented with a simple open source device known by the name of ARDUINO. This was a micro-processor which could be programmed to input information from sensors to control eternal devices.

A few quiet moments led Mike to expound on the use of Builder's under floor insulation foam sheets to make boats. The blue closed cell foam sheets are stuck together with PVA adhesive and then 'carved' into shape. A thin layer of glass mat and resin were then applied to give a homogeneous surface. Much discussion ensued as to whether the foam was closed cell and if so, the purpose of adding heavy GRP laminate to an otherwise lightweight hull. The consensus was that the GRP layer provided impact resistance.

The meeting ended around 4.00 pm on a much lighter note with Colin offering everyone information about a YouTube video by Ricky Gervais entitled NOAH (Ricky Gervais - *Noah's Ark* - YouTube). '"Well it is about a boat!" he exclaimed!.

Footnote.

2016 has been another successful year for the North West Local Group. We have held four meetings and an outing to Manley Mere. We participated in the Northern Boat Show, where we recruited eleven new members into the Society. Several of our members continue to develop their own pet projects, FLIP FLOP Powering Device, Wing Sail, a Kite Powered Canoe and Correx boats, with the help and encouragement of the other members of our Group. We look forward to an interesting and active 2017.

The Future Shape of AYRS Publications

Dear Editor

As a committee member I feel that the production of Catalyst is proving to be a problem, not only do you have a full time job and poor internet links when in Norfolk; but unless articles are sent to you in a ready to publish form it involves a large amount of time re-arranging the article and its illustrations and planning its relationship to other articles.

I feel that it might be sensible if we started to publish articles in the members only section of the web site as and when they become available. This would I hope let members get something more frequently and letters discussing the article could be added soon afterwards; giving additional reason for members to visit our new web site frequently.

Hard copy members might feel left out; and to ensure they are rewarded we ought to produce an annual edition including comments, however to retain their goodwill and continued membership we need to know how many members have

1) NO internet access or

2) could get access but absolutely HATE the idea.

If these are significant abandon my suggestion, otherwise ask how we can keep them involved maybe individual article posted by snail mail could be affordable.

My long term thoughts are that we should only accept electronic membership and offer a Yearbook at an extra charge which of course would provide a hard copy of member's experiments and theories to be deposited in the major libraries as a permanent record of what we publish.

Fred Ball

[This letter also appears on the AYRS website discussion forum - http://ayrs.org/phpbb/ in the section restricted to paid-up members ("Management Matters") for you to comment. (You will need to have registered first.) OK If you fall into either of Fred's categories, you may just have to use the old-fashioned postal service! Write to him c/o AYRS, BCM AYRS , London WC1N 3XX - Editor]

Wingsails

Thinking about wingsails; anyone considering their design should read Fekete and Newman's paper "Analysis and development of a sailboat with self-trimming wing sail"[1] in particular the second order differential equation which allows prediction of its stability. NACA sections are probably not the best for this application. They are aircraft sections and perform poorly at low Reynolds Numbers. A better choice would be Wortmann FX LV-152 K25, or FX 71-L-150/25. However both of these have a flap, which would mean an extra control. The data for these is in Stuttgarter Profilkatalog 1 by Althaus and Wortmann [2]. The symmetrical Eppler sections numbers E474 and E475.

I have started work on articles on reinforcements and sandwich structures, and I think I should write ones on wingsails and hydrofoils. I will send you copies as soon as I can.

Graeme Vanner.

[1] Available at http://digitool.library.mcgill.ca/R/?func=dbin-jump-full&object_id=93367&local_base=GEN01-MCG02; also available at http://ayrs.org/files/Analysis%20and%20development%20of%20a%20sailboat%20with%20self%20trimming wing%20sail.pdf

[2] See http://www.iag.uni-stuttgart.de/IAG/institut/abteilungen/laminarwindkanal/profcat2.html

Austin Farrar book

You might find this interesting and I'd be grateful if you could forward this information to AYRS members or use in the next Catalyst please.

I have just republished David Chivers biography on Austin Farrar "An Eye for Innovation"

There are more details here: boatswainbooks.uk/an-eye-for-innovation/

including links to the various Amazon sites worldwide where it can be bought.

David and I gave a talk about Austin at Royal Harwich YC where we 're-launched' it.

All the best

Robert Deaves

Multihull Capsize Recovery
An application to the Howard Fund

Mark Hillmann

The Problem

Multihulls can be light and fast but cruising ones must never capsize: They stay inverted.

Single hulled yachts can be self-righting and seaworthy, some large and small ones can survive storms and work to windward in gales but to be quick they need deep weighted keels and a wide hull. Built in buoyancy can avoid sinking but they are outperformed by multihulls.

Can a multihull be seaworthy? Could one work to windward in a gale or sail on when mid Atlantic breakers flatten her? After that happened in my Contessa, I got up (from safe mode: in a bunk with a lee cloth) looked round, nothing broken, self-steering working well, no need to heave to, back to the bunk. Another year we picked up an empty life raft south of Bermuda after hearing of an inverted catamaran. We found no name on the life raft but it was last serviced in Southampton.

The trimaran I had long ago was quick but never seaworthy: It filled floats at night and taught a nervous skipper to swear as gusts came through. Cruising catamarans I have sailed on since could not go to windward in bad conditions, wind and wave forces were more than the drive from a safe amount of sail. Running with trailing warps was the experienced owner's alternative.

Could a proa be seaworthy? "Cheers" long ago showed speed and knock-down survival. What about an automatic system for capsize recovery? A proa should be able to sink and then re-inflate the float to allow self-righting. With those two problems solved could a proa heave to in heavy weather and work slowly to windward like a Contessa? Probably not, but perhaps it would be as seaworthy as the offshore racing fleet.

Project Description

A cruising proa is being built with folding float beams and small accommodation but also low weight and cost. Performance and comfort should be high with a shallow draft allowing inshore work.

Pods help proas right themselves from a knock down. A slender hull with the cabin extended each side lets Dragonfly trimarans win races. A proa is longer for the same accommodation but has lower beam forces: A simpler structure.

Proas have been built in various configurations but my preference is for the main hull with accommodation and rig to leeward and the float carrying heavy items to windward.

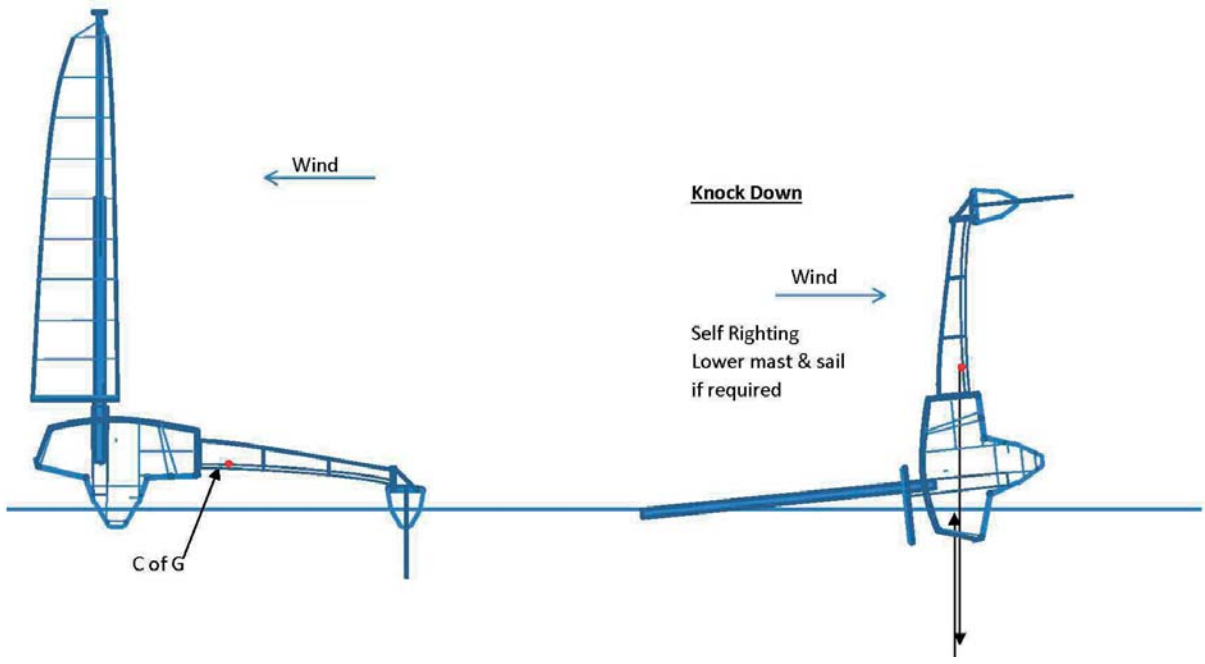
Inversion following capsize or pitchpole would need air release from the float to sink it, then air or CO2 to right it. This all works on paper but presents problems with different solutions from normal yachts.

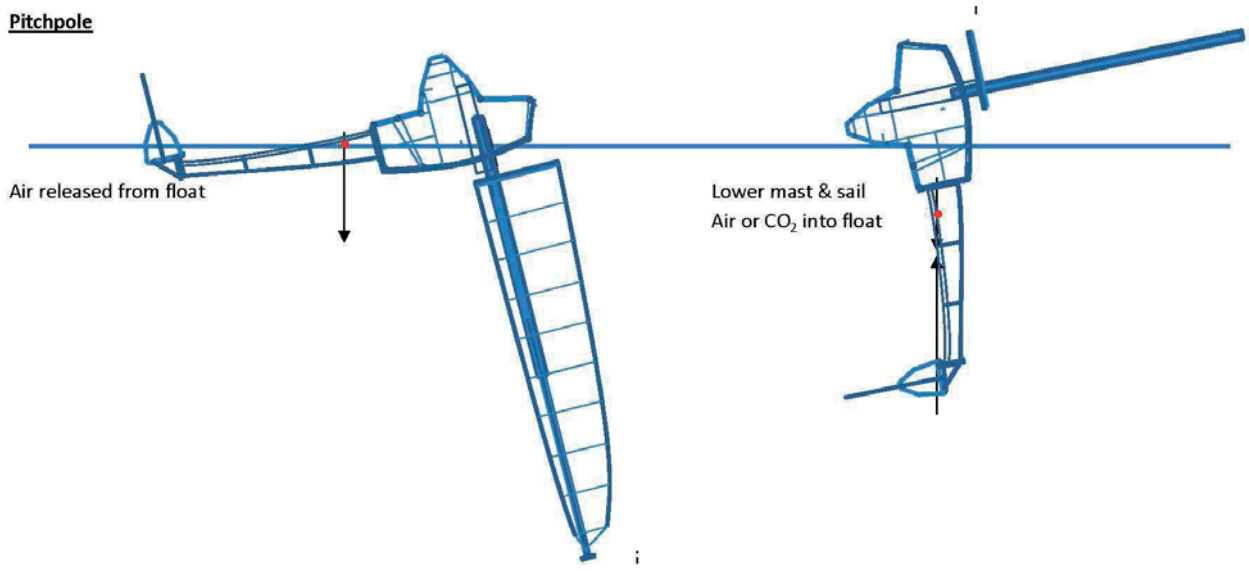
Design Features

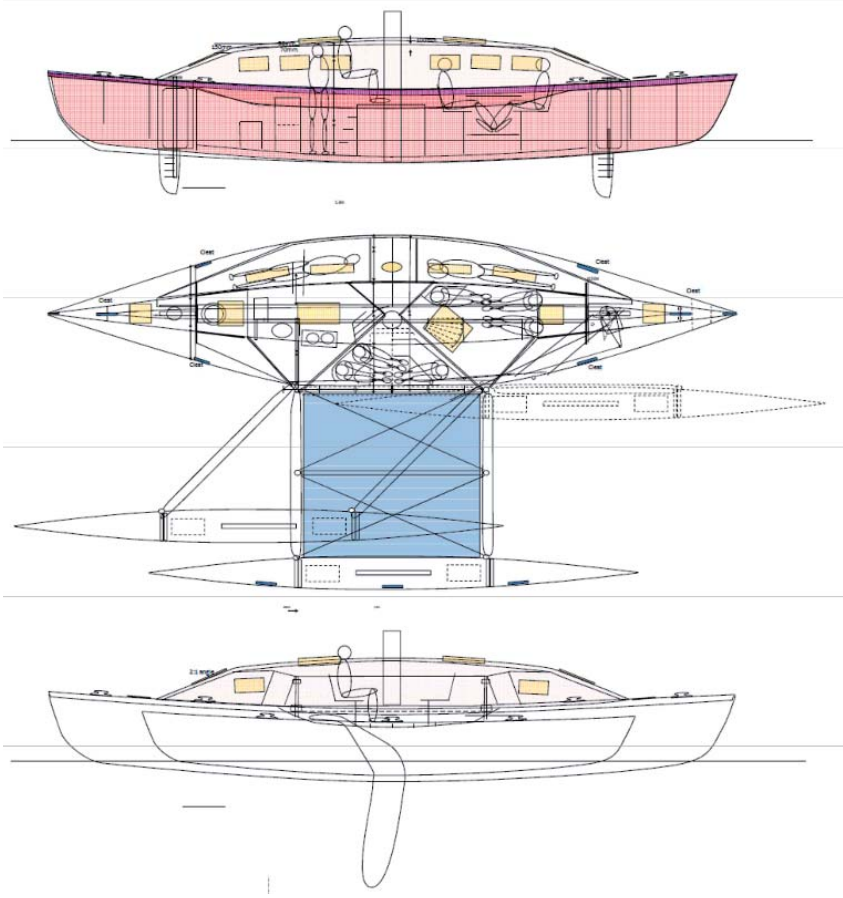
Knockdown recovery may be possible with the full sail up. If the position of the centre of gravity needs adjustment then the sail and topmast can be lowered. A high cabin structure raises the centre of buoyancy and a buoyant topmast prevents heeling beyond 90 degrees.

After a knockdown the sail will drag in the water and the wind will push the hull to leeward. Wind on the float should then help to unstick the sail from the water.

Inversion is a risk in a serious capsize or pitchpole. Recovery should be possible with air released through the ventilation system of an inverted float. It must carry enough weight, such as anchor and engine, to sink it. An air replacement or CO2 system when the float is below the main hull should then right it. Lowering the rig can again correct the centre of gravity position.







Layout

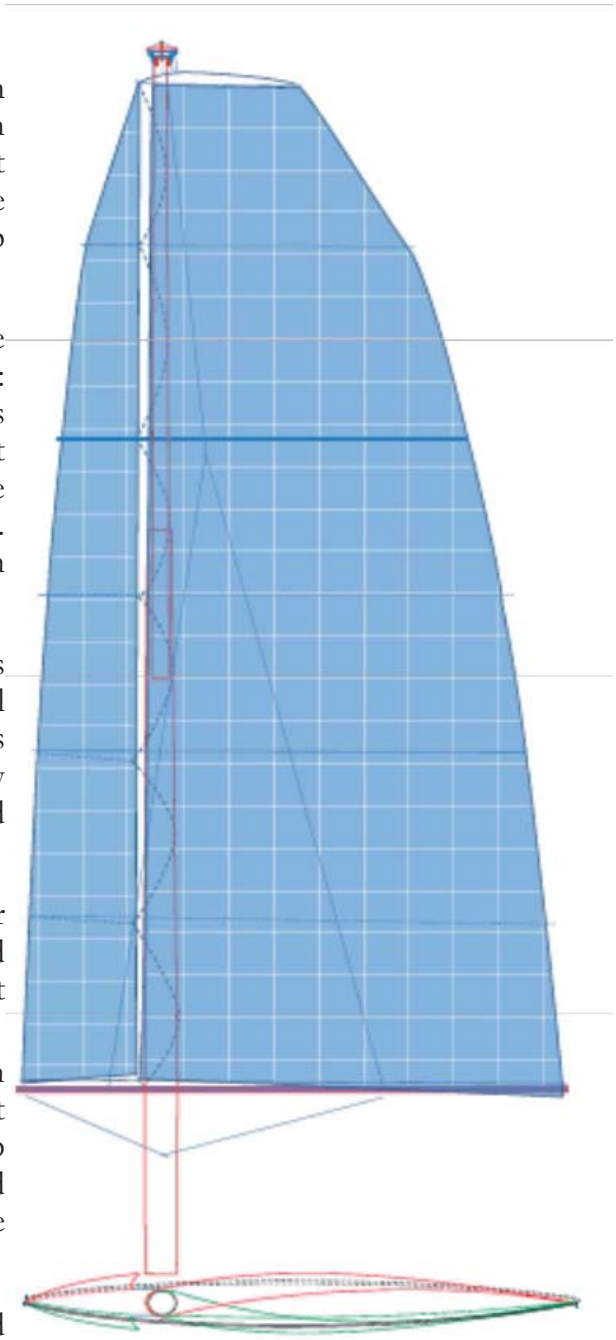
Dragonfly trimarans demonstrate performance with folding wings.

The high cabin is beneficial for knockdown righting. It will be built as a 50mm box structure of thin plywood. Filled with lightweight open cell foam this should have strength and give insulation as well as buoyancy if inverted

A short proa suffers, like wave penetrating multihulls, from low buoyancy at the ends. This is good for performance but bad for stability.

A proa with a heavy float can trail it and lift the bow with little loss of righting moment. This also allows adjustment of the position of the float mounted centreboard for sailing balance.

Rig



A mast mounted to leeward makes knockdown recovery possible but on a proa gives a problem rigging a backstay. An unstayed mast avoids this but is heavy. A telescopic topmast will reduce both the weight aloft and windage when lowered. This will help performance in strong winds.

Normal masts are aluminium or carbon fibre but an unstayed mast needs strength not stiffness: If the top bends it eases gust loads. Stayed masts on the other hand depend on stiffness to resist rigging tension. Carbon fibre has many times the stiffness of GRP but less additional strength. Timber lies between them but is compatible with glass in strength and stiffness.

A simple conical layout with 1:100 taper makes a two section telescopic mast possible. A thin wall timber stave design with unidirectional epoxy glass coating has been built. Timber has a lower density than resin giving good stiffness for the weight and allows composite construction without a mould.

Unstayed masts are larger diameter and heavier but the absence of rigging allows a wrap round "Freedom" type rig which performs well except to windward.

External battens from jib luff to main leach allow a fully battened wrap-round mainsail but with a jib to give windward performance. The jib will be set inside a parrel system threaded round the mast to give a soft wing rig. The tension in the parrel sets the mainsail shape.

The rig can allow tacking when shunting would be too slow.

The full bending moment of the unstayed mast is taken on the beams so a ladder structure has been designed: The main beams will have structural handrails above them. Conventional netting between the beams will give access to the float at sea but allow float folding in harbour. The ladder layout allows simple hinges at the beam ends.

Contribution to Nautical Science

It is hoped this project will demonstrate the feasibility of both knockdown and inversion recovery in a practical multihull. Safer cruising and harder racing should be possible if multihulls can survive squalls and breakers as well as monohulls.

Thin wall timber / GRP masts may have been researched long ago to give the right mix of timber/glass. Without that answer the large cost saving makes a composite timber stave/GRP telescopic mast attractive but risky. We will have to test ours.

The fully battened wrap round main and jib arrangement may give a useable soft wing rig.

Progress so far

A 9.5m proa is being built to test these ideas. It is based on an American (Madness) design from Fyne Boat Kits in Cumbria. This is large enough to give realistic weight and buoyancy distribution but with cabin, mast and beam details all entirely different from the original design.

Many versions of the drawings and calculations were followed by building the rudders, centreboard, hulls, decks and mast in the last year. The cabin, beams, sails and all the fitting out and finishing may take another year.

Project plan/budgeting

I am retired, with my time spent designing and building the many details that are different on a proa from any normal sailing craft. The following items are still to be done:

- The cabin structure with the cockpit, its bulkheads, and beam connections are underway. The float needs outside glass/epoxy.
- The beams and float connections are barely started.
- A masthead unit is needed to set the sails shown and a ghoster to the bow. It then all needs paint and antifouling.
- Sails and battens to be made
- Interior fitting out will be left until sailing trials have been done.

The original budget of £15,000 has risen to £17,700 including £3,600 in overheads but now excluding sails and outboard. The wrap round mainsail can be made from an old heavy weather spinnaker and our yuloh can provide calm weather propulsion.

	Original Budget	Spent	To Spend	Current Budget	
Plywood kit	£3,750	£3,750		£3,750	
Epoxy package	£2,400	£2,400		£2,400	
Timber	£1,000	£964		£964	
Glass fibre	£2,000	£1,724		£1,724	
Mast	£1,000	£1,000		£1,000	
Sails	£1,000		£0	£0	Old spinnaker

Ropes	£250	£164	£250	£414	
Fittings	£500		£250	£250	
Furling	£250		£0	£0	Omit
Outboard	£850		£0	£0	Yuloh
Trailer	£1,000		£1,000	£1,000	
Towbar	£1,000		£400	£400	
s/s rudder tubes		£678		£678	
Fixings & brushes		£470		£470	
Gloves & overalls		£397		£397	
Paint		£427	£200	£627	
Overheads					
Machinery		£820		£820	
Hand Tools		£540		£540	
Shed		£242		£242	
Electrics		£375		£375	
Barn Use		£500		£500	
Labour		£1,162		£1,162	
TOTALS	£15,000	£15,613	£2,100	£17,713	

I am funding this from my own savings. I am happy to let any of the details submitted be freely available and have little interest in commercial exploitation.

Contribution Requested

If the unstayed mast is satisfactory then properly made sails and battens would be valuable. If it is too heavy or not useable a conventional stayed mast from a Windermere One Design yacht (there is a pile of old ones at the club) would be purchased with conventional sails.

An outboard would also allow use at sea, especially getting out of our Cumbrian marinas.

Minimising Risks

Amateur boat design and construction are the major risks with error rectification a possible long delay. As a water industry design engineer, working to yacht codes (Principles of Yacht Design by Larssen) is not too different. Construction delay is not a cost problem with my own time and a borrowed barn. My own boats started with a 24ft trimaran rebuilt long ago and I have cruised a Contessa for the last 10 years.

We are proposing several novelties: Knockdown and inversion recovery, Unstayed telescopic mast, Fully battened wrap-round main with a pocketed jib, Float trailing for parking and to adjust both centreboard position and buoyancy

If these are identified as new features, each should work, with perhaps a 25% risk of failure. This gives a 30% chance of total success. The ones that do not work will need replacement:

Knockdown and inversion recovery both depend on weight and buoyancy distribution. Items are being weighed as work proceeds: The hull and the mast are both overweight. The cabin, beams and rig weights are still estimates; it is only when these are built that the calculations can be rerun and finally verified afloat.

Initial calculations indicated knockdown recovery was possible with the topmast up. Current weights show lowering it may be necessary.

Inversion may allow the buoyant topmast and battens to be lowered with a single rope release. If the float ventilation system traps water the float bilge pump pipe may need to be used for air evacuation. Once the float has sunk full righting only needs a CO2 system to bring it the right way up.

The unstayed telescopic mast needs a secure fit between the halves. Both have been built as 1:100 conical sections. A 1.5m overlap with 1:5 mating tapers of graphited epoxy at each end should allow full bending moment transfer. Only testing will show if these will pull up tight enough to prevent mast movement but allow lowering.

The lifting system has an 8:2 pulley system. Only testing will show the best arrangement. The mast has a 1:50 reverse taper where it sits into the support. Graphite epoxy mating surfaces again should allow the mast to be lifted out, but sit firmly without movement.

If the lifting system proves unreliable the mast could be rebuilt as a single spar. If it proves too heavy it may need replacing with a conventional stayed mast but with running lee shrouds set up on each tack. These would be set forward like inner forestays to support the rig if taken aback; it would not allow tacking in restricted water. The wide shroud angles will reduce mast loads but float trailing would need careful rigging design.

The split jib with wrap round main combines two elements that work individually: The wrap round "Freedom" mainsail has been used for many years. The added external battens from jib luff to main leech and multiple sheets are for reefing and sail shape control. Slieve McGalliard's split junk jib has careful sail shape design between the battens. Setting between the parrels may allow a simpler jib for this proa.

Mainsail shape is intended to be set by the battens and parrels with mast stiffness having less effect. Comparison of it in use with junk rig sails and their parrels may be instructive.

The main risk may be snagging of the parrels, especially when it is lowered over the mainmast head. Several years of development are expected to make it into a useable rig with wingsail efficiency but junk rig reefing ability.

Float folding allows the beam to be reduced from 5.5 to 3 metres for marina parking. Diagonal ropes between the beams can let the float trail to windward and lead downwind. Only when sailing can the effect on centre of effort of the rig and bow buoyancy be assessed. Low bow buoyance and pitching resistance may be a problem that trailing the float a small amount does not alleviate. A longer proa may be needed.

Design Intentions	Reasons	Tests to be applied
Proa for serious cruising	Different and fun: Fast, light, simple & cheap	Fun, fast, light, simple & cheap?
Knockdown recovery& inversion recovery	Safety over wider operating window	Righting from sails in water Righting from inversion
Cabin & cockpit to leeward	Crew survival when cruising Sit on float when racing	Safe in cockpit for knockdown Cabin escape route after pitchpole
Other weight to windward	Inversion recovery and performance	Weight to sink inverted float without slowing sailing
Unstayed telescopic mast	Proa backstay layout Lowering in gales	Lower without sticking Sail to windward in gale Enable righting
Folding beams	Marina berthing Float trailing for buoyancy and sailing balance	Robustness & pontoon height Bow buoyancy if trailed Sailing balance
Battened wrap round main with jib	Performance Ease of use	Racing success Extended use in varied conditions
Rudders rotate 360° & are liftable	One used for fast sailing Both for manoeuvring,	Control together or separately Lift from cockpit with block system.
Foam filled cabin structure	Insulation Inversion recovery	Cabin condition Buoyant volume to support boat
old-under centreboard	Poor navigation	Folding tests for grounding and rope snagging

Mark Hillmann
Cumbria, UK

[Note: As this is an application to the Howard Fund for financial support, comment is invited in the appropriate part of the AYRS Forum http://ayrs.org/forum (See p 24) - Editor]

Norwegian Blue: a test bed for a new proa rig

Robert Biegler

One of the design challenges of a proa is that the centre of effort of the hulls is forward of the midpoint, but the combined centre of effort of any fore-and-aft sail attached to a fixed spar will be aft of the midpoint. The solutions I know of are:

1) Putting the whole rig on the windward hull, so that the drag of the lee hull partly balances weather helm. That worked well on some Atlantic proas, but has the drawback that the boat may prefer to lie ahull with the aerodynamic drag of rig and accommodation to lee, which leaves it less stable.

2) Move the centre of effort forward, as in the crab claw rigs of many traditional Pacific proas, or the two-way sloop of Russel Brown. The drawback is that, as illustrated in Figure 1, that balances forces on sail and hull only for one course, but when going downwind it may generate weather helm. I have seen that reported for traditional designs, but not for Brown's, though the theory is the same.

3) Adding a windward staysail. People have for decades used the wide staying base of a multihull to add light wind sails, but only Fritz Roth seems to have made a windward staysail an integral part of his proa's rig.

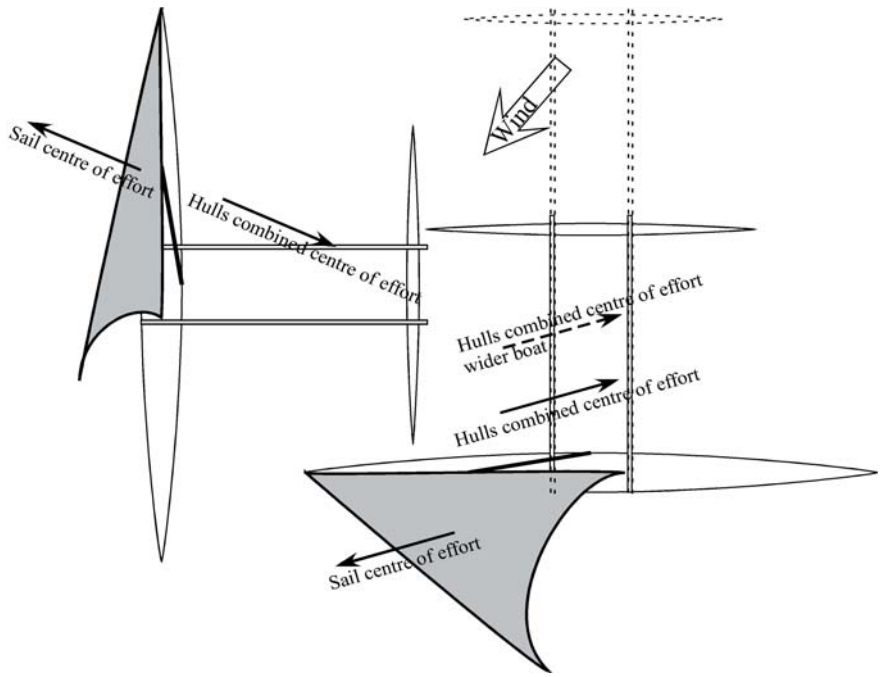


Figure 1. Sail balance on the wind and while reaching. A rig to the lee of the hulls' combined centre of effort may balance sail and hull forces on one course (left) but not another (right). If greater beam increases the lateral separation between sail and hull centres of effort, the problem becomes worse

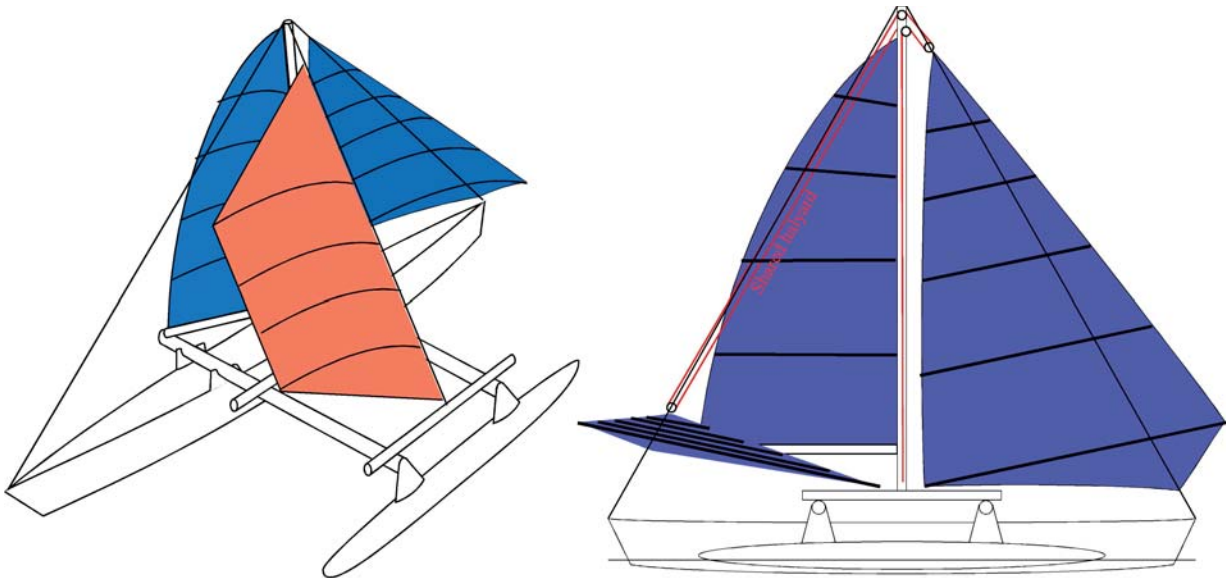


Figure 2. Jib (blue like the mainsail) and windward staysail (red) with rigid, curved battens. With the battens controlling the shape of the sails, it is not necessary to pull hard on the clew of the sail, which means it is not necessary to keep the stay very tight.

A shared halyard for both jibs makes it possible for the weight of the jib that is up to help raise the other when shunting.

I once asked on the Yahoo proafile group why Pacific proas were not built to be very wide, say about as wide as long. The theoretical advantages are greater righting moment for a given weight, and greater rotational inertia, resisting wave-induced capsize.

The problem, I was told, is that the drag so far to windward would give wildly unbalanced steering. If halving the weight and volume of the ama failed to reduce the drag by less than half, then the problem of steering imbalance off the wind would get worse on a wider proa (Figure 1).

However, take a Pacific proa half as wide as long. Double the beam. Neglecting the weight of the beams for a first approximation, the same righting moment can be had with an ama half the weight. If we treat both hulls as point masses, and take into account that rotational inertia is proportional to both weight and the square of its distance from the point of rotation, we find that, even though stability is the same, rotational inertia is twice as much as before (assuming rotation around the lee hull). If the ama also has low volume, breaking crests should roll right over without lifting it much, and lifting only the lee hull.

The windward staysail seems like a good way to move the centre of effort to windward without the structure needed to support another mast. I also wanted to decrease structural loads compared to those imposed by conventional staysails that need a very taut luff even while pulling hard on the clew to give the sail its desired shape. Remembering my junk rig experience, I reasoned that if the sail gets its shape from rigid battens, it wouldn't need that taut luff. The sail could be like a junk sail hanging on a wire instead of a mast. In fact, if the stay sags off to lee, that should tend to flatten the sail. On the other hand if the leach is held in place by the sheet, the sails angle of attack could increase.

That reasoning led to the jib and windward staysail in Figure 2. Each jib can have rigid, curved battens. It should have all the advantages of the AYRS-sail, without most of its problems (see Catalyst No. 8, April 2002, page 29). It could even be made into a double surface soft wing sail with lower sensitivity to angle of attack. Having some area in front of the stay to which it is attached, the force is partly balanced around the rotation axis, and sheet loads should be low.

The battens in the staysail would also be rigid and permanently curved, but the batten pockets need to be wide enough to allow the battens to rotate around the profile's chord line, but only about 45º either way from the plane of the sail. Then wind pressure and weight should make the batten flip over so that the sail's camber is always down and on the lee side. Because the battens take care of the sail profile, the sheets do not need to stretch the sail into the right profile. Should the boat be caught aback, the staysail

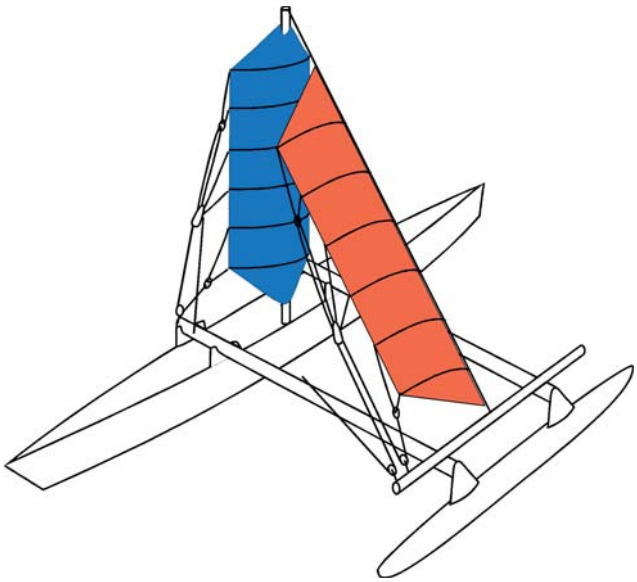


Figure 3. Two sails may be enough to steer the boat by controlling the lateral position of the centre of effort. With sail shape controlled by the battens, junk rig style sheeting would be possible.

should lift the ama, reducing the problem of having a small volume hull on the lee side.

Then I thought about how many sails would need to be trimmed, raised and lowered during each shunt. When short-shunting up a channel, perhaps only the windward staysail and the main would be needed. Also, when going downwind, main and staysail would blanket the forward jib. The logical next step was to reduce the rig to main and windward staysail only. That gives a sloop rig turned by 90º, a biplane sloop (Figure 3). If the mast is engineered to be unstayed, then the stays to either end can be omitted, and the mainsail can have a big roach without causing trouble when caught aback.

Such a boat may achieve self-steering by sail trim only. On all courses from hard on the wind to a broad reach, the mainsail would be trimmed to have a smaller angle of attack than the staysail. It is mostly the stay sail that drives the boat. If the boat falls off the wind, the staysail does not gain very much lift, and eventually begins to stall. Meanwhile, the mainsail powers up and moves the centre of pressure leeward, and turns the boat back into the wind. If the boat luffs, the mainsail should lose drive faster than the staysail. The centre of pressure moves to windward and makes the boat fall off. I think this should work for apparent wind angles from hard on the wind to at least 120º. When sailing dead downwind, the two sails could be sheeted to a V-shape, like trade wind sails. All this should work better the wider the boat is.

Because the mainsail needs to operate at small angles of attack, I have drawn a symmetrical soft wing sail: a wing because it should not flutter at small angles of attack, and symmetrical because asymmetry induced by wind pressure depends on larger angles of attack, and mechanisms to bend the wing would be too complicated to bother with on a cruiser. A racer would not use the biplane sloop because it is a negatively staggered biplane (the leeward wing is farther back than the windward wing), and those have a reputation for poor performance (unless the wings are connected into a box wing; that apparently reduces tip vortex by a mechanism that I don't understand).

Another feature of the rig is that the windward staysail pulls the windward hull down. Depending on the angle of the stay to the horizontal, the sail may need a bit of reefing before it reaches the point where it does not heel the boat. Of course, the mainsail and drag on the structure exposed to the wind would still generate a heeling moment, so non-heeling may only be achieved when the staysail is deeply reefed.

I have drawn in junk rig style sheeting, because it makes reefing so much easier and reduces loads. I am not sure that will work for the staysail. The greater the stay's angle to the vertical, the more the wind would tend to blow the reefed sail panels up the stay. If the rig needs reefing lines to keep them down, the junk-style sheetlets may no longer offer any advantage.

Figure 4. Model proa Norwegian Blue. The blue jib seemed to contribute most to driving the boat, while the yellow wing was used primarily for steering. The leeward counterweight was needed because of the small volume and high density of the solid wood windward hull.

If beating upwind in breaking seas, it would be good not to have much lateral resistance on the lee side. A keel or dagger board in the ama would be an option, though I am rather temped by a hinged vector foil between the hulls. For my radio-controlled model, I wanted to keep things simple, so I just put a fixed foil into the ama. To find out whether sail balance could be as good as I hoped, I built the model without rudders.

The first iteration of the model failed. Its angle to the wind was entirely determined by the leeward wing. The windward staysail didn't have enough leverage to make the boat fall off. There was too much drag to windward, and not enough drive.

I could have moved the keel to the lee hull, but it was simpler to move only the staysail, but not the ama further to windward. Moving the ama as well would have moved drag to windward, too. The second iteration, shown in Figure 4, could be steered by sails alone, though not with precision. Still, being able to shunt and sail on courses from hard on the wind to a broad reach did show that the sail balance was good. I also saw that gusts pushed the ama down. The staysail was inclined enough to perform that stabilising function. I did capsize the model a few times, but always by pitchpole. The hulls are rather short compared to the height of the rig. And yes, the boat did end up nearly twice as wide as long.

Having tested the biplane sloop, for a crewed boat I would prefer the rig in Figure 2 after all, possibly even without the mainsail. The model test suggests that the boat should balance reasonably well under windward staysail alone, which is the sail that could be used when much manoeuvring is expected. The jib would be far enough forward for positive stagger, and thus less interference from the staysail, at least up to a close reach. The shared halyard I have drawn would make the weight of the to be lowered jib help raise the other.

Robert Biegler

The Vampire Project
- Why make it different?

William Sunnucks

[Taken from a presentation given to Foiling Week]

The Vampire project is based on an M20, a tough carbon nomex platform from Goran Marstrom

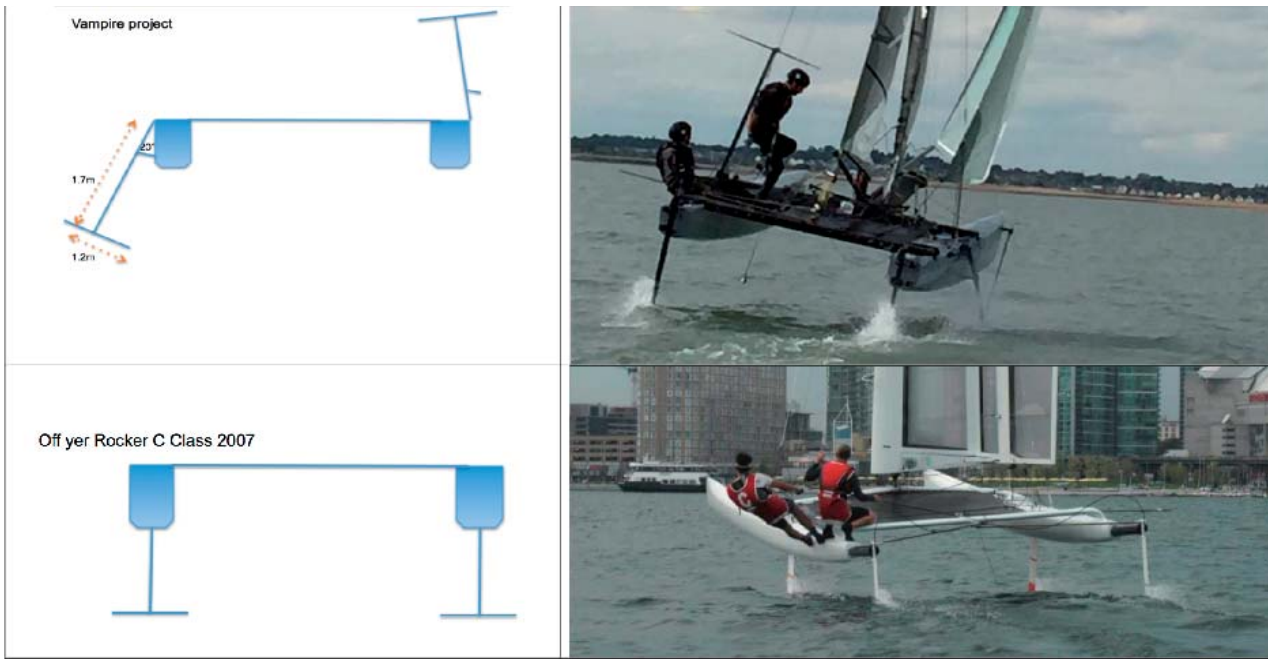
- 2009 - added a 12 foot beam and jib – Texel line honours
- 2014 –Canted T foils added courtesy of Kevin Ellway and Graham Eeles

It's an "open source" development project -
- no secrets
- no attempt to commercialise
- success is measured by how much is copied

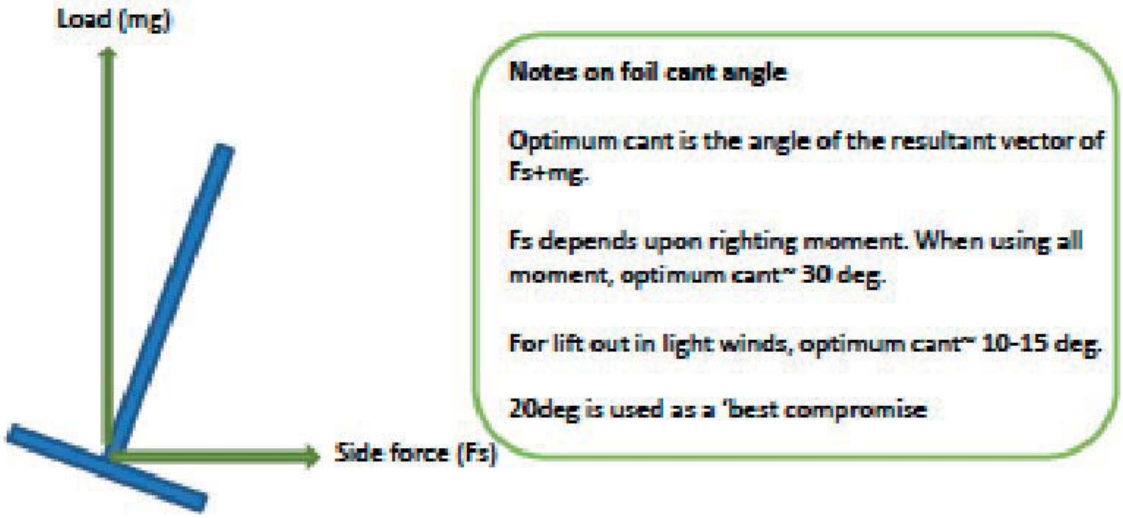
Objectives:
- to build something faster, more sailable and more versatile than a Moth
- to create an alternative to the current generation of L foilers
- to enjoy an innovative project. "Always make new mistakes" (Nico Boon)

So what's new?

Compare



Calculating "zero leeway angle of cant"



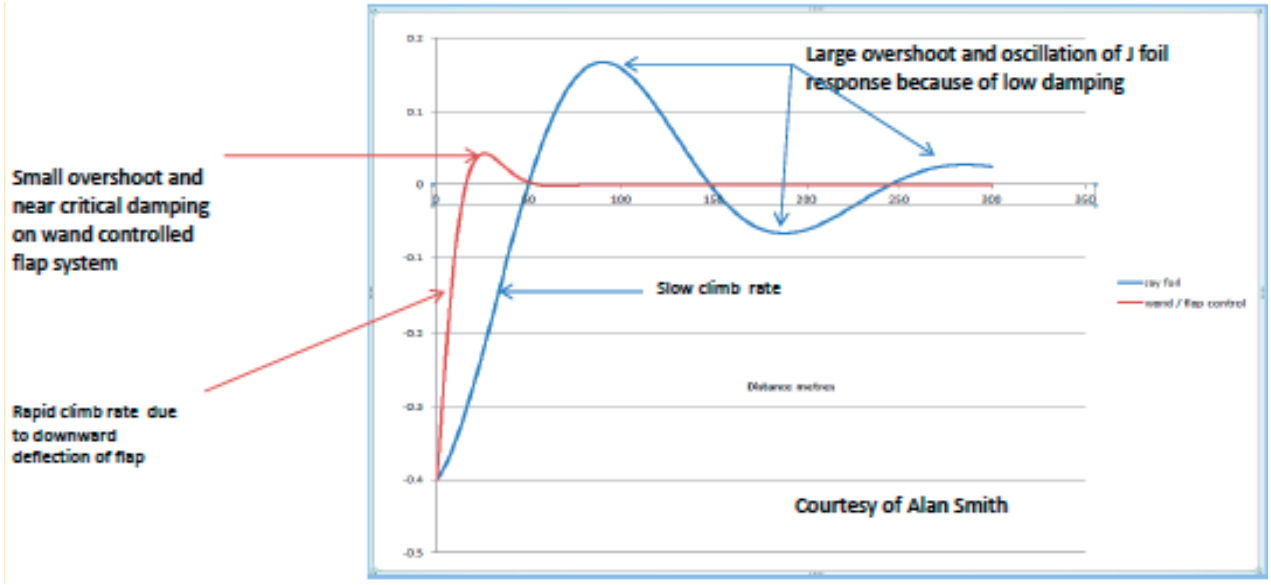
Dynamic control system – similar to Moth

- Wand system
- As far forward as possible
  - more pitch control
- Pull wire instead of push rod
- Bias adjustment through deflection of pull wire
- Modelling to get correct lever arm and bellcrank dimensions
- Wand length adjuster

Design Analysis

Comparison of the dynamic response of the Vampire to a 'step' function when fitted with J and wand controlled T foils

Conclusion: wand controlled T foils offer far better control than leeway coupled foils



Why gull wing foils?

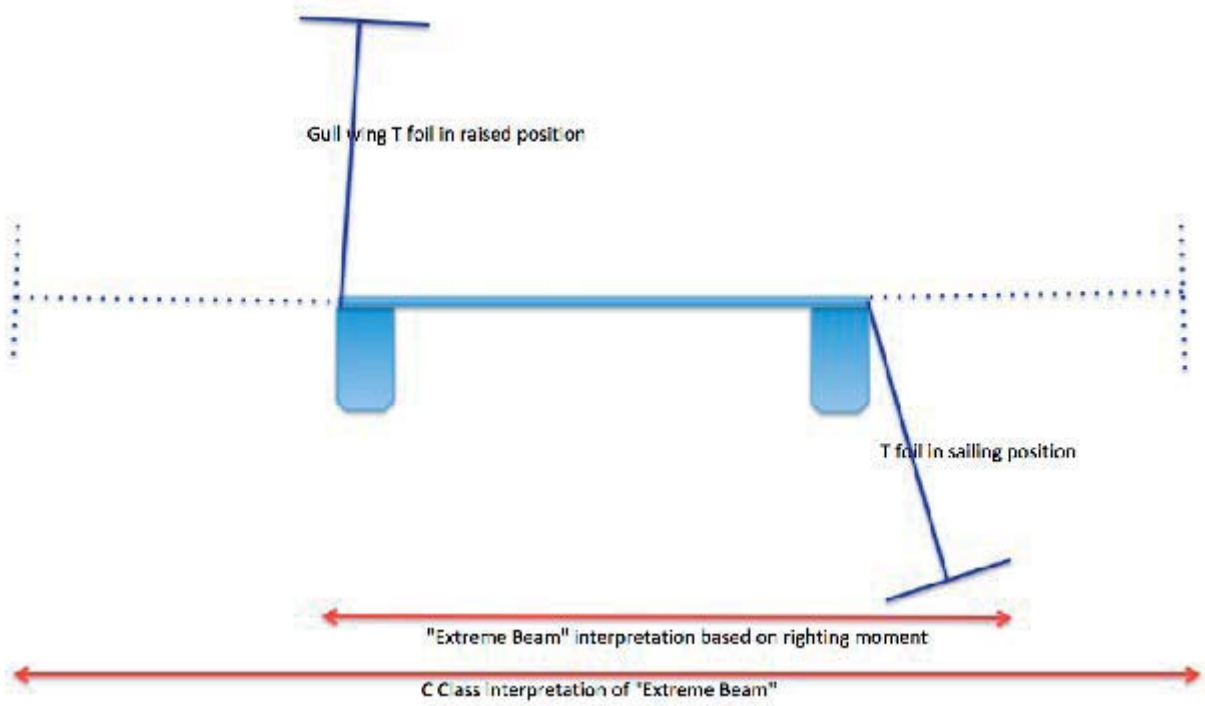
Advantages

- More righting moment, more speed
- Can be raised without disconnecting dynamic control system
- Can be fully raised completely in light winds and replaced by straight daggerboards – less wetted surface
- Easy to assemble and launch from a beach

Problems

- Tacking and gybing can be slow
- Click down after gybing can be difficult
- Rules have yet to adapt – C Class, SCHRS etc.

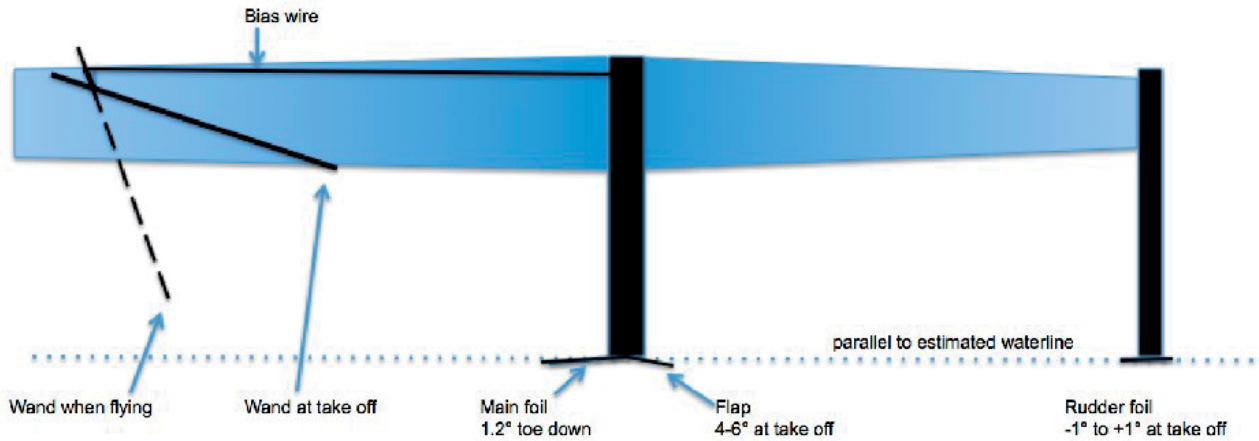
- e.g. How should beam be measured? (See next page)
  - Engineer's approach – measure the beam that contributes to righting moment.
  - Lawyer's approach – hold current position by taking the least favourable view.



Controls

Adjustable while sailing:
- Length of bias wire
- Length of wand
- Rudder foil angle

Permanent settings:
- Gearing arm length
- Cant - main foil angle from vertical
- Main foil Angle of Incidence



Bias adjuster system

- Stainless rod links to flap
- Bias adjuster
- Bell crank

Development programme – significant adjustments

- Cant increased to 30° then reduced back to 20°
- Rig reduced and flattened
- Beam reduced from 3.52m to 2.94m
- Main foils moved back
- Angle of incidence of main foil increased
- Calibration improved

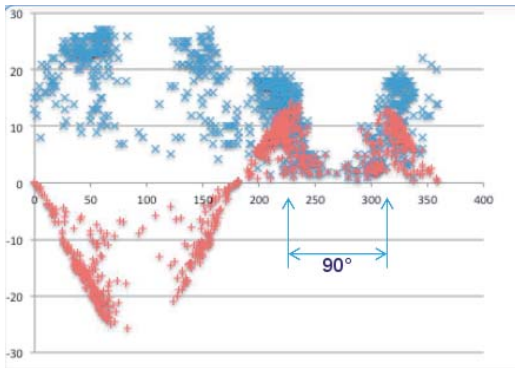
Key points for sailing technique

- Windward heel is fast upwind
- Spinnaker only fast in marginal foiling conditions
- Upwind foiling in light winds – easy to head too low
- Rudder toe down is good for lifting out, but slow
- Don't worry about waves! Trust the wand.

Performance measurement

Sunday 21st June 2015.

Wind Westerly 12-18 knots. Tide from West at +/- 1 knot. Tracks downloaded from Garmin 76 to Homeport then Excel



Speed (blue) and VMG (red) in knots plotted against course.

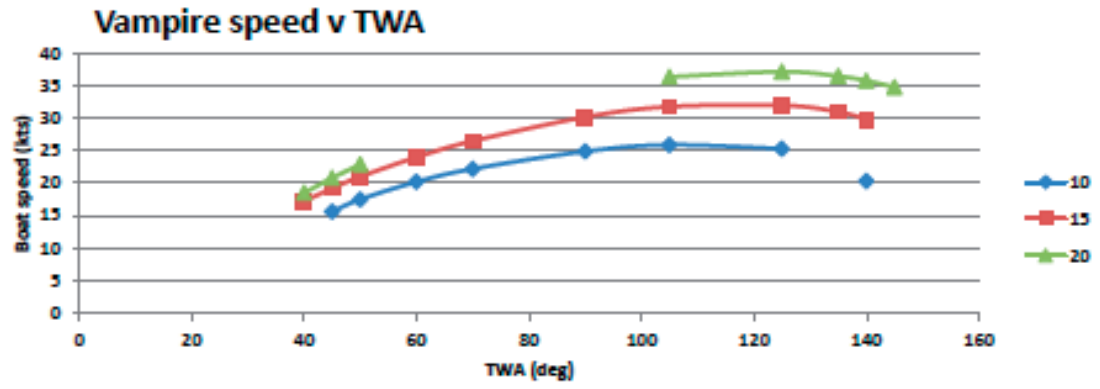
- *Tacking angle is just under 90° - TWA 45°.*
- *% of time at max VMG still low*

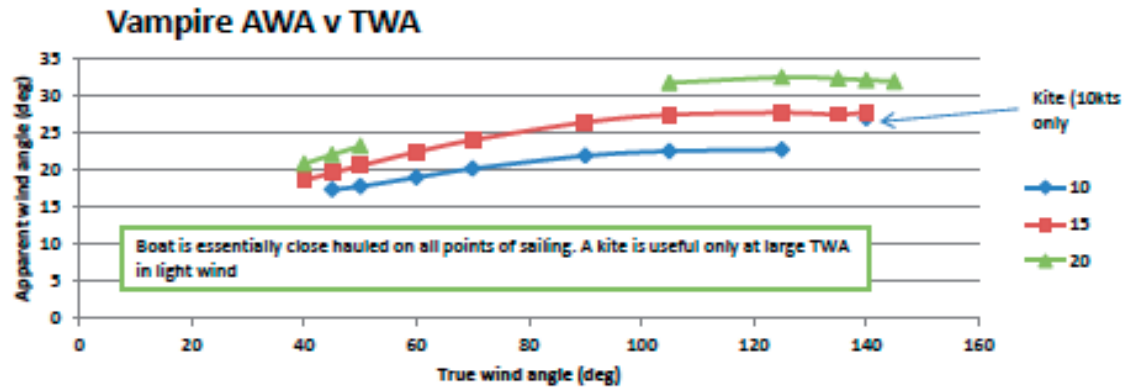
Additional information

	Configuration Texel 2009	Foiling configuration
Length in metres	6.08	6.08
Beam (excluding foils) in metres	3.52	2.94
Beam (including leeward foil in sailing position)	-	4.08
Beam (as per C class interpretation – max is 4.3m)	-	6.34
Mast length in metres	10.5	10.5
All up sailing weight in kgs (WS)	144	193
Mainsail area (including mast) in square metres (CM)	22.2	20.1
Jib area in square metres (CJ)	5.6	5.8
Spinnaker area (55% SMG/SF) Grey	-	20.5
Spinnaker area (75% SMG/SF)	28.3	27.3
Main foil length in metres	1.14 (from keel)	1.7 (from deck)
Main foil span in metres	-	1.2
Rudder foil span	-	0.6

Extracts from a presentation by Kevin Ellway / Alan Smith

Note that theoretical downwind speeds not achieved yet because we are only twin wiring upwind

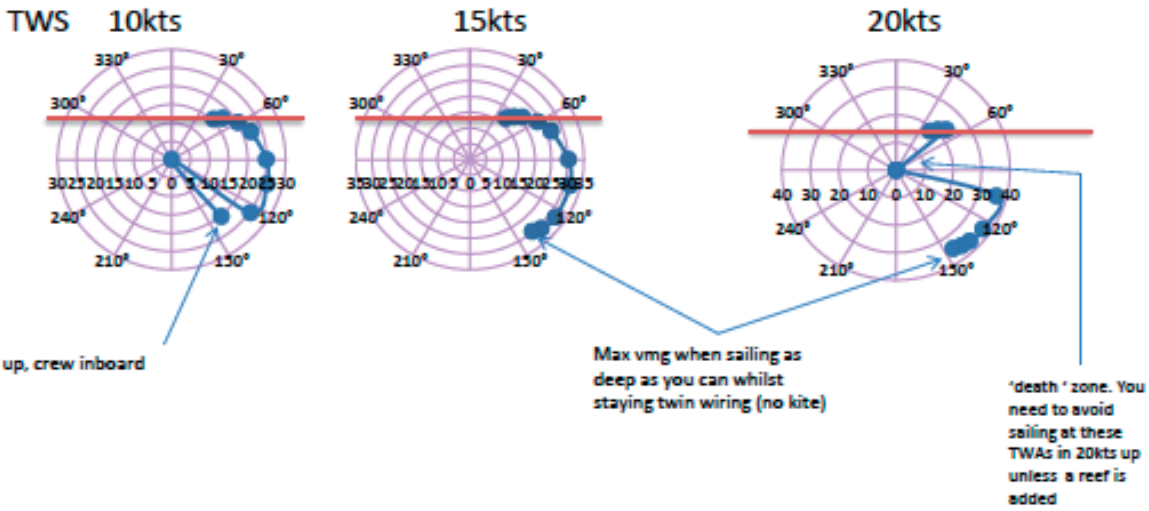




Opt vmg at about 50-55 deg

Opt vmg at about 45-50 deg

Opt vmg at about 45-50 deg



Contributors to the Vampire project

Kevin Ellway – foil design, VPP, feedback on all aspects of rig and sailing technique

William Sunnucks – design concept, owner

Graham Eeles – foil build, boat adaptation, coaching, problem solving

Mark Self – boat testing, sail alterations

Grant Piggott – GP sails

Graham Bridle – foiling Cherub

Alan Smith – dynamic modelling

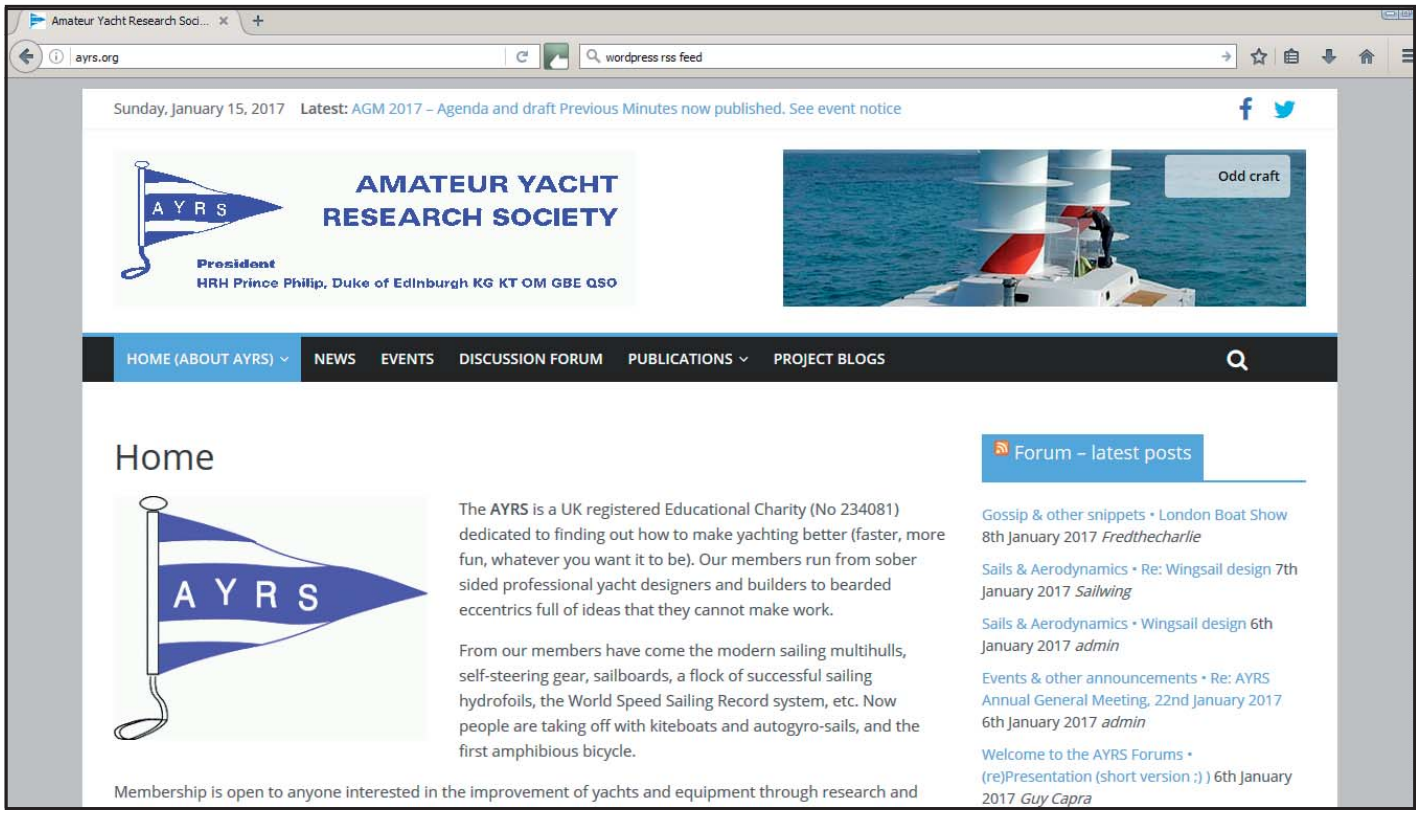
Andrew Sinclair, Ollie Egan

White Bear

The AYRS Website

http://ayrs.org

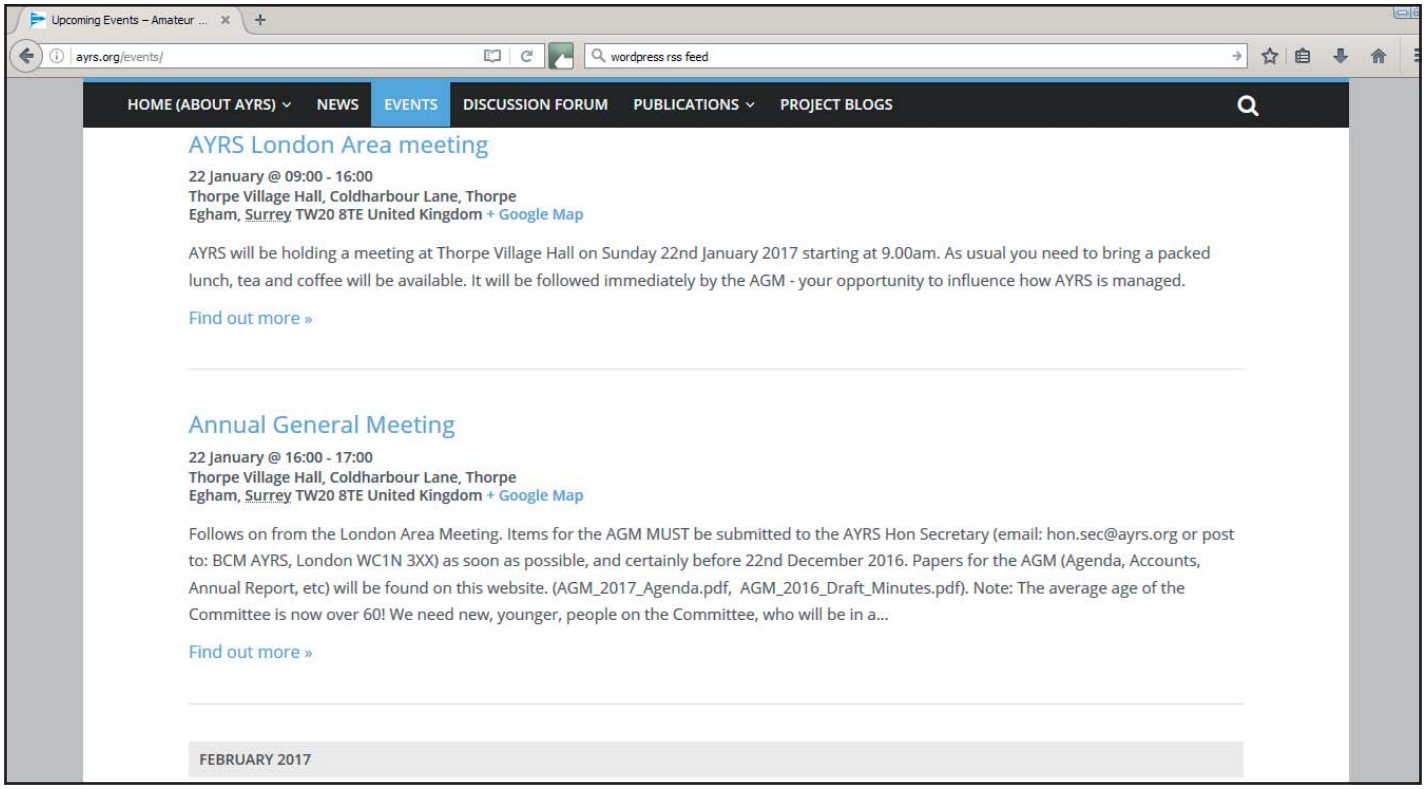
S Fishwick (AYRS WebAdmin)



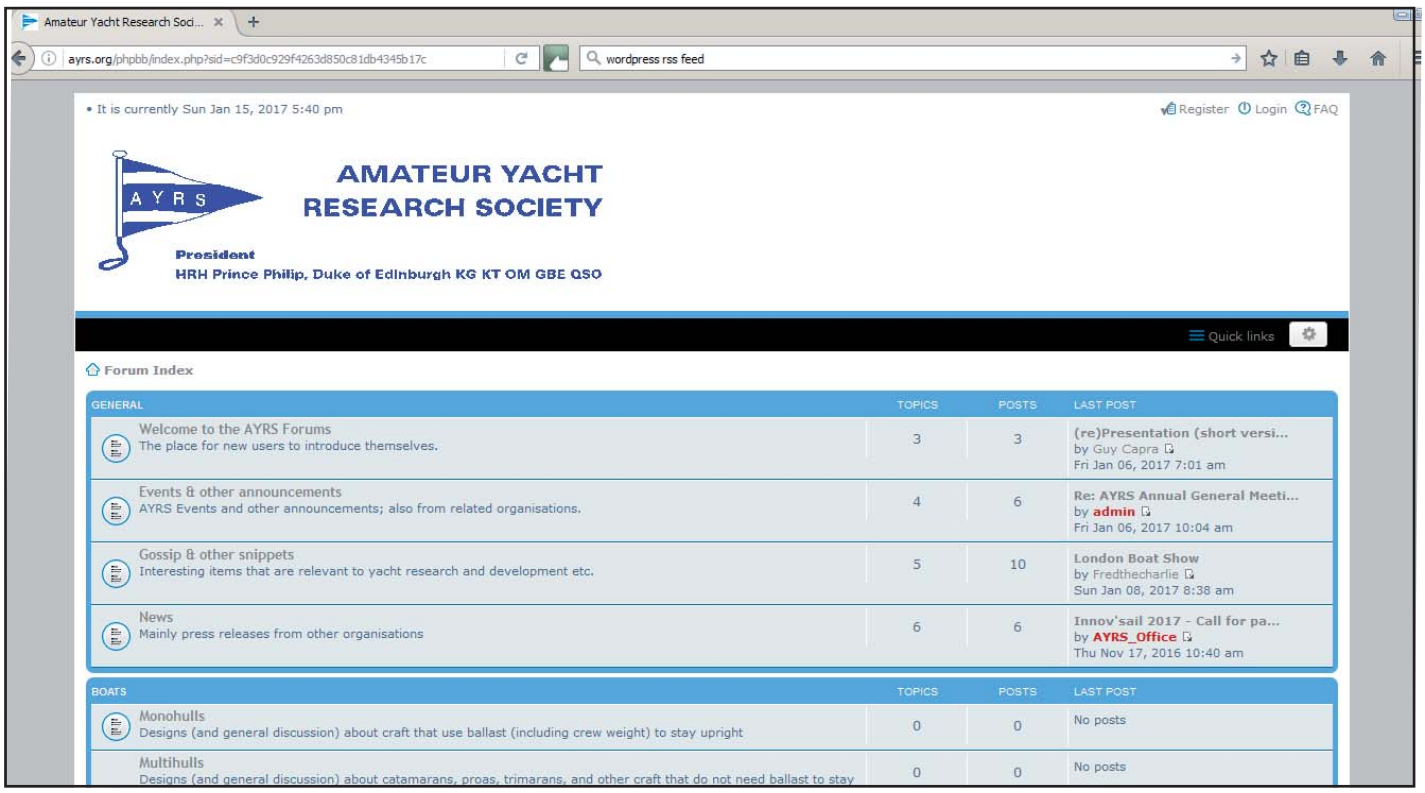
This is the front page of the "new" AYRS website. It looks a bit different from the old one, which was getting a bit tired. We've changed the way we generate it, (we now use Wordpress) and as a result it should be more friendly to read on smart-phones. It was built for us by Robert Deaves. (Thank you Robert)

The black bar across the middle is a site menu. If you click on one of the entries you will be taken to the appropriate page. If you click on a down arrow "V" next to an entry the system will display a menu of other, subsidiary, pages you can select.

Essentially, the site content is divided into two parts. There are what we call the "Static Pages" which are written by AYRS and which are not expected to change very often. They present some basic information about AYRS, lists of publications and how to get them etc. They also include the Events calendar (click on "Events" in the menu), which lists all those events we know about of likely interest to members and others.

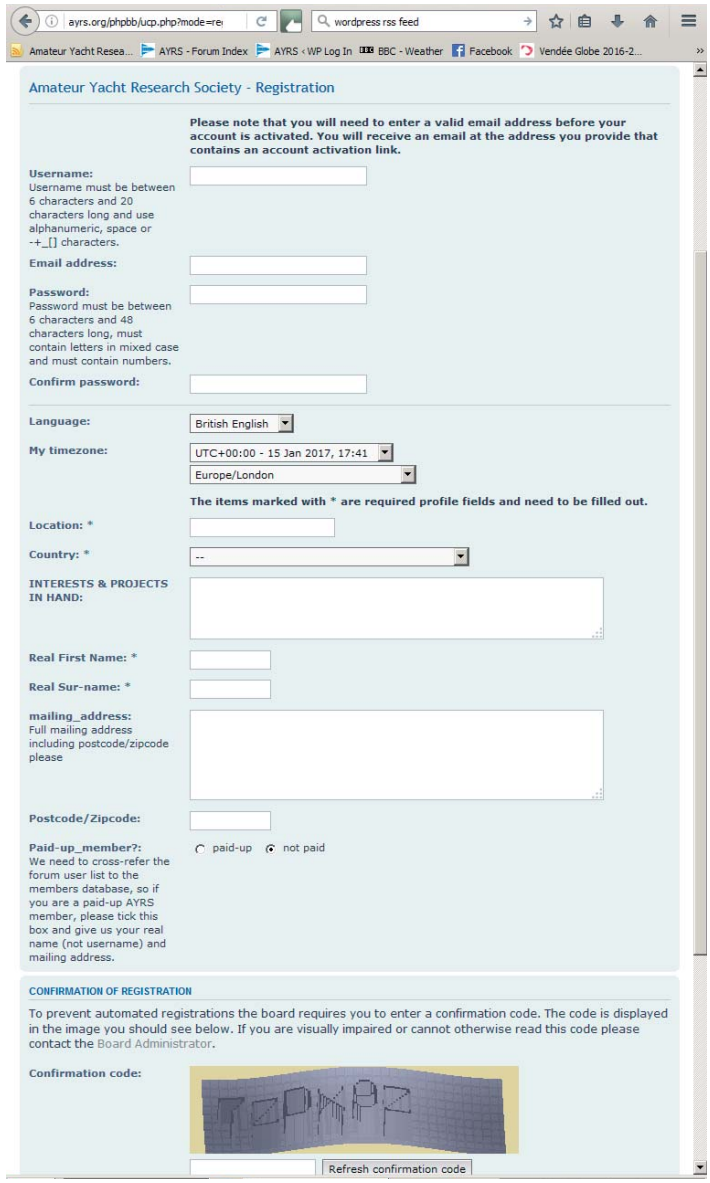


The Events page (top part)



The Discussion Forum front page (top part)

The other part of the site is the Forum. This is your part, not ours. It replaces the old AYRS forum on Yahoo, and is where you can follow and contribute to discussions. Part of it is private to paid-up members, but the rest is open to the public to read and contribute.



The Forum Registration page

To access the Forum fully, you will need to register. (Click on the link in the top right-hand corner of the Forum page).You will need to tell us your email address, the Username by which you would like to be identified on the Forum, and also your real name and address. The last two will NOT be made public, but are necessary for us to check and ensure that you are not someone whose only interest is in selling pornography or sex aids. (We've been getting a lot of those trying to register – about 50 a week!) If you have a current subscription to AYRS, then you need to tick the "paid-up member" box also as a signal to us to upgrade your forum access accordingly.

We need your email address to complete registration – you will be emailed your password, and also a link to go back to. You can change your password once you have registered (click on the arrow in the top-right-hand corner next to your username and select "User Control Panel"), but your new password will need to meet certain complexity requirements (so you can't just put in "password" or your username for instance). Once you've completed registration, the Forum is open to you.

(Note: you may also find that the first few contributions you make get referred to a Moderator who will check that you've posted your contribution to the right part of the Forum. This checking will stop after a little while, but it will delay things to begin with.)

At the time of writing most of the contributions have come from AYRS Committee members. That is NOT the idea! The idea is that it's your part, and the Committee contribute

as individuals, not as an "AYRS" presence. The exceptions to this are posts by "Admin" - the persona representing the AYRS Office, and those signed with an AYRS officer's title e.g. "AYRS Editor" (me!).

If you want to follow the action on the website without going there, then there are two options. There is an RSS feed both from the Static pages (at http://ayrs.org/feed/) and from the Forum itself (http://ayrs.org/forum/feed.php). These will "push" information to appropriate software on your computer or smart-phone. You can also select a Forum area and subscribe to it – tick the box at the bottom of the page, and the system will email you when there is a new contribution in that area. You can also manage your subscriptions through your User Control Panel.

If you have difficulty trying to operate this, please post a message in the Forum technical Support area, or in extremis, send a message to Admin (use the "Contact Us" button at the bottom of the webpage), and we'll try and sort you out.

The User Control Panel

("What do you mean – this is so simple a four-year old child could understand it!"
"Get me a four-year-old child, I cannot make head or tail of it" – *Groucho Marx*)

Catalyst Calendar

This is a free listing of events organised by AYRS and others. Please send details of events for possible inclusion by post to Catalyst, BCM AYRS, London WC1N 3XX, UK, or email to **Catalyst@ayrs.org**

January 2017

22nd **All-Day AYRS Meeting**
9.30am-4pm, Thorpe Village Hall, Coldharbour Lane, Thorpe, Surrey Tea and coffee available but bring your own lunch. Donations invited to pay for hall. Further details from Fred Ball, tel: +44 1344 843690; email: fball@ayrs.org.

22nd **AYRS ANNUAL GENERAL MEETING**
4pm-5pm, Thorpe Village Hall, Coldharbour Lane, Thorpe, Surrey, immediately after the All-Day meeting (see above). Agenda, Committee report and other papers are on the AYRS website http://ayrs.org.
AYRS desperately needs new Committee members, especially those with computer skills! Contact: Fred Ball tel: +44 1344 843690; email: fball@ayrs.org

February 2017

11th **Visit to the U-Boat Story**
Wirral Tramway & Transport Museum, including ferry 'cross the Mersey and lunch overlooking the Liverpool skyline. Contact: Mike Howard, email: ecotraction@aol.com.

March 2017

4th-5th **RYA London Dinghy Show**
Alexandra Palace London N22 7AY. The RYA Dinghy Show is the only show in the world dedicated to Dinghy Sailing. It's a great day out for all the family and offers visitors the opportunity to visit the AYRS on Stand H12!

11th **SW UK Area Meeting**
7 Cross Park Road, Wembury, Devon PL9 0EU
In past years the meeting has been held in Wembury, a coastal village about six miles to the south east of the centre of Plymouth. This will probably be the location for our meeting in 2017, unless the level of interest is higher than in the past in which case we will hire a hall somewhere in the vicinity of Wembury. For more details see http://ayrs.org/event/devon-meeting-march-2017/.

18th @ 2.00 pm **AYRS NW UK Local Group Spring Meeting**
Lydiate Merseyside. Contact: Mike Howard, email: ecotraction@aol.com

May 2017

6th – 8th **Sailing Trials Weekend Portland and Weymouth Sailing Academy, Portland Harbour, Dorset UK**
A weekend messing around with boats in Portland Harbour. For more details contact Norman Phillips email: wnorman.phillips@ntlworld.com

19th – 21st **Broad Horizons 2017 Sailing meeting**
Barton Turf Adventure Centre, Staithe Road, Barton Turf, NORWICH NR12 8AZ, UK. Joint with the UK Home Boat Builders Rally. Bring your boats or projects. Camping available, for details contact the Centre – http://www.btac-services.co.uk or email: bookings@btac-services.co.uk, for Sheila Fishwick.

June 2017

2nd -4th **Beale Park Boat Show**
As usual we will have a stand and would appreciate small exhibits and display material and, of course, offers of help to run the stand. Contact: AYRS Secretary, email office@ayrs.org

23rd -25th **Liverpool Boat Show**
AYRS will also be at this event with a stand run by the North West UK group. So if you are in the North of England (or in Scotland) and find Beale Park too far to go, try Liverpool instead where Mike Howard will make you welcome. He too would appreciate small exhibits and display material and, of course, offers of help to run the stand. Contact: Mike Howard, email: ecotraction@aol.com

July 2017

8th @ 2.00 pm **AYRS NW UK Local Group Summer Meeting, Lydiate**
Contact: Mike Howard, email: ecotraction@aol.com

August 2017

12th **AYRS NW UK Local Group Summer Outing to ?**
Contact: Mike Howard, email: ecotraction@aol.com

September 2017

9th @ 2.00 pm **AYRS NW UK Local Group AUTUMN MEETING**
Contact: Mike Howard, email: ecotraction@aol.com

Income & Expenditure Report of the Committee of the Amateur Yacht Research Society Limited for the Year Ended 30th September 2016

2014-5			2015-6	
		Income		
£ 4,432		Subscriptions	£ 4,243.34	
£ 267		Donations	£ 284.80	
£ 47		Misc Income (Loss) from US$ (Note 5)	£ 115.49	
£ (32)		Misc Income (Loss) from Euros (Note 5)	£ 99.61	
£ 548		Boat Show receipts (Note 6)	£ -	
£ 30		Interest received	£ 32.78	
£ 140		Sale of publications (incl. Catalyst) & stock	£ 121.44	
	£5,432			£ 4,897.46
		Less:-		
		Direct Charitable Expenditure		
£ 1,380		Printing & copying publications & Catalyst	£ 1,882.00	
£ 1,013		Opening stock	£ 1,013.00	
£ -		stock purchase	£ 48.60	
£ (1,013)		less closing stock	£ (1,061.60)	
£ 688		Postage on Catalyst etc	£ 356.90	
£ 240		Meeting and room hire	£ 205.90	
£ 69		Website & Internet Forum	£ 369.47	
£ 427		Support to Speedweek	£ 440.28	
£ -		John Hogg Prize	£ -	
	£(2,804)			£ (3,254.55)
		Other Expenditure		
£ 282		Administrative & office expenses	£ 317.33	
£ 2,297		Boat Show costs (Note 6)	£ 2,924.15	
£ -		Accountancy charges	£ -	
£ 1,244		Insurance	£ 263.50	
£ (15)		Misc	£ 26.00	
£ -		Bad debts	£ -	
	£(3,808)			£ (3,530.98)
	£ 6,612	**Total expenditure**		£ 6,785.53
	£(1,180)	**Surplus/(Deficit) of Income**		£ (1,888.07)

Notes and Schedules to the Accounts

1 **Accounting policies**

a) These accounts have been prepared under the historical costs convention.

b) Depreciation was provided on fixed assets until 1994 when the residual value was written off.

2 **The Society is limited by guarantee and has no Share Capital**

4 **The Committee** received no remuneration during the year. Receipted expenses were paid to certain members.

5 **Income in US$ and Euros**. Income in US Dollars was $30.00 (£23.05) being subscriptions paid in advance. The rate of exchange used at the year-end was $1.30128 =£1.00. Cash & at bank includes $1049.12 (£806.22) held on 30th September in PayPal, the remainder is in currency notes. Income and Expenditure in Euros was zero, however changes in exchange rates resulted in a profit on paper of £99.61. The exchange rate applied at the beginning of the year was €1.35383=£1.00, and that at the year end was €1.15775 =£1.00.

6 **Boat Show**s. Receipts amounting to £172.50 were banked from subscriptions, donations, and sales of publications at the March 2016 London Dinghy Show. Expenditure amounted to £1061.40. The 2016 Beale Park Boat Show cost £250.00 and brought in £107.00. The Liverpool Boat Show cost £1606.27 and brought in £118. These sums have all been subdivided in the accounts.

The full accounts will be found at http://www.ayrs.org/management/AGM 2017 Directors report.pdf

Catalyst — *a person or thing acting as a stimulus in bringing about or hastening a result*

On the Horizon . . .

Nothing much really.

Would you like to write something?

Email it to catalyst@ayrs.org please.
Guidance notes are inside the front cover.

ISSN 1469-6754 51
9 771469 675405

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Printed by Rapidity Communications Limited, London EC1V 7JD