



NASTAVAK PODMORSKOG ISTRAŽIVANJA NA TRSTENIKU U KAŠTEL SUĆURCU

Continuation of underwater research at Trstenik in Kaštel Sućurac

Istraživanje na Trsteniku započelo je 2002. godine, a uz kraće prekide traje i danas (Radić Rossi, Šuta 2024). Ovogodišnja istraživačka kampanja provedena je u organizaciji Odjela za arheologiju Sveučilišta u Zadru, a financijska sredstva osigurali su Ministarstvo kulture i medija HR, Splitsko-dalmatinska županija, Sveučilište u Zadru, Muzej grada Kaštela i Institut za pomorsku baštinu ARS NAUTICA. U istraživanju, provedenom tijekom mjeseca rujna, sudjelovali su stručnjaci i studenti Sveučilišta u Zadru, stručnjaci Muzeja grada Kaštela, članovi Instituta za pomorsku baštinu ARS NAUTICA i profesionalni ronionci iz Splita i Zagreba. S obzirom na to da je tijekom istraživačke kampanje 2023. godine u cijelosti otkriven brod *Trstenik 3*, ovogodišnji radovi bili su usmjereni na fino čišćenje, uklanjanje proveza i izradu potpune dokumentacije o stanju brodske konstrukcije.

Research at the Trstenik site began in 2002 and has continued to the present day, with only short interruptions (Radić Rossi, Šuta 2024). This year's research campaign was organized by the Department of Archaeology of the University of Zadar, with financial support provided by the Ministry of Culture and Media of the Republic of Croatia, Split-Dalmatia County, the University of Zadar, the Kaštela City Museum, and the Institute for Maritime Heritage ARS NAUTICA. The September campaign involved participation from experts and students of the University of Zadar, professionals from the Kaštela City Museum, members of the Institute for Maritime Heritage ARS NAUTICA, and professional divers from Split and Zagreb.

As the *Trstenik 3* ship was fully uncovered during the 2023 campaign, this year's work focused



Irena RADIĆ ROSSI

irradic@unizd.hr

Ivan ŠUTA

sutaster@gmail.com

Alice LUCCHINI

als.lucchini@gmail.com



Istraživanje je započelo označavanjem pozicije broda *Trstenik 3*, postavljanjem pomoćnoga metalnog mrežišta dimenzija 12 x 4 m (6 x 2 kvadrata) i razvlačenjem konopa kojim je obilježeno protezanje drvene konstrukcije pretpostavljene operativne obale. Potom se pristupilo uklanjanju velikog kamenja i geotekstila, kojima je prošle godine brod *Trstenik 3* privremeno zaštićen na morskom dnu. Zbog velike količine materijala taj je postupak potrajao dva radna dana. Kamenje se izbacivalo izvan mrežišta, nakon čega se u košarama odnosilo do gomile sjeverno od broda. Nakon toga pristupilo se uklanjanju geotekstila te finom čišćenju nalaza. Uklanjanje nakupljenog sedimenta potrajalo je sljedeća tri radna dana, nakon čega su na sve elemente brodske konstrukcije postavljene odgovarajuće oznake. Oznake su se sastojale od kratice za ime broda TR 3 i kratice za označavanje pojedinih elemenata na engleskom jeziku (K = keel, kobilica; SM = stem, pramčana statva; SP = stern post, krmena statva; F = frame, rebro; P = plank, platica; W = wale, bokoštitnica; S = stringer, proveza; SE = supporting element, podržavajući element; TN = tenon, drveni jezičac). Iako se pretpostavlja da se na istočnoj strani nalazi prova broda, što bi značilo da je sjeverna strana zapravo njegov lijevi, a južna strana njegov desni bok, oznake su razlikova-

on meticulous cleaning, removal of the stringers, and the preparation of complete documentation detailing the condition of the ship's structure.

The investigation began with marking the position of the *Trstenik 3* ship and installing an auxiliary metal grid measuring 12x4 meters (6x2 squares). A guideline rope was then stretched to outline the extent of the wooden structure, presumed to be part of an operational waterfront.

The next step involved the removal of large stones and geotextile fabric that had been used to temporarily protect the shipwreck on the seabed during the previous year. Due to the volume of material, this process took two working days. The stones were first moved outside the grid and then transported in baskets to a designated pile north of the ship. Then the geotextile was removed, and fine cleaning of the ship's remains began. The removal of accumulated sediment occupied the next three working days. Once cleaning was completed, all elements of the ship's structure were marked accordingly. The markings included the abbreviation for the ship's name TR 3 and English-language designations for individual structural components: K = keel; SM = stem; SP = sternpost; F = frame; P = plank; W = wale; S =



Početak istraživanja na nalazištu (foto: B. Vukičević, Cropix)
Beginning of the excavation at the site (photo: B. Vukičević, Cropix)



Pogled na ostatke broda s provezama in situ (foto: B. Vukičević, Cropix)
View of the ship remains with stringers in situ (photo: B. Vukičević, Cropix)

ne po stani svijeta, tj. oznaka N (*north*) postavljena je na elemente sjeverno od kobilice, a oznaka S (*south*) na one južne. Nakon što je dovršeno označavanje nalaza napravljeno je prvo fotogrametrijsko snimanje kojim je zabilježena situacija na morskom dnu. S obzirom na to da su proveze prekrivale spojeve između rebrenica i rebrenih nastavaka, odlučeno je da se one pažljivo uklone i dokumentiraju na kopnu, a potom vrate na nalazište, umotane u geotekstil. Budući da je uklanjanje proveza rezultiralo ponovnim zasipanjem broda sedimentom, pristupilo se finom čišćenju koje je rezultiralo u cijelosti očišćenom brodomskom konstrukcijom.

Svi elementi detaljno su nacrtano i fotografski dokumentirani, a provedeno je i ponovno fotogrametrijsko snimanje nalazišta. Brod se sastoji od kobilice, početnog dijela pramčane i krmene statve, šest vojeva sa svake strane (sastavljenih od jedanaest platica sa sjeverne i osam platica s južne strane), po jedne bokoštitnice sa svake strane (sedmi voj), trideset i četiri rebra koja se sastoje od rebrenica ili polurebrenica te rebrenih nastavaka, triju proveza sa sjeverne i dviju proveza s južne strane te dvaju kratkih elemenata postavljenih, čini se, za pridržavanje proveza. Na nekim je rebrima izvedena jedna slivnica nad kobilicom, dok se na drugima nalaze po dvije ili tri, smje-

stringer; SE = supporting element and TN = tenon. Although it is assumed that the ship's bow is located on the eastern side—implying that the northern side would represent the port (left) side and the southern side the starboard (right) side—the labelling of elements was based on cardinal directions. Elements located north of the keel were marked with 'N' (north), and those to the south with 'S' (south). Following the completion of the marking process, the first photogrammetric survey was conducted to document the condition of the seabed. Since the stringers covered the joints between the floortimbers and futtocks, it was decided to carefully remove and document them on land, after which they were returned to the site wrapped in geotextile for protection. The removal of the stringers led to further sediment accumulation within the ship, necessitating another round of fine cleaning. This process resulted in a fully cleaned and exposed ship structure.

All structural elements were thoroughly documented through detailed drawings and photographs, and a second photogrammetric survey was carried out to capture the updated condition of the site. The ship consists of a keel, the initial sections of the stem and sternpost, six strakes on





Tri slivnice na rebru TR 3.F 13 (foto: I. Radić Rossi)
Three limber holes on the frame TR 3.F 13 (photo: I. Radić Rossi)



Krmeno rebro TR 3.F 28 (foto: I. Radić Rossi)
Stern frame TR 3.F 28 (photo: I. Radić Rossi)



Ortomozaik iz virtualnog 3D modela nalazišta
(foto: D. Demetlika; model: A. Lucchini, K. Yamafune)
Orthomosaic from the virtual 3D model of the site
(photo: D. Demetlika; model: A. Lucchini, K. Yamafune)



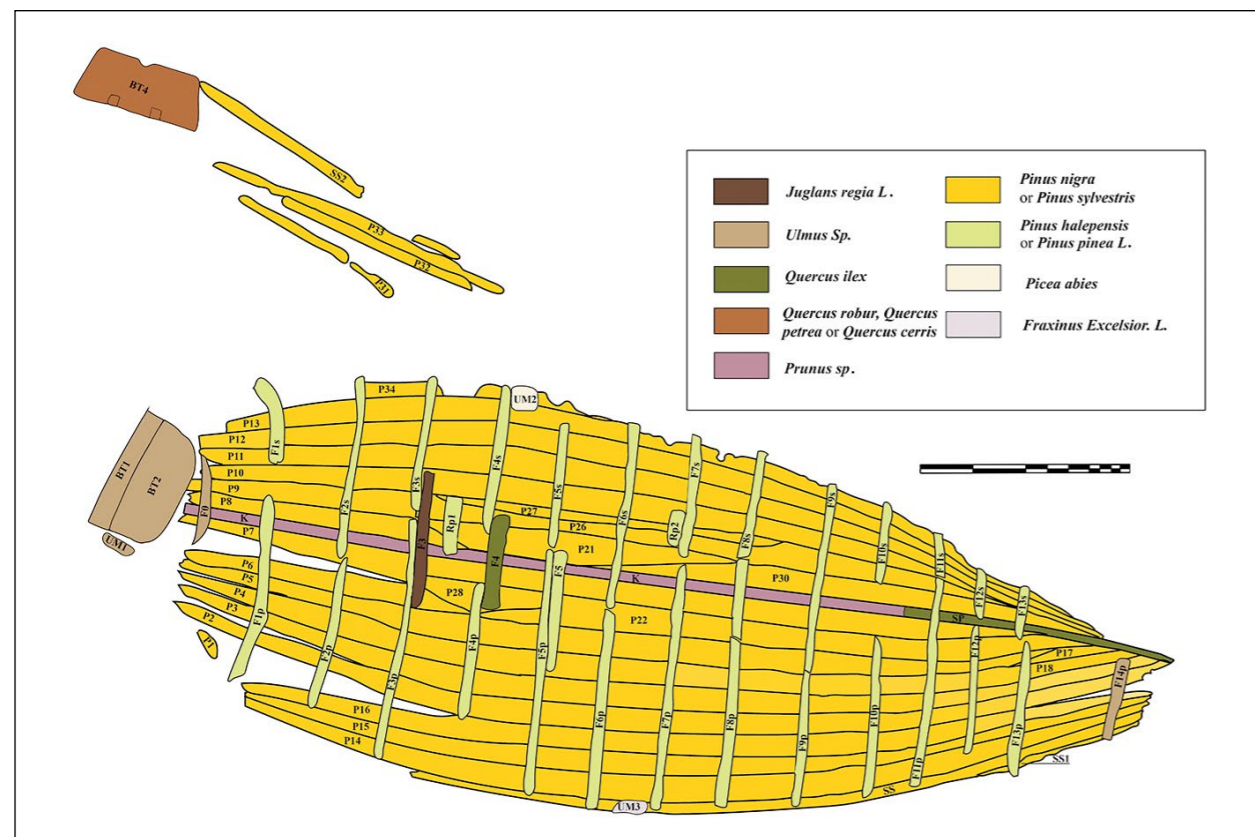
štene nad kobilicom i u razni drugog ili trećeg voja. Rebra su imenovana od istočnog prema zapadnom dijelu broda, tj. od pretpostavljene prove prema pretpostavljenoj krmu. Provedeno je i sustavno uzorkovanje drvene građe.

Osim istraživanja na prostoru broda *Trstenik 3*, istraživanje se odvijalo i na istočnom dijelu nalazišta, uz veliki prošupljeni dolij od kojeg se donja polovica očuvala *in situ*, u neposrednoj blizini sjeverne strane linearne drvene konstrukcije. Na tom se prostoru, u dubljim slojevima, kao i tijekom prijašnjih istraživačkih kampanja, osim antičke, pojavila i prapovijesna keramika koja bi po svojim osnovnim karakteristikama mogla pripadati brončanom dobu. Nekoliko metara dalje u smjeru istoka otkriven je donji dio još jednog dolija koji se vjerojatno nalazi *in situ*. Po završetku istraživačke kampanje brod *Trstenik 3* i ostali nalazi privremeno su zaštićeni geotekstilom i sedimentom.

Tijekom istraživačke kampanje 2023., za potrebe analize drvene građe iskorištene za izradu brodske konstrukcije uzorkovani su sastavni elementi broda *Trstenik 2*. Analizu je tijekom veljače 2024. provela Alice Lucchini, poslijedoktorandica Sveučilišta u Zadru, u Laboratoriju za dendrokronologiju Instituta za bioekonomiju talijanskoga Nacionalnog centra za

each side (comprising eleven planks on the north side and eight on the south) along with a wale on each side (forming the seventh strake). The structure also includes thirty-four frames, made up of floortimbers and half-frames with futtocks, three stringers on the north side, two on the south, and two short elements that appear to have been used to support the stringers. On some frames, one limber hole is present above the keel, while on others two or three are visible, positioned above the keel and at second or third strake. The frames are numbered from east to west, that is, from the presumed bow toward the presumed stern. All timber underwent systematic sampling.

In addition to the investigation of the *Trstenik 3* ship, research was also carried out in the eastern section of the site, near a large, perforated dolium, the lower half of which was preserved *in situ*, close to the northern side of the linear wooden structure. In this area, deeper stratigraphic layers, similar to findings from previous campaigns, yielded both ancient and prehistoric pottery. Based on its basic typological features, some of the prehistoric pottery may date to the Bronze Age. A few meters further east, the lower part of another dolium was discovered, which



Rezultati analize drvene građe broda *Trstenik 2* (autor: A. Lucchini)
Results of the xylological analysis of timber from the ship *Trstenik 2* (autor: A. Lucchini)



Ulomci prapovijesne keramike iz sonde (foto: A. Sunko Katavić)
Fragments of prehistoric pottery from the excavation trenches (photo: A. Sunko Katavić)

znanstvena istraživanja (CNR). Rezultati su pokazali da su platice broda bile izrađene od crnog ili bijelog bora (*Pinus nigra* ili *Pinus sylvestris*), a većina rebara od alepskog ili pitomog bora (*Pinus halepensis* ili *Pinus pinea*). Kobilica, pramčano (ili krmeno) ogledalo i element koji ga je učvršćivao za brodsku oplatu te posljednje rebro na drugom kraju broda bili su izra-

also appears to be *in situ*. At the conclusion of the campaign, the *Trstenik 3* ship and other exposed finds were once again temporarily protected using geotextile and sediment.

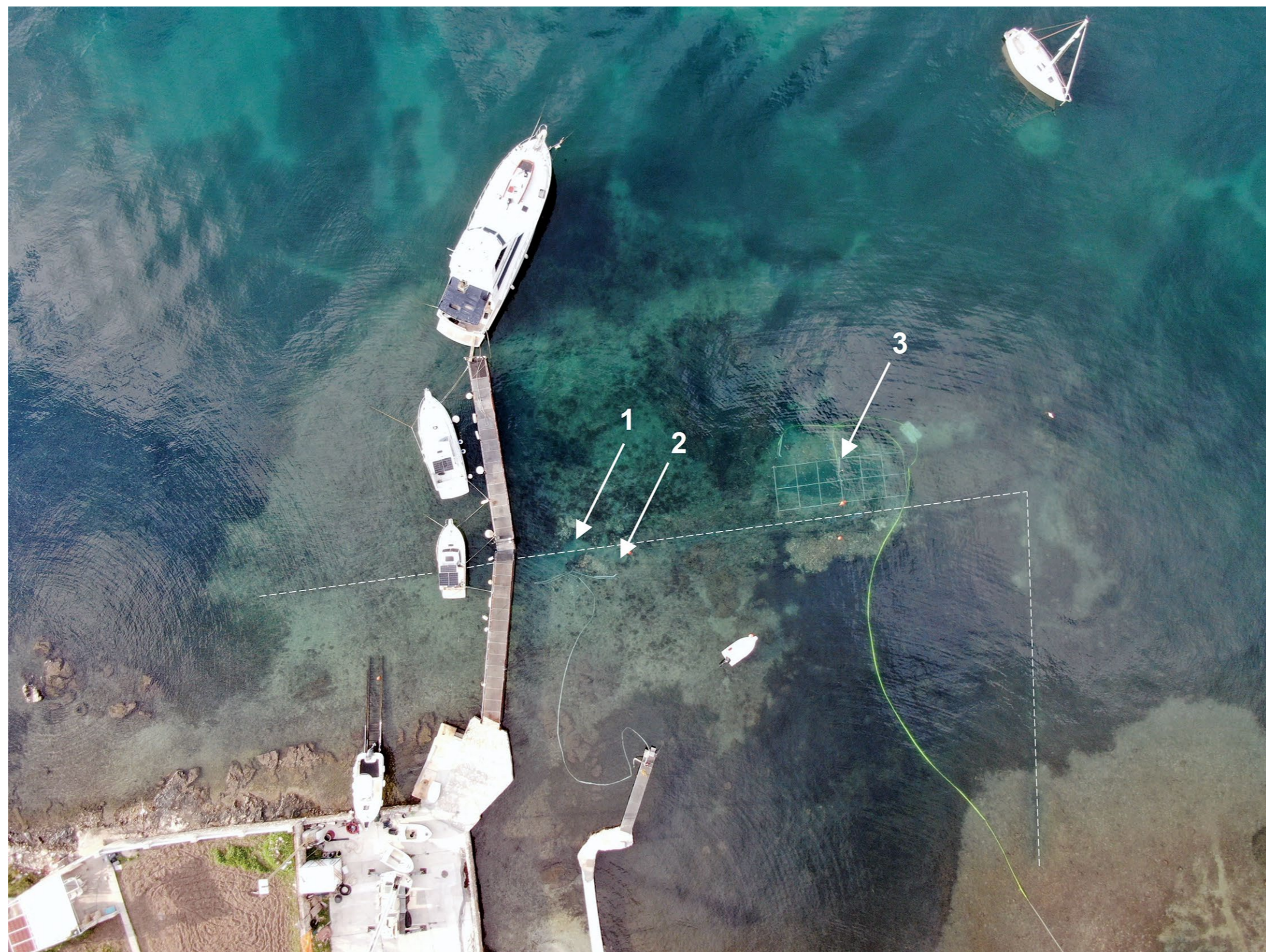
During the 2023 research campaign, samples were taken from various components of the *Trstenik 2* ship to analyse the types of timber used

đeni od brijesta (*Ulmus Sp.*); statva je bila izrađena od crnog hrasta (*Quercus ilex*), a naknadno ubačeni elementi za učvršćivanje rebara F3 i F4 od ora-ha (*Juglans regia L.*) i crnog hrasta. Izmješteni element, koji je u prvi trenutak podsjećao na ogledalo i činio se njegovim sastavnim dijelom, bio je izrađen od hrasta lužnjaka, kitnjaka ili cera (*Quercus robur*,

in its construction. The xylological analysis was carried out in February 2024 by Alice Lucchini, a postdoctoral researcher at the University of Zadar, at the Dendrochronology Laboratory of the Bioeconomic Institute, part of the Italian National Research Council (CNR). The results revealed that the ship's planking was made of either black pine (*Pinus nigra*) or Scots pine (*Pinus sylvestris*), while most of the frames were constructed from Aleppo pine (*Pinus halepensis*) or stone pine (*Pinus pinea*). The keel, the bow (or stern) transom, the fastening element connecting the transom to the hull, and the final frame at the opposite end of the ship were all made of elm (*Ulmus sp.*). The post was constructed from holm oak (*Quercus ilex*), while additional strengthening elements inserted next to frames TR 2.F3 and TR 2.F4 were made of walnut (*Juglans regia*) and holm oak. A displaced component, which initially resembled a part of transom and appeared to be an integral part of the ship's structure, was made of oak—likely *Quercus robur*, *Quercus petraea*, or *Quercus cerris*. However, its exact function remains undetermined.

The site at Trstenik in Kaštel Sućurac offers exceptional potential for studying the organization of ancient coastal economies. The intentional scuttling of ships to reinforce harbour structures appears to have been a common practice during the 1st and 2nd centuries AD, as evidenced by comparable findings at the site in the Caska bay on the island of Pag (Radić Rossi, Boetto 2020) and in Sukošan near Zadar (Pešić 2022).

Additionally, the discovery of perforated dolia at Trstenik is particularly noteworthy, as such features have so far been documented only in Dalmatia and are absent elsewhere in the Mediterranean. The abundance of Dressel 20-type amphorae further supports the hypothesis of intensive activity in the area during the 1st and 2nd centuries AD, when empty amphorae were also repurposed in the construction of port infrastructure.



Zračna snimka nalazišta s označenim nalazima: 1) donji dio prošupljenog dolija s vanjske strane linije pretpostavljene operativne obale; 2) donji dio prošupljenog dolija s unutrašnje strane linije pretpostavljene operativne obale; 3) brod Trstenik 3 (podloga: Muzej grada Kaštela)
Aerial photograph of the site with marked finds: 1) Lower part of a perforated dolium on the outer side of the presumed operational waterfront; 2) Lower part of a perforated dolium on the inner side of the presumed operational waterfront; 3) Trstenik 3 ship (photo: Kaštela City Museum)



Quercus petraea ili *Quercus cerris*), ali se za sada još ne može utvrditi njegova točna funkcija.

Nalazište na Trsteniku u Kaštel Sućurcu iznimno je zanimljivo za proučavanje organizacije antičkih gospodarstava koja su se nalazila u blizini obale. Namjerno potapanje brodova kako bi se učvrstile lučke konstrukcije bilo je, čini se, popularno tijekom 1. i 2. st. po Kr., o čemu najbolje svjedoče brodovi pronađeni na nalazištu u uvali Caski na otoku Pagu (Radić Rossi, Boetto 2020) i u Sukošanu nedaleko od Zadra (Pešić 2022). Osim toga, na nalazištu je zabilježena i prisutnost prošupljenih dolija koji su za sada pronađeni samo na prostoru Dalmacije, dok ih u drugim dijelovima Mediterana nema. Veća količina amfora tipa Dressel 20 također svjedoči o intenzivnom korištenju prostora tijekom 1. i 2. st. po Kr., kad se prazne amfore upotrebljavaju i za izgradnju lučkih struktura.

Pojava prapovijesne keramike dodatno doprinosi značenju ovog nalazišta u proučavanju prapovijesnog naseljavanja obala Kaštelanskog zaljeva. S obzirom na još neistražene dijelove i na devastaciju šireg prostora suvremenom izgradnjom, istraživanje na Trsteniku potrebno je nastaviti kako bi se stvorila čim cjelovitija slika o nekadašnjem izgledu priobalnog dijela velikoga antičkog gospodarskog kompleksa te pokušalo otkriti što se na tom mjestu događalo u prapovijesno doba.

The presence of prehistoric pottery adds further importance to the site, contributing valuable information to the study of prehistoric habitation along the shores of the Gulf of Kaštela. Given the areas of the site that remain unexcavated and the impact of modern development on the wider zone, continued research at Trstenik is crucial. Future investigations will help reconstruct the original appearance of the coastal segment of this extensive ancient economic complex and may shed light on the nature of activity at the site during prehistoric times.

LITERATURA / REFERENCES

- PEŠIĆ, M. 2022, Nastavak istraživanja brodske konstrukcije u antičkoj luci Barbir / Continued investigation of a ship's structure at the antiquity period harbour at Barbir, *Potopljena baština / Submerged Heritage*, 12, 24–30.
- RADIĆ ROSSI, I., BOETTO, G. 2020, The Roman Scuttled Ships and Harbour Structures of Caska, Pag Island, Croatia in their Cultural and Historical Context, *The International Journal of Nautical Archaeology*, 49.2: 263–290.
- RADIĆ ROSSI, I., ŠUTA, I. 2024, Istraživanje trećeg antičkog broda na Trsteniku u Kaštel Sućurcu / Research of the third Roman ship at Trstenik in Kaštel Sućurac, *In Situ – Godišnjak Odjela za Arheologiju / Yearbook of Department of Archaeology*, 2, 134–144.