Tróia 1, a journey in time and sea. Shipbuilding and the shipwreck

Tróia 1, un viaje en el tiempo y el mar. La construcción naval y el naufragio

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Abstract: The 19th century is considered the epitome of shipbuilding techniques employed in Iberian dockyards. The increasing need to carry products over longer distances at higher speeds promoted the building of vessels and challenged the basic rules of buoyancy and maritime safety. In parallel with the need to produce more advanced vessels, shipyards also had to respond to new commercial interests that increasingly exploited existing maritime trade routes. The preliminary conclusions presented here describe multicultural and multifunctional ports where crews, passengers, dockers and sometimes shipowners interacted in such a small space. Based on this socio-economic, maritime and cultural context, this paper will focus especially on the shipwreck of Tróia 1 which sunk in the second half of the 19th century, near the city of Setubal, Portugal.

Key words: Maritime archaeology, shipbuilding, maritime routes, contemporary Age.

Resumen: el siglo XIX es considerado el epítome de las técnicas de construcción naval empleadas en los astilleros. La creciente necesidad de transportar más productos, a través de largas distancias a mayor velocidad, promovió la floreciente construcción de navíos que desafiaron las leyes elementales de la flotación y la seguridad marítima. En paralelo a la necesidad de producir navíos más avanzados, los astilleros también tuvieron que ajustar esta nueva realidad para poder corresponder a una interesada demanda comercial en el extranjero. En este siglo se asientan las rutas de comercio marítimas y los puertos representan una multicultural y multifuncional imagen, donde tripulaciones, pasajeros, estibadores, y a veces los propietarios de los barcos se cruzaban en un espacio tan reducido. Este artículo se centrará especialmente en el pecio de *Tróia 1* que se hundió presumiblemente en la segunda mitad del siglo XIX, cerca de la ciudad de Setúbal, Portugal.

Palabras clave: arqueología marítima, construcción naval, rutas marítimas, edad contemporánea.

Concepts and thoughts

Historians and archaeologists seek to reconstruct the past by reading and analyzing written sources and excavating structures and artifacts. Steffy is changing the way of looking at the past with his remarkable *Wooden Ship Building and the Interpretation of Shipwrecks* (Steffy, 1994). This teaches us that the act of reassembling the pieces of a long lost vessel, consists of much more than simply record their spoils. His concept allows us to think and go further than just the simple approach of trying to understand the remains of a vessel. A ship is born when the owner is moved by his desire to increase profit or the dream of exploring new worlds. The ship's writers and carpenters bring to life their thoughts and experience when the first basic lines started to be drawn and the first timbers started to gain the correct shapes. Their knowledge passed from generation to generation and demonstrates the complexity required to build a vessel capable of leaving a port, crossing an ocean and reaching its destination safely. With these ideas inspiring their actions, the shipwrights, carpenters and blacksmiths teach us today how they were able to convert hundreds of trees in the most diverse shapes and dimensions. Once built and launched on the water, the vessel becomes the residence of its captain and crew. These humans act as fishermen risking their lives in the North Sea or merchants who moved from port to port.

Analysis and interpretation of the wood structures and methods of shipbuilding

The remains of the Tróia 1 are completely scattered on an area of approximately 13000 square meters, where different wooden fragments of the hull may be seen.

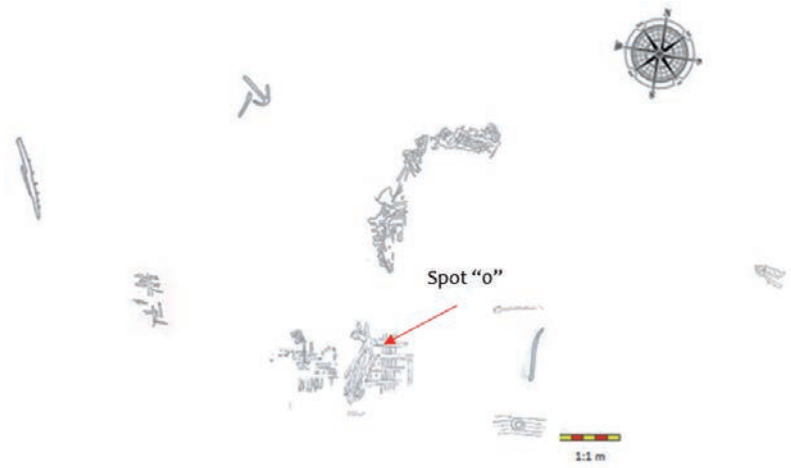

Figure 1. Tróia 1 Archaeological site.

The wooden structure located in the central core is a fragment of the ship's hull where several planks are still attached to the timber frames. The wooden hull fragment close to the set of two anchors toward east-west (central core-spot «0») has a similar configuration to the first wooden fragment. At the west sector a fragment of a deck knee can be seen as well as the presence of beams. However, this section of the deck is displayed in an inverted position enabling the full visual observation of the deck planks. The keelson, and second keelson or buttress, were isolated from other hull structures after the collapse of the vessel and dragged through the bottom of the sea.

The anchor type «admiralty» located near the central core, presents a similar configuration to the other located at spot «0». Although it only remains a fragment and it's presumed wooden stock.

During the excavations the late finding of the bow proved to be critical for the interpretation of the shipbuilding method used in the manufacture of the ship. As a result of further analysis it was possible to identify and assess the possible dimensions of the vessel and to develop a theory as to the ship's size and function. Moreover, the positioning of the remains with respect to their geographical orientation provided useful information about the heading of the vessel. The bow was facing north which means that the ship's crew was trying to enter the Sado estuary bearing northeast. The winch also facing the same way, apparently fell on top of what would be the mooring storage and has not moved since the ship structure has collapsed. However, we still have not concluded where the ship was built or its provenance on its last journey. The timbers were analysed and we conclude that the hull is made from *Ulmus Minor* (elm) and *Abies Mill* (silver fir) (wood anatomy analysis developed by Claudio Monteiro (project curator)).

Another unanswered question that remains is related to the ship's propulsion. Given the presence of huge set pieces of rigging, the absence of any mechanism to add propulsion (such as boilers or any other kind engine), shaft, or bearings, and propellers. In order to address this question, it was necessary to analyse similar ships to understand the shipbuilding methodologies employed. The remains of the schooner *Novos Mares* displayed nearby the Maritime Museum of Ilhavo were analysed as well as the publications written by shipwriters and shipbuilders (Desmond, 1919; Castanheira, 1991; Silva, 1948). Table 1 shows the results of that analysis where the different measurements (schooner Novos Mares, Tróia 1 and the guidelines from the shipbuilder Silva Valente (1948: 33) are displayed.

Timber Typology		**Ships**		**Rules for shipbuilding from the shipbuilder Silva Valente**		
		Troia 1	Schooner Novos Mares	Basic measurements		
futtocks:				vessel configuration	length between perpendiculars	45.50 m
	futtock configuration	double	double		floating length	10.60 m
	thickness	16 cm	15 cm		deck length	10.60 m
	width	14.5 cm	15 cm		careens depth	4 m
	length	n/d	35 cm		aft draft	5.05 m
	spacing	17 cm	15 cm		fore draf	3.82 m
planks:				bottom-line of the hull and the perpendiculars fore and aft	bottom-line to the line	4 m
	outside	6 cm	10 cm / 8 cm		bottom-line to deck	7.75 m
	inside	4 cm	9 cm / 12 cm		bottom-line to the castle	10 m
					bottom-line to the bow top	10.80 m

Timber Typology		Ships		Rules for shipbuilding from the shipbuilder Silva Valente		
nails:	iron	n/d	1.5 cm	heights in the master frame	from bottom-line to deck	6.60 m
	copper	1.5 cm	n/d		bottom-line to top	6.60 m
kell:				height aft	bottom-line to fluctuation	4 m
					bottom-line to deck	6.25 m
	shape	n/d	composite		bottom-line to castle	8.50 m
	thickness	n/d	51 cm		bottom-line in the middle of the stern contour	5 m
	width	n/d	n/d	length of castles, depending of perpendiculars in overall length	sft castle	11 m
	length	n/d	n/d		Bow castle	15.50 m
					keel width	0.50 m
					keel thickness	0.50 m
keelson:	thickness	15	29 cm			
	width	35	32 cm			
length			43.68 m		53 m	
width			10.41 m			
depth			4.91 m		5.6 m	
Tonnage (bruta)			433.74 tons		between 110-1200 t	
tonnage (Liquida)			334.66 tons			

Table 1. Comparison Table between the dimensions of Tróia 1-Schooner the *Novos Mares* and Valente (1948, 36) and Desmond (1919, 22) tables.

Based on the foregoing table, it is possible to find answers to questions relating to the type, measurements and chronological period. For instance, there are some similarities in measurements between Tróia 1 and *Novos Mares*. Especially in timber thickness and width, the inside and outside keelson and lining as well as the thickness of the pins. The vessels therefore could have similarities in type or function. Moreover, according to the records the *Novos Mares* has strong similarities with the rules written by Valente, and in the applied scale we may achieve the Tróia 1 measurements by the rule (length × pontal *Novos Mares*) / length) = (43.68 * 5.6) / 53 = +/– 4.91). These measurements and analyses allow us to fit Tróia 1 into the typology of a schooner.

The last large wooden ships built in the country until the mid-twentieth century had bolts, rivets and iron nails (Silva, 1948). Although in some cases they could still be manufactured in brass materials to reinforce the assembly used in areas below the water line. However, neither

of these situations applies to Tróia 1, since in all wooden structures bolts, rivets and nails of bronze were used. This indicates that the Tróia 1 was first built between the beginning of the 19th and the first quarter of the 20th century.

According to the current stage of the site formation, its positioning, the scattering of remains found and the absence of structural parts of the hull, including the keel, may lead us to think that the reason that the vessel sank was a wrong approach to the deepest canal of the Sado (northeast). Where soil conditions promote significant variations on the water column that goes from depths below 20 m to 8 m and then to 4 m in relatively short distance. This may have influenced or originated a crash against the sand banks, causing massive and ongoing destruction of the hull along the entire length of the shoal.

Other issues arose during the research, such as: What was brought on board? We have not yet reached clear conclusions related to the cargo or structures and containers, but based on the existing archives (Torre do Tombo, Arquivo Distrital de Setubal), the port of Setúbal, was commonly used for trading fish and raw material such as salt. So we may conclude that the Tróia 1, *as* a schooner would have possessed a significant space for cargo and its main activity was likely related to the transport of salt, fish or other goods in bulk.

Historical background – the navigation and maritime routes

To make possible the interpretation of traces related to underwater cultural heritage in the Sado region, as well as the strategic importance of the delta of Sado, it is necessary to go back in time until the moment that people, having the need to transport more quickly, crossing a river or to navigate goods between islands, soon began to build small boats. Along with the evolution of the people and improving techniques of shipbuilding, work continued on a rolling process that has been recorded up to the present day. Tróia was located on the south bank of the River Sado during the Roman period (1st to 6th century of our era) and was an important center for the fish industry which benefitted from the significant abundance of salt and fish in the cool seawater. High levels of production and an expansion of the industrial compound also contributed to the increase maritime traffic. Not only with the intensification of fishing, but also with an increase in the number of vessels used to carry the fish products that mostly supplied Rome (Almeida: 2008, 12). However, the use of salt for the purposes of industry or trading was not only developed during the Roman occupation, but the beginning of it through centuries.

Since the early 1950s most of the archaeological artefacts recovered from the river Sado (especially in the Caldeira de Tróia) are mainly related to the Roman period. Although, the archives refer to a large number of shipwrecks in the Sado estuary especially at its mouth. There are just a few located shipwrecks though, and mainly from the second half of the 20th century, which made the finding of the Tróia 1 very significant for the area and its chronology.

For a better understanding of the importance of the sea and the estuary of the River Sado for the population of the surrounding towns, we can highlight two different usages of the water. The first one refers to a partnership with the sea, with populations in which its economy was based on the shipbuilding industry, stowage and transportation and fish commerce. For the second, the more restricted usage of the confined water of the estuary. Based on the nautical history perspective, we are in the presence of a population in which their livelihood is based unequivocally on activities related to the sea and the river. There are several factors that contribute to the success of this industry, such as the geomorphological setting of Sado region. Which is the first natural harbour for vessels sailing from south to north, which has ideal conditions for the safety of populations settled in nearby villages. This provided two things – easy access to the sea, essen-

tial to their livelihood; and a broad estuary capable of hosting an extensive and varied range of vessels regardless of their type, size or functionality. Strongly attached to *Sadino* culture, salt has over the centuries been of the utmost importance and reaches a greater significance in the mid-19th century, when the need to preserve food items was essential during long ship journeys. Thus it achieved the status of essential good, and became vital for countries producing goods with basic conservation needs, but were not salt producers themselves. For instance, countries in northern Europe, particularly Ireland with unsuitable atmospheric conditions for the production of salt, had a need to import in order to safeguard the production of artisanal butter (which was Europe's largest producer), and meat preservation for consumption across regions.

1. Bovine cattle, low metabolic productivity but very important as they were the typical *milch cows* of this landscape, are responsible for the production of milk and therefore the production of butter.
2. Swine cattle, which was considered highly productive but exclusively targeted for immediate consumption, since without salt for conservation, this could not be sent to British colonies.

During this process, operating in the prevailing commercial and maritime corridors between the two countries, the commercialization of salt saw it named locally as *white gold*. The salt, traded on a frequent basis but in small amounts, would eventually prove essential to the populations of Cork (Horta, 2005) whose livelihood was based almost exclusively on the production of handmade butter. However, Portugal later realized the importance of Cork, which proved to be decisive in establishing trade between the two countries, becoming one of the main destinations for the trade of domestic products (Horta, 2005).

The port of Cork, set in the south of Ireland and geographically aligned with the Atlantic Ocean currents, proved to be a strategic port for maritime trade between Portugal and the British Empire. The established shipping lanes and business relationships that came to develop, accelerated the trade in various goods such as salt, wine, cork and fruit (Horta, 2005). These products were transported almost exclusively by Portuguese vessels enhancing the economy of Portugal – particularly for shipbuilding and other labor associated with marine industries as well as all the necessary logistics for export (crews, ports, shipyards, etc). It became necessary to establish consular offices across borders in order to protect the rights of Portuguese navigators and sailors. Trade regulation was established including customs duties and aid to Portuguese vessels in case of wreck or accident. The importance of this export trade was so large that consuls and vice consuls were installed in many different areas such as Dublin, Limerick, Waterford, Belfast and Derry, embracing all Irish territory (Horta, 2005).

Salt production was carried out seasonally, which suited the slower and purely handmade production of butter in the country side cottages. In the return circuit, butter from Ireland was received in the port of Lisbon and then consumed in all regions of Portugal, which was the second largest consumer of butter immediately after England. This justifies the intense maritime traffic between the two countries, and highlights the fact that the port of Setúbal was the largest port of exports to Ireland, and Lisbon – the main destination of vessels from Ireland.

Considerations

The remains of Tróia 1, represent the first known underwater archaeological site near the mouth of the river Sado. But, as mentioned before, it likely represents just a small portion of the maritime heritage. The archives may tell us much about incidents related to ships, but under the perspective of an archaeologist it is far more interesting if we join the archives with material evidence. The Tróia 1 Project was developed during three (amazing) years where «us» archaeol-

ogists had the precious help of marine biologists, geologists, hydrographers, conservators, enthusiasts, and undergraduate and postgraduate students. This project was born from the will to know more about tremendously scattered ship remains. The dedication and enthusiasm of the team led to the development of the research project and it is expected that the answered questions constitute only the starting point for another three years of research. Every one that was involved in the diving operations soon became more and more interested to know about the site formation. The hull fragments, by the way they are displayed tell us so much, that sometimes we just stayed looking at it trying to figure out where to start. The Tróia 1 research project brought to light that a team with completely different backgrounds may work for the same purpose.

At the beginning no matter from which perspective we look, the wooden fragments remained a mystery. The devastation caused at the moment that the ship was sinking and successive winter seasons and storms, covered most part of the hull timbers. The first results only started to be achieved when the team learned when were the best tides to collect data during the dive operations. The site is predominantly plagued by strong tides and waves due to its 6 meters depth (in other places – such shallow remains are an advantage!). In this particular case there is an asymmetry between the northern and southern shore of the mouth of the river Sado. In the north where the navigation channel is established, the depth and tidal currents are stronger, but the bottom of the sea maintains its shape. However, in the southern channel, which today is only fit for the navigation of small boats, the depth changes from tide to tide. Day by day we may see a different sea landscape, which generates a permanent seabed mutation. This, the essential task of collecting data took us more time than expected. But yet, now we know with reasonable confidence that the Tróia 1 ship is very similar to a topsail schooner; the crew was trying to enter in the Sado estuary, possibly was bringing bulk products; the hull shape represents a shipbuilding methodology used between mid-19th century and the early 20th century; and, finally that the eventual cause that led to its sinking was a wrong approach to the entrance of the river, which was significantly violent to destroy the ship over a vast area.

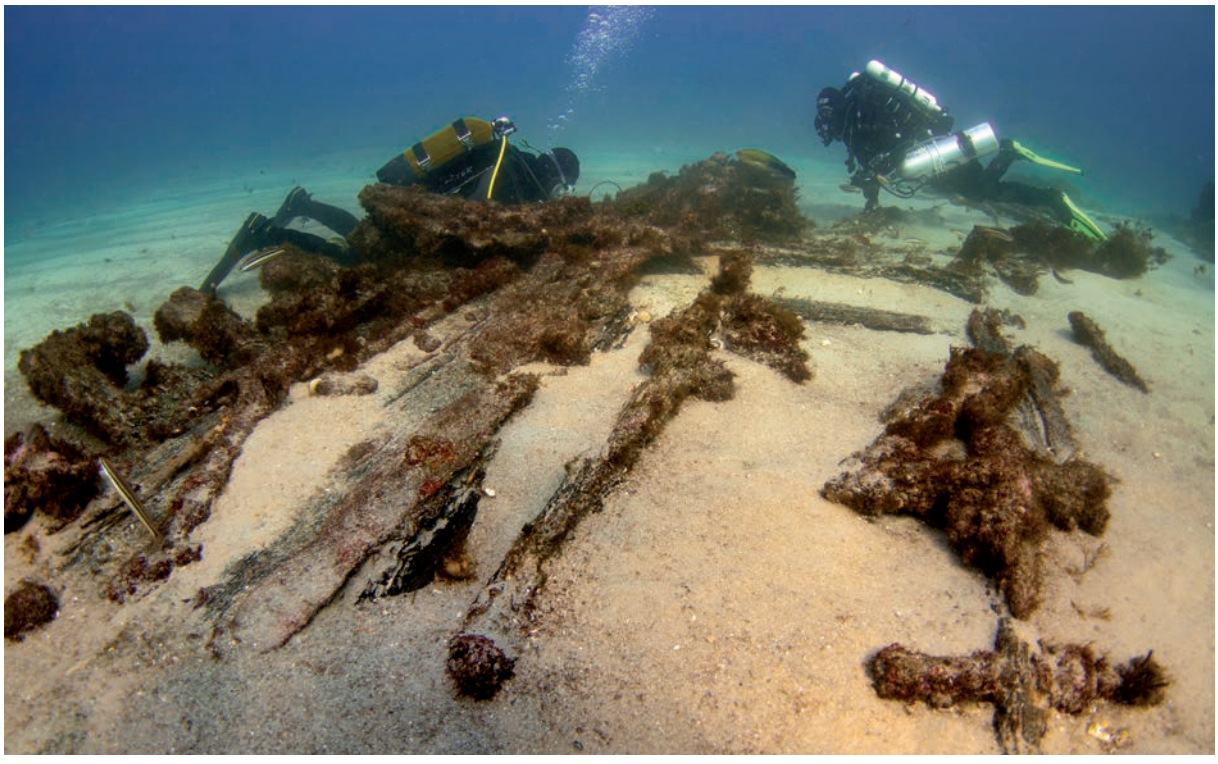

Figure 2. General view of ship wooden remains.

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