

# Second scuttled ship of Trstenik, Kaštel Sućurac, Croatia; Preliminary report

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**Abstract:** In 2020, during the research of a scuttled Roman ship at Trstenik in Kaštel Sućurac, two more scuttled ships were discovered on its western and eastern sides. All the ships were filled with large rocks, and scuttled in order to reinforce the operational waterfront of the economic complex (*villa rustica*), which existed from the end of the Late Roman Republican to the Late Imperial period. In 2021, the westernmost ship, called Trstenik 2, whose total length slightly exceeded 5 m, was fully explored. It is a specific type of vessel, characterized probably by a bow transom, in ancient sources called *horeia*.

**Keywords:** Gulf of Kaštela, Roman villa, operational waterfront, scuttled ship, *horeia*

## 1. Introduction

At the location of Trstenik, at the eastern end of Kaštel Sućurac, since 2002 with short interruptions, research has been carried out on the submerged remains of the coastal part of the Roman economic complex, which existed from the 1<sup>st</sup> century BC to the 4<sup>th</sup> century AD (Radić Rossi, Ruff 2021). In 2002 a complete perforated ceramic dolium was found in the shallow sea. It was recovered the same year and stored in the Croatian Maritime Museum in Split (Radić Rossi 2003; 2006). Although the underwater site was only entered into official records then, it was already known to the local population (Delić 1994).

The operational waterfront, bounded by horizontally laid planks and a number of poles driven vertically into the seabed, stretched in front of the coastal buildings for a length of over 80 m. At the western end, the wooden structure turns to the north and extends towards the shore for a length of over 30 m. The underwater excavation stopped at a distance of about ten meters from the coast due to the insufficient depth of the sea. The eastern end of the operational waterfront has not yet been confirmed with certainty, but it is much closer to the coast than its western end.

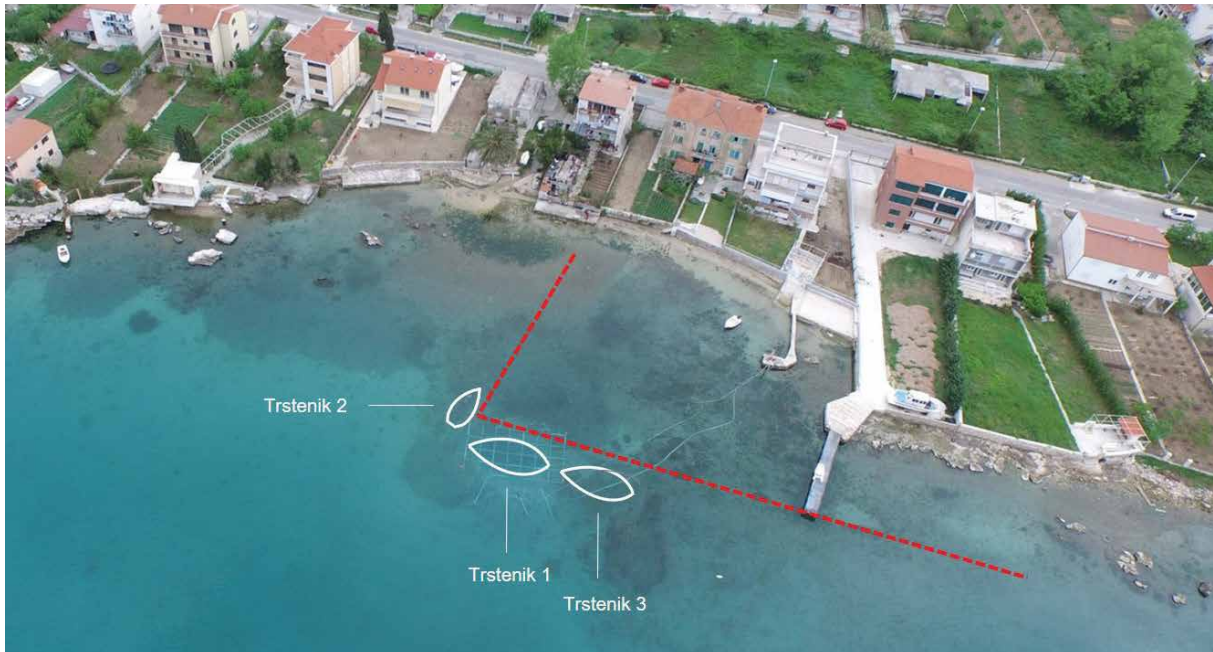
During research in 2006, along the westernmost part of the southern border of the operational waterfront, the remains of a Roman ship were discovered, laid in the east-west direction. Later research determined that it was scuttled to protect the waterfront from the effects of southern winds. During research in 2020, the remains of two more scuttled ships were found, so the ships were named Trstenik 1, Trstenik 2 and Trstenik 3 (Fig. 1). The ship Trstenik 1 was fully explored until 2020 (Ruff 2020; Ruff, Radić Rossi 2015; Radić Rossi, Ruff 2021), and in 2021 the ship Trstenik 2 was researched.

## 2. Research

The research of the ship Trstenik 2 took place according to the usual work methodology. First, a metal grid was placed over the hull remains (Fig. 2). The cleaning of the ship's structure consisted of the removal of large stones that had been thrown into it before sinking. This was followed by the removal of sediment, then fine cleaning and marking of all the components of the ship and the nearby wooden structure of the operational waterfront (Fig. 3).

After marking the elements of the ship's structure, photogrammetric recording was performed. Based on the virtual 3D model, an orthogonal representation of the ship was created (Figs 4a, 4b). In addition, a series of working photos

was taken, followed by photos of interesting details. All elements of the ship's structure were measured and described, and the details of the hull were drawn. At the end of the documentation process, the ship was covered with sediment and geotextile, waiting for the appropriate funding for its recovery and conservation treatment. In 2023 the sampling and wood sampe analysis were performed by Alice Lucchini, in the Laboratory for dendrochronology of the CNR IBE (Centro Nazionale delle Ricerche – Istituto pe la BioEconomia) in San Michele all'Adige (TN), Italy (Fig. 5).



**Fig. 1** Aerial view of the site, with marked positions of the three scuttled ships (photo: Project archive, drawing: I. Radić Rossi)



**Fig. 2** Aerial view of the ship Trstenik 2 and the metal grid over the excavated area (photo: Project archive)



Fig. 3 Position of the ship in relation to the operational waterfront (photo: B. Vukičević)

### 3. Preliminary analysis and interpretation

The ship has been preserved with a length of 4.8 m and a width of 1.98 m. It was made using the mortise and tenon building technique. The east side was much better preserved because it was leaning on the wooden structure of the operational waterfront, so it did not crumble under the weight of the stone filling. On that side, the turn of the bilge is preserved (Fig. 3), and in the central and northern part of the ship there is evidence of the sheer strake (TR2.SS). In the extreme northern part, at the height of the frame TR2.F12p, traces of an element added above the sheer strake (TR2.SS1) were noticed. It probably extended to the northern extremity of the hull, but, unfortunately, is rather poorly preserved.

The ship's keel (TR2.K) has been preserved in its full length of 3.42 m, and it is continued by the stern post (TR2.SP) with a length of 1.5 m, which is missing the end part. The average width of the keel is 5.4 cm, and its height is about twice as much. The ship ended in the southern part with a transom composed of two elements, interconnected by three tenons. The transom was found displaced from its original position. Its lower side is slightly rounded, and the edges on the inside are thinned. The transom (TR2.BT1 and TR2.BT2) was found in a horizontal position, lying on its outer side. The maximum width on the upper side is 60 cm, the width on the lower side is 43.5 cm, the maximum thickness is 5.7 cm, and the overall height is 34.5 cm. It was attached to the ship's planking by means of four long metal nails, driven from the outside (Fig. 6). In addition, an element marked TR2.F0, placed in the position of the initial floor timber, tied it to the ship's planking. This element was attached to the keel from the bottom with a metal nail. The function of the small rectangular element measuring 17.8 x 7.2 x 3.4 cm (TR2.UM1), found on the eastern side of the transom, has not yet been satisfactorily explained. As the transom was examined, resin was discovered on its external side. Apparently, resin covered the exterior of the transom.

The east side of the ship consisted of nine strakes. The second strake was probably repaired, which can be concluded from the shape of element TR2.P28 inserted between frames TR2.F3 and TR2.F5p. After that element, the plank marked TR2.P22 continues. The third strake was composed of at least two planks, TR2.P5 and TR2.P17, the second of which is visible at the stern, between frames TR2.F13p and TR2.F14p. For the other strakes, it is not possible to say with certainty whether they consist of only one plank or more, as the joints between them could be hidden under the existing frames, which were not removed from the planking during the excavation.

On the top of the sheer strake, in the immediate vicinity of the front side of frame TR2.F9p, which was preserved to its full height, a square opening was observed. Three metal nails are positioned on its southern side, and two more on the northern one. Another opening of smaller dimensions and without any trace of metal nails is located on the top of the sheer strake, north of frame TR2.F11p.

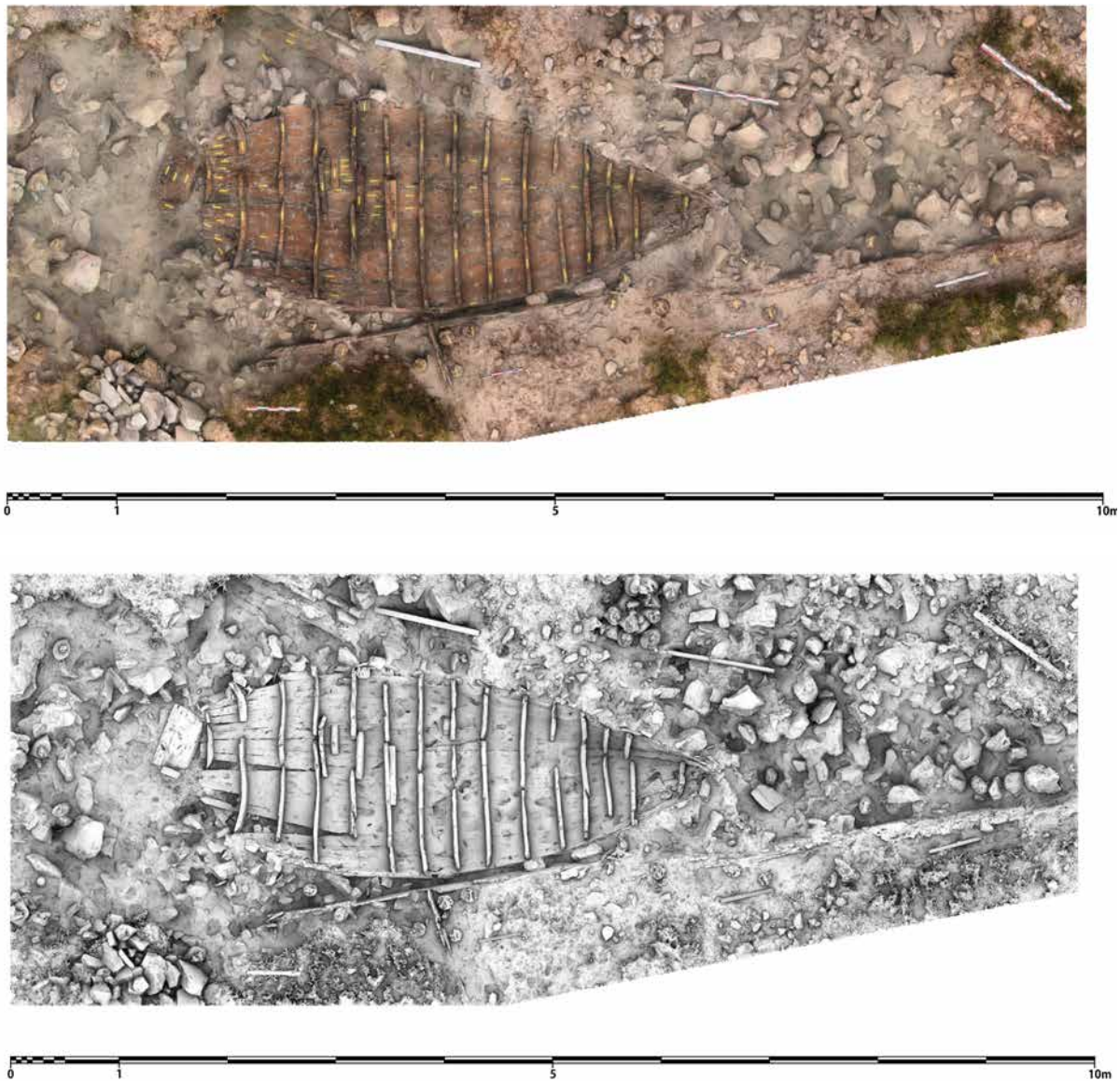


Fig. 4 Orthogonal view from the virtual 3D model of the site, a) color; b) black and white (model: K. Yamafune, D. Taras)

On the west side of the ship, six strakes and traces of the seventh have been preserved. The first strake consists of planks TR2.P8 and TR2.P30, among which there is probably a later inserted plank TR2.P21. The second strake begins with plank TR2.P9, which is followed by plank TR2.P26 and a thinner insertion marked as TR2.P17. The remaining four strakes are in the same situation as the eastern side of the ship, i.e. it is not possible to say with certainty whether they are composed of only one plank or multiple planks. In addition, the planks of the second and third strake do not end on the stern post, but terminate between frames TR2.F12s and TR2.F13s. On the northern side of frame TR2.F4s, at the level of the sixth and seventh strakes, a square element, TR2.UM2, measuring 12 x 12 x 6.8 cm, is attached, for currently unknown purposes.

The average thickness of the planks is about 1 cm. The mortises and tenons are relatively regularly spaced, and the centre-to-centre distance between the pegs is about 16–20 cm. The diameter of pegs is 0.7–0.8 cm. On the dislocated element TR2.SS2, identified as the ship's sheer strake, the mortises and tenons are present only on one side.

The ship's framing consists of two floor timbers, marked TR2.F3 and TR2.F4. Floor timber TR2.F3 continues with futtock TR2.F3s, added on the southern side and protruding towards the east. The TR2.F3p half floor continues to the west. Floor timber TR2.F3 was probably added to the ship later, because it lacks a limber hole. Two futtocks, TR2.F4s and TR2.F4p, were added to floor timber TR2.F4. The appearance of the remaining framing points to the fact that this element could also have been added later to strengthen the ship's structure.

The elements TR2.F1p, TR2.F3, TR2.F5p, TR2.F7p, TR2.F8p and TR2.F11p are asymmetrical floor timbers that only slightly cross the keel towards the western side of the ship. They continue with futtocks to the west. The elements TR2.F2s, TR2.F6s, TR2.F9s and TR2.F13s are also asymmetrical floor timbers that only slightly cross the keel towards the eastern side of the ship, and the corresponding futtocks continue to the east. Only floor timber TR2.F9s protrudes more towards the east. The futtocks TR2.F10s and TR2.F10p are not connected to each other by floor timbers; TR2.F12s and TR2.F12p were made as half floors, and in the case of the futtock TR2.F14p, it is not known what was positioned on the west side of the ship.

The half floor TR2.F5p is fixed at the northern side by frame element TR2.F5, which was also probably added later, because similar to TR2.F3 it lacks a limber hole. In contrast to the centrally located semicircular limber holes on all other frames positioned above the keel up to frame TR2.F9s, the TR2.F11p frame is equipped with two triangular openings, located at both sides of the keel.

All the frames were fixed to the planking by means of trenails with a diameter of 1.1–1.2 cm, driven into each individual row. Traces of metal nails were observed on frames TR2.F3, TR2.F4, TR2.F5 and TR2.F14p, and on the preserved end of the stern post. The lower sides of the four southern and four northern frames were bevelled due to the elevation of the ship's structure. The average sided dimension of the frames is about 5–6 cm, the average moulded dimension is about 5–6 cm, and the average sided dimension of the two symmetrical floor timbers is about 10 cm. The distance between the frames measures 25–30 cm.

On the southwest side of the ship, fragments of three more planks, marked TR2.P31–TR2.P33, and one fragment of a sheer strake, marked TR2.SS3, were observed, which certainly belonged to the west side of the ship, but were separated when the structure collapsed under the load of the stone filling. Along with them, an interesting trapezoidal element (TR2.BT4) was found, which is slightly narrower in the lower part than the transom (46.5 cm), slightly wider in the upper part (62 cm) and less rounded on the lower side. The upper and lower edges are bevelled in profile, with a lower part at the back, and slightly projecting outwards. On the upper part, there are two grooves, the bottoms of which are bevelled upwards, and on the lower part there is an opening in the form of a limber hole. In the left profile, the trace of one metal nail is visible, while in the right profile, there is evidence of two others. In the lower left part, there are two round openings that appear as if they were intended for the reception of trenails, but this is not certain.

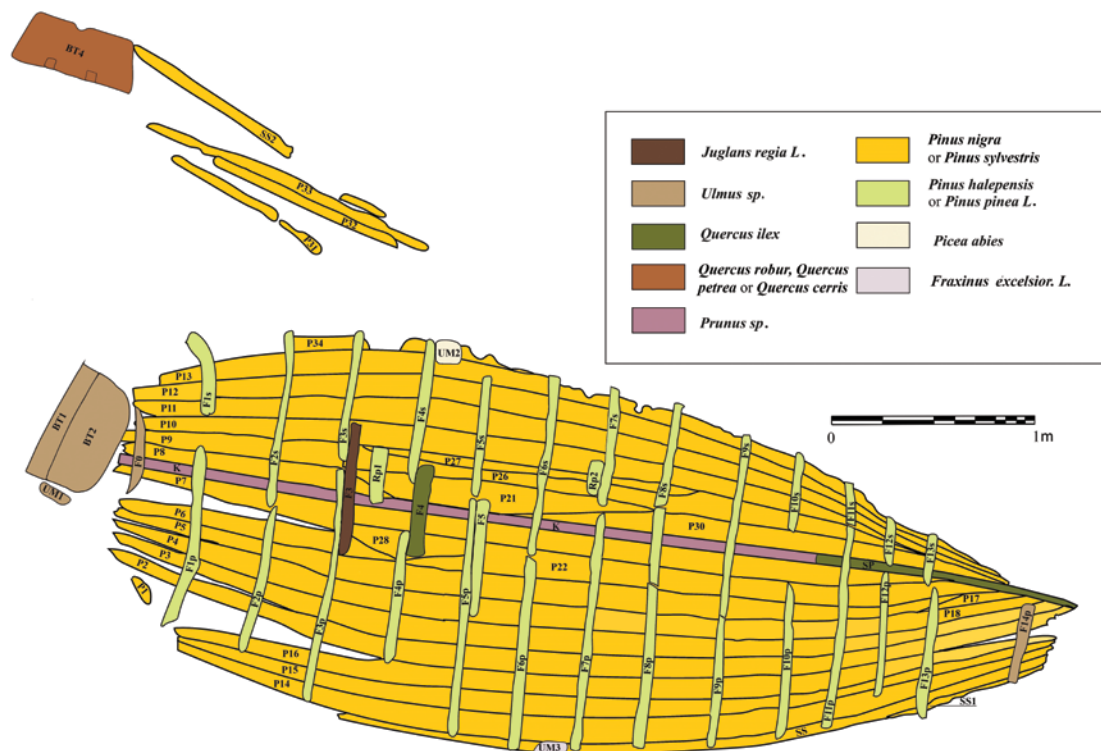


Fig. 5 Drawing of the ship Trstenik 2, with the results of xylological analysis (drawing: N. Lete, E. Šilić, A. Lucchini; analysis: A. Lucchini)

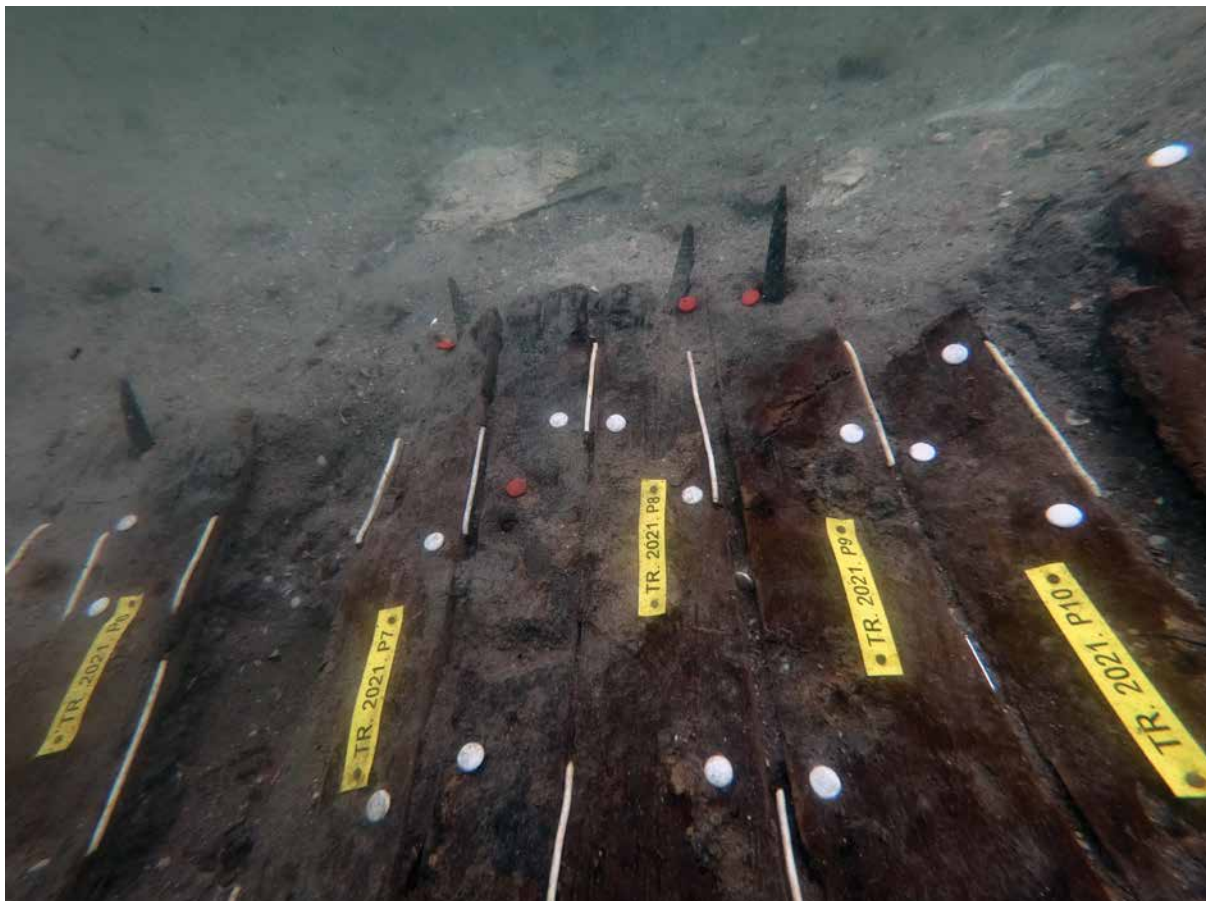


Fig. 6 Four metal nails which were fixing the transom to planking (foto: I. Radić Rossi)

Although at first it seemed that, considering the shape and position of the described element, TR2.BT4 was attached to the outboard side of the transom, this cannot be confirmed. As mentioned, a layer of resin was observed under the transom, i.e. on its outside, which could have been used to connect an outer element. Although the shape of TR2.BT4 roughly corresponds to the shape of the transom, it has on its sides the evidence of metal nails that once connected it to something, but there are no elements of the hull where it could have been attached.

The overall preserved length of the ship, 4.8 m, points to the fact that its original length slightly exceeded 5 m. Judging by the width of the eastern half of the ship, where the turn of the bilge and sheer strake are preserved, its original beam was around 2.3 m. It is, therefore, a vessel of small dimensions that could have been used for fishing and other daily activities in the coastal area of the Gulf of Kaštela.

#### 4. Dating

Unlike the ship Trstenik 1, in which an entire ceramic oil lamp of the Loeschcke X / Iványi XVII type was found under the stone filling (Radić Rossi, Ruff 2021: 28, 37), no ceramic find was found in the ship Trstenik 2 that could suggest a possible dating of the ship's sailing or sinking. The only find that can be attributed to the 1<sup>st</sup> or 2<sup>nd</sup> century AD is a fragment of the handle of an amphora of the Rhodian type, found above the ship structure in square D3.

Taking into account the described situation, one sample of the wood of the ship's structure was sent for radiocarbon analysis. The TR2.F1p Trstenik 2 frame sample was analysed at the Beta Analytic Testing Laboratory (Miami, FL, USA), under the number Beta – 601117. Radiocarbon measurement resulted in a dating of 1970±30 BP. This result, calibrated using the IntCal20 calibration curve, corresponds to the period from 41 BC to 124 AD (95.4% probability), which generally corresponds to the results of the radiocarbon analysis of the wooden structure of the ship Trstenik 1.

Given the absence of sapwood in the processed sample, it is not possible to determine with certainty when the wood was cut, and it is necessary to take into account the fact that after cutting the wood could have been subjected to an

aging process, which preceded the construction of the ship. Judging by the results of the radiocarbon analysis and the mentioned facts, the ship was probably built during the 1<sup>st</sup> century AD, and it is difficult to say how long it was in service before its intentional sinking. As it is a small ship of extremely fragile construction, its lifespan can probably be estimated at a few tens of years, so it is likely that it was deliberately sunk at the end of the 1<sup>st</sup> or during the early 2<sup>nd</sup> century AD.

## 5. Discussion

The ship Trstenik 2 belongs to the type of ships called *horeia* in Roman sources. Such a ship is characterized by a transom at one end, as shown on the mosaic from the 3<sup>rd</sup>/4<sup>th</sup> century AD from Althiburus in today's Tunisia. Whether it is the bow or the stern is still being discussed in the professional literature.

The discovery of mosaics depicting various types of ships at Althiburus led to the publication of a catalogue in which Paul Gauckler interpreted the *horeia*-type ship as a ship with a flat stern (Gauckler 1905). Four decades later, Paul-Marie Duval argued that it was a transom bow, and not a transom stern (Duval 1949). Peter Marsden and Marco Bonino tried to deny Duval's theory (Marsden 1963; Bonino 1963), but they were opposed the very next year by Lionel Casson, who further argued for a transom bow (Casson 1964; 1995). Lucien Basch then favoured the transom stern theory (Basch 1987).

In 2002, the problem of fishing boats with a transom end was addressed by Deborah Carlson who, following Casson's conclusion, interpreted the transom of the boat as a transom bow (Carlson 2002). In addition, she concluded that there is a possibility that such ships moved in both directions, which, in fact, softened the previous debate to some extent. Giulia Boetto also agreed with Casson's conclusion, interpreting the archaeological finds from Naples (Boetto 2009), Portus (Boetto, Ghelli, Germoni 2017), and Toulon (Brun 1999; Boetto 2009; Brun *et al.* 2022) as ships equipped with a transom bow (Boetto 2009).

In 2017, Vittorio Bovolin again opposed such an interpretation, and he based his theory on the reinterpretation of iconographic sources and hydrostatic calculations made on the Napoli C ship model (Bovolin 2017). In any case, his arguments proved insufficiently convincing, so five years later the Toulon finds were republished as ships with a transom bow (Brun *et al.* 2022). The find of the small ship J3, found in the eastern port of Alexandria known as Portus Magnus, was initially interpreted in the same way (Belov *et al.* 2022). The researchers, however, changed their minds over time, and based on the position of the mast step, they concluded that the transom was probably at the stern, although the position of the oar locks suggests that the ship could have moved in both directions.<sup>1</sup>

The ship from Naples, called Napoli C, is about 13 m long, and its framing consists of 50 frames. The ship from Portus near Ostia, known as Isola Sacra 1, is about 12 m long. Its framing consists of 37 preserved frames, and seven more certainly existed judging by the marks on the planking. The two ships from Toulon are somewhat smaller in size. Toulon 1 was preserved to a length of 8.5 m, and Toulon 2 at a length of 6.3 m. Thirty-five frames were found on the first ship, and 27 on the second. The well-preserved J3 ship from Alexandria is 6 m long and equipped with 21 frames. All boats are characterized by a flat bottom and a slightly rounded hull, with minor differences, while in one extremity they assume the V shape.

Although the Trstenik 2 ship is even smaller than the smallest transom-ended ships found so far, J3 from Alexandria and Toulon 2, and only 15 frames were recorded on Trstenik 2, they are all quite similar in terms of basic characteristics. Taking into account the fact that all mentioned ships were probably used for fishing and port communication in shallow coastal areas, the assumption of the existence of a transom bow, or the extremity for double use, is quite convincing.<sup>2</sup> Such ships were intended exclusively for local navigation, thus their size and seaworthiness would not have been suitable for the open sea.

Another argument that could be taken into consideration while interpreting the transom end as the bow is the fact that the ships Trstenik 1 and Trstenik 3 lie in the position bow to stern. If the situation is similar for the Trstenik 1 and Trstenik 2 ships, then the transom end should be interpreted as the bow.

1 A. Belov, personal communication.

2 The fact that ships with transom bows existed also in the 16<sup>th</sup> century is confirmed by a graphic by an unknown author, which shows a Turkish acrobat in front of the bell tower of the church of St. Mark in Venice, whose movements are closely followed by the audience in boats of various shapes and sizes (Carboni 2008: cat. 38, pp. 331, 132, 134).

## 6. Conclusion

Unlike the ship Trstenik 1, which was much larger in size and intended for the transport of heavy cargo, the ship Trstenik 2 was a small ship with a completely different function, which probably moved exclusively in the area of the Gulf of Kaštela. Although fishing is most often mentioned in the sources, other tasks that could have been performed with it should not be neglected, such as, for example, transshipment of goods from large ships to the coast or in the opposite direction.

The relatively large ship Trstenik 1 was scuttled in an east-west direction near the western end of the southern part of the operational coast, which was probably well protected from the devastating southern wind. The western side of the operational coast was in less danger, which is probably why a much smaller ship was chosen for its reinforcement. For now, it is not possible to say with certainty that both ships were scuttled at the same time, as the oil lamp found in Trstenik 1 suggests a slightly earlier time for its abandonment. Given the radiocarbon dating uncertainty for both ships, coupled with the possibility that the ships were in operation for decades after their construction, it is certainly conceivable that both ships were scuttled and ended up at the bottom of the sea at the same time.

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