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Human-powered Craft

Mike Bedwell
Michael_Bedwell@hotmail.com

Who Needs Rowing?

What a question ! Imagine the reaction at Henley, or from the dragon-boat racers who – or their bosses – believe that they will thereby bond and so become better 'team players'. Or what about heroes like John Ridgeway who, having helped pioneer sailing the Atlantic, earned a place in the Guinness Book of Records after joining forces with Chay Blyth to row instead? Or going back into history, the exploits of Captain Bligh, Erik the Red, the Greeks and Phoenicians in their galleys?

What is Rowing?

We need to ask this question in order to answer the first. A popular description might be 'sitting in a boat facing the wrong way, usually with two or more others each with an oar sticking out on one or other side'. The more knowledgeable might add that sometimes the crew have two oars each, one for each side, a variant the *aficionados* call 'sculling'. But, irrespective of terminology and notwithstanding its long history, rowing suffers a number of inherent disadvantages. One of these is that having oars 'sticking out' makes it difficult to manoeuvre in confined waters, a crucial problem in UK's narrow (7' ≈ 2.1 m) canals. Most of the other disadvantages follow from Newtonian mechanics,:-

1) energy is wasted through windage during the recovery part of the stroke.,
2) with the notable exception of the Gondola, the blade enters and leaves the water at the beginning and end of each stroke, so even in calm conditions there are impact losses.
3) again with the exception of the Gondola, the crew sit. This has the advantage of low 'hull' windage, and allows the crew to pull on their oars with a force greater than their weight, but the disadvantage that either
   i) only partial use can be made of the leg muscles, or
   ii) a sliding seat must be fitted. This not only carries a cost and weight penalty, but further impairs the exchange of momentum between the crew and the boat.

These disadvantages are largely avoided in lift devices, for the same reasons that the propeller is now generally preferred over the paddle-wheel. However, the parallel should not be pushed too far, since propellers operate at Reynolds numbers better suited to machines than human beings as prime movers. Further, if drag is fundamental to impact devices, it represents a waste of energy in lift devices.

If Not Rowing, then What?

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I'd recommend anyone seeking to avoid rowing while still using muscle-power, whether as the auxiliary or as the sole means of propelling her/his vessel, to begin by entering the four words

RO SCULL YULLAH GONDOLA

into Google. You will find, *inter alia*, some exciting video clips, but may leave you wondering why there seems to be no systematic way of making an informed choice from among the different variants.

This note is an attempt to fill that perceived need.

1) Terminology
Unless otherwise stated, from now on I restrict the word 'scull' to the use of reaction- or impact- operating paddles..
2) Yullah (various spellings) is where the paddle is used as a lift device, and can be viewed as a slowly-rotating, variable-pitch propeller that moves through less than half a revolution before reversing direction, the change of pitch being effected by a lanyard wrapped round the loom.
3) 'Ro' is at first sight simply the Japanese term for 'Yullah', but appears to differ from yullah in at least two ways: first, that the shape of the blade allows its use as both a lift and a reaction device, and second that the change of pitch is effected not by a lanyard but by a mechanism at the crutch..

Pros and cons

In the table below, most of the devices are lift. This is both for the reasons already given, and because the body motion is substantially athwartships, thus avoiding the momentum-exchange disadvantage of conventional rowing. The two exceptions are the Pedalo, familiar on park lakes, and the icon of Venice, the Gondola.

	Advantages	Disadvantages	Notes
Gondola	Technique proven over many centuries. Crew face forward. In modern Venice use seems to be extended to in punts of conventional design.	Technique needs skill. Traditional hull of sophisticated asymmetrical shape. Relatively high air draft.	French Feature Film 'Impardonables' (2011)
Pedalo	Low windage, high stability, crew face forward	The human body better at rocking than rolling! Greedy for cockpit space. If used with paddle wheel, the disadvantages discussed above.	
'Stern Sculling'	Lift technique despite name. Widely practised for auxiliary or emergency propulsion in dinghies and sailing yachts of up to at least 8 metres LOA. Uses simple oar with blade section symmetrical about both chord and width. Economic on cockpit space.	Impairs roll stability, as crew stands. Slightly impairs pitch stability. Technique requires practice, as angle of attack controlled by wrist rather than hydrodynamic forces. Paddler faces aft	
Oriental yullah	Widespread technique proven over many centuries. Uses simple oar with blade symmetrical about chord, and coaxial with shaft.	Impairs stability as above. Greedy for cockpit space; pitch is controlled by lanyard rather than hydrodynamic forces. Shaft curved. Paddler faces aft	
Ro	As above, but more economical on cockpit space. Blade reported to be usable in both lift and reaction.	Impairs stability as above. Pitch is controlled by device fitted at crutch rather than hydrodynamic forces. Paddler faces aft	Tabakian, G. "Wave Propulsion' AYRS Catalyst 44(2011), 12-15
Scullmatix	Apparently a proprietary development of Ro, commercially available in the West.	As Ro above.	

	Advantages	Disadvantages	Notes
'Flowtiller"	Facilitates use of rudder to propel sailing dinghies. Axis of rotation about 25% chord width from leading edge of blade. Blade incidence auto-controlled by fluid dynamic forces. Uses no cockpit space. Crew sits facing abeam, so good view forward and no loss of stability.	For best performance, needs blade with tear-drop-shaped offering high lift/drag ratio. Established NASA and sail-related data of limited value because of low Reynolds number. Uses arm muscles only No record of use since first published 10+ years ago. Might be banned by racing rules.	See AYRS website: Hazelwood 112=19-23
'MB Yullah'	Seeks to exploits Flowtiller principle, but needs no moving parts. Uses short, straight shaft but specially shaped blade. Can be used in tandem*.	Impairs roll stability, as crew stand. Crew faces aft. Hull must provide large lateral stability, for reasons comparable to those when sailing close-hauled. Difficult to design a paddle which both (i) remains near the vertical when temporarily out of use and (ii) floats if accidentally dropped over the side.	

*The photograph shows the initial trial in 2012 of my new test-bed raft christened 'Tandem Yuloh'. Speeds of over 4 knots were achieved, but the following problems found:

1) Winds above force 1 – common enough, even on rivers – impair control
2) Although almost impossible to capsize, her light construction means
(a) moving about the deck is disconcerting, especially when manoeuvring into a lock, and
(b) stress in my lumbar regions because of the effort to remain standing. .
3) I have been using the same paddles as in my erstwhile 2-tonne steel-hulled estuary cruiser *Mercia Maid*. These are less suitable for the raft since

- Having steel shafts, will sink if dropped overboard., and are clumsy to ship and unship.
- Have inadequate blade area

To overcome (3), have designed a paddle in which it is possible to vary the linear dimensions and sectional shape of the blade. I speculate the other problems may ultimately,need a return to steel constriction .

Would be delighted to hear from anyone keen to try out any other type of paddle, whether or not mentioned above.