Frame First and Framing First built traditional wooden fishing boats. A Phoenician legacy?

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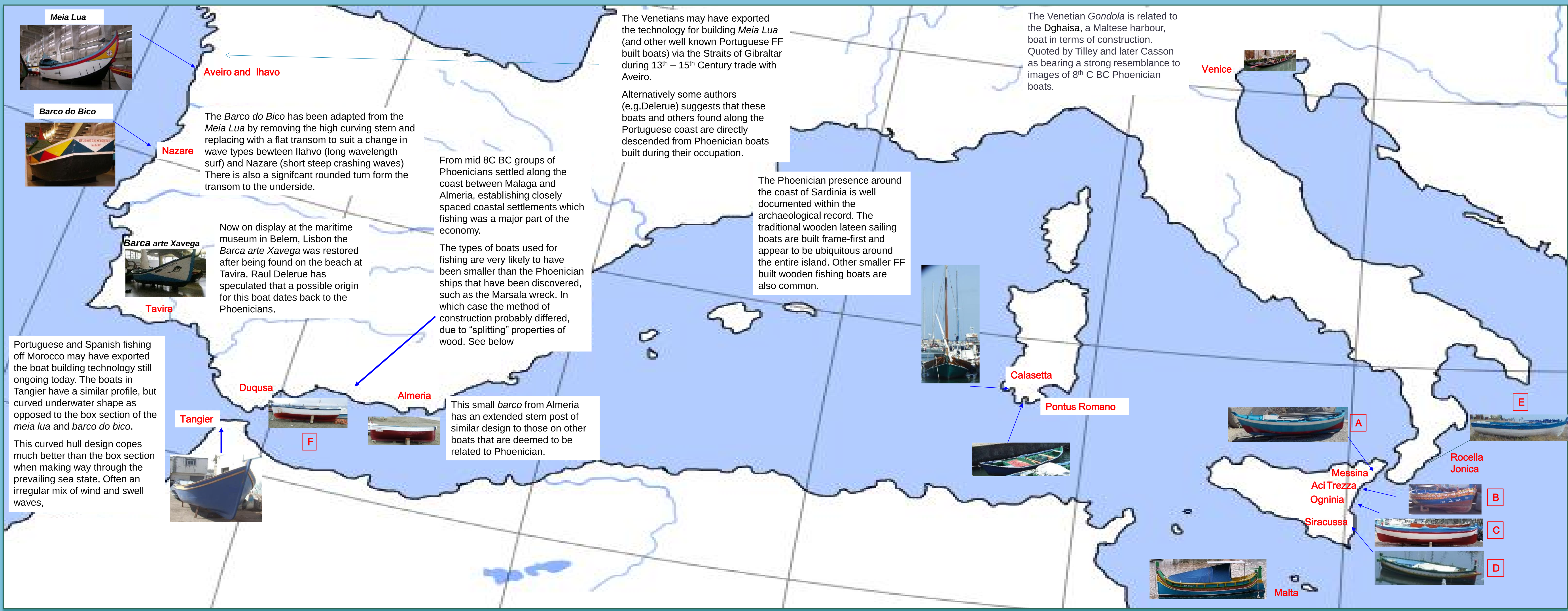
Traditional wooden fishing boats are ubiquitous along the Mediterranean coastline of Spain, France, Italy, Sicily, Malta and Sardinia. A visual examination reveals, without exception, a common method of construction: Planks fitted around a pre-erected framework consisting of a keelson, stem post, floor timbers and futtocks, and depending on stern shape a stern post. The same type of boat construction method is also apparent at Sozopol on the Black Sea coast of Bulgaria, along the Iberian Atlantic coast and is thriving at Tangier in Morocco. It is a boat building sequence that has recently been described by Professor Sean McGrail as either "Frame-First" (FF) or "Framing-First" (FrF)

This study examines a number of extant boats built either by FF or FrF and presents arguments that the same (or very similar) fishing boats date back to the Phoenicians.

Another outcome of this study will demonstrate how a sample of the subject boats, was evolved to suit the particular sea state in which they are deployed. And also show how adjustments to the shape of a hull can be made by altering the main operators of this technique, i.e. the master frame shape and values for the narrowing and rising offsets. This could be considered in a Darwinian context.

The boats featured below have all been photographed (and recorded where practical) by the author. They are part of a larger set and have been included to illustrate the ideas proposed within the study. In general boats built FF or FrF are evident across much of the northern shores of the Mediterranean. Often they do not have specific names and are referred to as *Barca* or *Barco*. These boats have a flat transom, rounded bilge and sloping stem. Two examples of such boats are included in the overview map below, at Roccella Jonica (E) and Duquesa (F).

The text boxes located within the map below contain information regarding links to the Phoenicians or other connections that demonstrates how boat building technology spreads. Within the left hand panels below the map an outline of the principles and sequence of FF and FrF is followed by basic ship science theory and then a demonstration of how the shape of a hull can be adapted by changes to the master frame and offset measurements. In the right hand panel a case study of boats from the Straits of Messina is used to demonstrate evolution of hulls and cultural aspects. The final panel presents some considerations for a Phoenician origin of FF and FrF.



Frame First and Framing First wooden boat building sequences and principles

The two related techniques have been defined in a paper by McGrail (2015) as follows:

'Frame-First' - the entire hull is first outlined by framing; The shape defined by the "skeleton' is then planked. See below.

The technique involves a master frame shape (or several for a longer hull) and set of narrowing and rising offset measurements. The shape of the master frame(s) can be derived from a number of methods; directly off moulds of varying types (Figures 1 and 2), geometric construction and a combination of the two.

Where the boat narrows towards the bow and stern the frames are tailored to fit within the line scribed by battens fitted to the outside of the skeleton. There will also be a certain amount of shaping "by eye" of the frames.

'Framing-First'- in a step-wise manner: first, lower framing; then planking fastened to it; next higher framing, followed by more planking; and so on, upwards from the keel. The master frame is derived from the same methods as above.

For both sequences an element of the final hull shape is governed by the bending properties of wood. Initially by the batten fastened to define the shape of the bow and stern sections, and then by the planks that are finally fitted. Although a certain amount of extra bend can be induced into the planks by soaking in water and steaming.

In summary, positioning a series of pre-designed curves within a three dimensional space frame can be considered an elegant solution to obtaining a complex three dimensional curved surface, using the relatively simple technology

In 1988 Raul Delarue published a study that included FF methods used by Portuguese boat wrights. Figures 2 to 5 below are a small sample of devices and methods used to define and replicate the shape of master frames and offset measurements.

Fig. 1. Moulds and rising and narrowing offset devices located at the Maritime Museum in Nazare. Photo G.Caira

Fig. 2. Shipwright using hand callipers to take measurements off a 1/25 scale half model that are used to construct full size master frames.

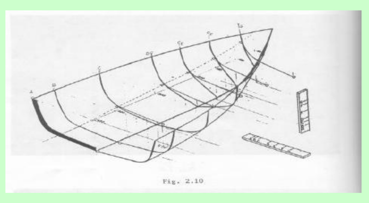


Fig. 3. 3-D representation of Barca Xevaga on which are marked, keel, ribs and planks. The half model master frame is in bold and the rising and narrowing measurements set out on strips of wood.

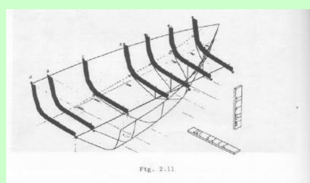


Fig.4. The effect of the narrowing and rising offsets are highlighted by the master frame position as it moves forward.

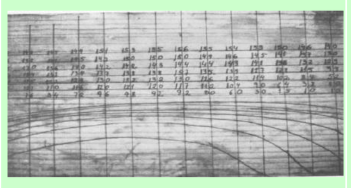


Fig. 5. Another way of recording the information required to scribe out a master frame is contained on a wooden panel. Curves of the mater frame are contained within the schedule

Form and Function

The underwater shape of the hull is the prime consideration when designing a boat for a particular sea state. It is a compromise to achieve safe operational stability, desired holding capacity, comfortable motion when underway, manoeuvrability and speed through the water. Most hull shapes exist within a narrow design envelope situated between two extremes: A cube (the most stable, but inefficient shape) and an 8 man rowing boat (very unstable, but eases through the water in a straight line). A safe, efficient hull can be considered a function of the forces of nature, the properties of wood and techonogical ability.

In Figure 4, a line of action of the upward buoyant force runs through the *centre of buoyancy* of the displaced water. ✶ The line of action of the downward gravitational force is through the *centre of gravity* of the boat. ◆

If the *centre of gravity* is above the *centre of buoyancy* the boat is stable.

If the *centre of gravity* and *centre of buoyancy* close on each other the boat is unstable.

If the *centre of gravity* lies above the *centre of buoyancy*—the torque couple causes the boat to roll over fill with water.

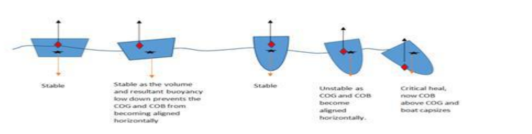


Fig.6. Illustration of how cross-sectional shape influences stability. Illustration by G.Caira

The longer the waterline length the higher potential speed of a hull and a plumb bow will facilitate this.

The downside is ingress of water when making way through waves.

To help keep the boat dry sloping stems and flared bows will displace the oncoming waves.

Adjusting the shape of a hull to suit a change to sea conditions

The Messina fishing boat being constructed below in Figure 7 is used to demonstrate how adjustments to hull design can be made by altering two of the main operators; master frame shape and narrowing and rising offset measurements

It was being built by Sig. Giovanni Rodolico, the current Mastro d'Asci at the Rodolico family Cantiere Navale in Aci Trezza, Sicily. He kindly explained how he constructed the boats and allowed photographs within his workshop. The moulds for obtaining master frames are simple wooden templates and the narrowing and rising offsets for different sizes and types of boats are kept safe within notebooks. (I was allowed to see these, but no photographs!) The final shape is achieved with the battens and "by eye" experience.

Design adjustments	Method of achieving desired shape
To increase buoyancy at the amidships section to offer better stability when deploying or recovering nets.	More curvature would be needed n the lower section of the master frame shape. Blue line in Figure 7.
For a more counter curved bow to keep water out of the boat when making way into a choppy sea (e.g. the Messina fishing boat, Fig. 12)	The forward ribs are lengthened and have an increased counter curve. See green line section A in Figure 7.
Increase carrying capacity and stability	For increased overall width; longer floor timbers and higher freeboard; longer ribs.
Ability to navigate through waves whilst keeping the boat dry.	There will also be an element of "by eye". For example to increase the flare on the bow in Figure.7 (at A) the forward ribs would have to effectively bend outwards a bit more whilst still marinating a fair line along a batten placed along the length of the boat.
A boat with box like cross-sectional is very hard to overturn, but uncomfortable and tiring when navigating across waves for a sustained period. The staccato motion is eased when the bilges are rounded	Easing of a staccato rolling motion can be achieved with rounded bilges. The floor timbers and frames must, therefore, be fashioned in curved shapes. The Meia Lua and Barco do Bico, formerly deployed off the Portuguese coast, to set seine nets, are examples of hard bilged boats that operated for a short time in breaking waves close to the shore.

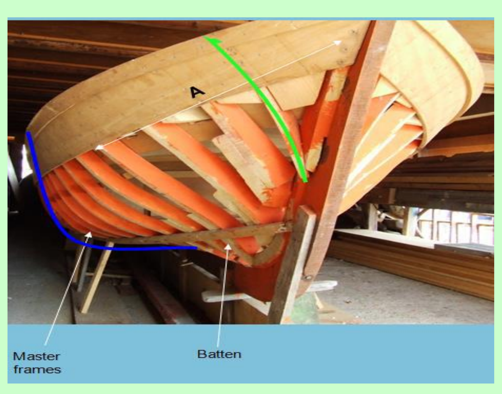


Fig. 7 Messina fishing boat under construction at the Rodolico family Cantiere Navale in Aci Trezza, Sicily. Photo G. Caira

CASE STUDY The Messina fishing boat and close-by relatives. Boats A, B, C and D above.

Between Siracussa and Messina, a 70 km stretch of coastline along eastern Sicily, there is a high concentration of traditional wooden fishing boats. Their sequence of construction is FF, but there are distinct variations in shape. Siracussa is a large protected bay and Ognina is a small natural harbour within a small bay. In both locations there is predominantly calm water. The extanct boats from these fishing cultures are canoe stern with virtually plumb stems that allow maximum waterline length to give optimum speed through the water (Boats C and D above). Whereas the boats from Aci Trezza and more so for the Messina boat have sloping, flaired bows to deflect short steep waves that are common off the beaches they are deployed from, (Boats A and B above).

Any of the four hulls could have evolved from one of the others by changing the shape of the master frame, stem and stern posts, and schedule of narrowing and rising offset measurements At some point in the past FF and FrF boat building was introduced (or possibly evolved) to this region. Over time local boat wrights have reasoned the required adjustments to the master frame shape and offsets to make a boat more seaworthy in a particular sea condition. See Figure 7.

In addition to the changes enforced by the sea state these boats have strong cultural influences, as exhibited by the colourful decoration and extended stem post designs. Scuppers cut into the sheer strake to prevent standing water can be a variety of shapes including triangles and ovals. The form of the stem post above the bow is another way neighbouring cultures distinguish themselves.

Design and Cultural aspects to these boats

Fig. 8. Early 20th Century photo of wooden boat in Siracusa harbour. It has a canoe stern and is propelled (and steered) using oars. The oarsman is stood facing forward, the preferred method along the Straits of Messina and still practiced today The pole towards the bow was used by a spotter who sat atop and directed the rowers chasing a sword fish. At the bow a crew member armed with a harpoon would attempt to spear the fish. Ancient scholars such as Strabo allude to the hunting sword fish in the Straits of Messina by the Phoenicians.

Fig. 9. Ognina festival boat. This is a longer version of the canoe stern boats used for fishing. The stem is extended over 1 m up from the bow and a bow sprit extends forward in excess of 1 m. The hull is brightly painted with geometric shapes and more interesting a mix of religious and mystical icons. The use of non-Christian icons is interesting considering the boats are sponsored by the local Catholic church. The siren dates back to Greek mythology and were supposed to lure sailors and ships to danger. Whilst appearing the same they are not mermaids. At the base of the extended stem is a picture of San Giovanni the patron saint of fishermen.

Fig.10. Boats crowded in Ognina. There were over 100 boats all of which appeared to be regularly maintained and many put to sea providing fish for the family. They are very important status symbol amongst the male population. Many of them are canoe stern and are propelled by oars or outboards fitted to a small wooden bracket. Note the range of different stem extension shapes. These are used as identifiers between the local fishing communities and it is apparent that a collection of boats from along the coast has accumulated here. The strong association with the sea perhaps dates back to the time of the Phoenicians. The relatively high abundance of fish in the local waters may have maintained the traditions, whereas declining fish stocks accompanied the decline in traditional boats and boat building.

Fig 11. The festival boat at Aci Trezza an ancient town with strong associations with Odysseus and the Cyclops from Greek mythology. Within the small harbour there are many wooden boats of varying sizes, colours and stem shapes. The Aci Trezza festival boat in the photo is decorated in a similar way to the one in Ognina (Fig 9) a few miles down the coast, but with a stem extension uniquely associated with this town.

Fig.12. A Messina fishing boat. The curved, flared bow is the main difference in design compared to the other boats along this coast. They are launched and recovered using a specially built wheeled trailer, that would appear to be unique to the beaches close to Messina. There are two distinct colour schemes with which the boats are decorated to distinguish them from one of two beaches. Today they mostly have an inboard engine and rudder, but in the past sails and more commonly oars would have propelled these boats.

Frame First and Framing First boat building-some considerations for a Phoenician origin

Authors on the subject of FF and FrF boat building have, without exception , been unable to define where the technique originated. There are several well known shipwrecks from the time of the Phoenicians that have been interpreted as shell-built i.e. a shell of edge fastened planks, with frames assumed to be fitted after. More recently questions have been posed as to whether some kind of mould would be required to facilitate this. However, these theories and others have been constructed around building a ship where the plank thickness is sufficient enough to accommodate the cutting of a mortise and insertion of tenon without splitting the plank.

According to the Greek historian, Polybius, writing 2,300 years ago the Phoenicians hunted swordfish in the Straits of Messina, however, as yet no examples of small wooden boats from the time of the Phoenicians have been discovered.

Below is a list of arguments and proposed lines of enquiry that could help establish the Phoenicians did in fact build FF and/or Fr F fishing boats similar to those still being built today in fishing communities such as Aci Trezza. This could be a location close to where the FF and FrF methods may have been conceived and developed. In other locations similarities between the profile of boats from the time of the Phoenicians and more contemporary boats such as the Gondola may be chance or in fact represent an unbroken line of FF and FrF boat building. Then same type of comparisons can be made between other boats within this study.

1) If, assuming that the Phoenicians used smaller boats built for fishing, as opposed to a larger ship similar to the Marsala shipwreck then the planks would need to be thinner to bend over short distances. Thinner planks would be liable to splitting during the process of cutting mortises and inserting tenons. Therefore, constructing a stand alone shell is very likely not feasible and a mould or frame would have been needed. This could have evolved from a dugout, then as ribs were introduced for strength and planks added to increase freeboard an evolution to FF and FrF.
2) From this point the idea of using master frames and narrowing and rising offsets could have become established. The Phoenicians had an alphabet and used numbers. There was also a sufficient level of boat building technology and available materials at this time.
3) Boat shapes are held within a narrow design envelope for given set of sea conditions. An efficient safe boat will remain constant unless there is a change in environment, and in order to make fishing commercially viable the Phoenicians would have needed efficient boats easily reproduced to a standard. FF and FrF satisfy this requirement.
4) At first the boats could have resembled the Meia Lua in cross-section. A box-section is easier to build and then introduction of rounded bilges to make the boats more sea kindly.
5) As maritime cultures moved and re-settled at locations with different marine conditions the imported boats would have to be adapted to new conditions. This is demonstrated by comparing the boats in the case study above and the range of designs of wooden boats across the Mediterranean, Black Sea, Atlantic margins. With examples shown in the above map.
6) FF and FrF is an elegant solution for boat design and building . It has obviously spread across the Mediterranean and adjacent coasts from somewhere that may have been based at the trading centres established by the Phoenicians such as Sicily and Southern Spain coast.