Yearbook of the International Centre for Underwater Archaeology in Zadar
Godišnjak Međunarodnog centra za podvodnu arheologiju u Zadru

Submerged Heritage
Potopljena baština

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Measurement of the electric potential of the iron cannon at the Franina shipwreck/
Mjerenje električnog potencijala željeznog topa na brodolomu Franina (Photo: M. Kaleb)

Second page / Druga stranica:
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NOVOSTI / NEWS

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17th Croatian Museum Night

ICUA Zadar in cooperation with the City museum of Rovinj-Rovigno participated in the Museum Night on 28 January 2022. The seventeenth edition of the Croatian event was held under the title *Museums between the Physical and Virtual World*. The City museum of Rovinj - Rovigno presented an exhibition entitled *The Barrel - Cradle of Salted Sardines*. In order to prepare the presentation, the employees of ICUA Zadar filmed several shots of the conservation-restoration process on the barrels, along with a brief description of the work. Due to the limited number of the City museum of Rovinj-Rovigno visitors caused by the coronavirus pandemic, the restored wooden barrels and the projection were presented in front of the Museum and for the general public on the website and Facebook page of the Museum. On the occasion of the Museum Night 2022 event, ICUA Zadar prepared an innovative virtual photo exhibition of underwater research *Illuminated Secrets from the Deep*.

Congress on postmedieval ceramics in Europe

The international congress *Europa Postmediaevalis 2022* was held in the city of Coimbra, Portugal from 26 to 28 April 2022. The main theme of the congress was postmedieval ceramics in Europe. Roko Surić was one of 74 participants with the lecture "Exposing Dumpsites from the Depths" in which he presented the sites of modern ballast piles from the Croatian undersea. The congress was a place for the exchange of new knowledge and ideas about postmedieval ceramics from various parts of Europe, and the Portuguese colleagues made sure that, in addition to the theoretical lectures, the participants also experienced the practical part in which they had the opportunity to examine numerous types of Portuguese postmedieval ceramics in the depot of the interpretation center Santa Clara-a-Velha in Coimbra.

1. Preparing a presentation for Museum Night 2022 / Priprema prezentacije za Noć muzeja u 2022. godini (Photo: L. Bratović)

17. Noć muzeja u Hrvatskoj

MCPA Zadar u suradnji s Muzejom Grada Rovinja-Rovigno – Museo della Città di Rovinj-Rovigno sudjelovao je u Noći muzeja održanoj 28. siječnja 2022. g. Tema sedamnaeste po redu hrvatske manifestacije bila je *Muzeji između stvarnog i digitalnog*. Muzej Grada Rovinja predstavio je izložbu pod nazivom *Baril/Bareîl – Koljevka slanih sardona/Culla dei sardoni sotto sale*. Radi izrade prezentacije djelatnici MCPA Zadar snimili su nekoliko kadrova provedenog konzervatorsko-restauratorskog postupka na bačvama, uz kratak opis radova. Zbog ograničenog broja posjetitelja Muzeja grada Rovinja uzrokovane pandemijom koronavirusa, restaurirane drvene bačve i projekcija predstavljeni su ispred samog Muzeja, a široj javnosti na službenoj stranici i Facebook društvenoj mreži Muzeja. Povodom održavanja manifestacije Noći muzeja 2022 MCPA Zadar pripremio je inovativnu virtualnu izložbu fotografija s podvodnih istraživanja pod nazivom *Rasvijetljene tajne iz dubine*.

Kongres o novovjekovnoj keramici u Europi

Međunarodni kongres *Europa Postmediaevalis 2022* održan je u gradu Coimbra u Portugalu od 26. do 28 travnja 2022. g. Glavna tema kongresa bila je

2. Lecture of Roko Surić in Coimbra / Predavanje Roka Surića u Coimbri (Photo: Europa Postmediaevalis 2022)

Fourth meeting of the Coordination Committee for the Protection of Underwater Cultural Heritage on the *Skerki Banks* site and the thirteenth STAB meeting

The 4th meeting of the Coordination Committee for the Protection of Underwater Cultural Heritage on the *Skerki Bank* site was held in Gammarth, Tunisia from 5 to 6 May 2022 as a continuation of a multilateral underwater archaeological mission under the framework of UNESCO. The 13th meeting of the Scientific and Technical Advisory Body to the Convention on the Protection of the Underwater Cultural Heritage (STAB) was held on 7 May 2022. Meetings were organized by the Ministry of Cultural Affairs of Tunisia, in partnership with the Secretariat of UNESCO. Nominated by the Croatian Ministry of Culture and Media ICUA's Director Mladen Pešić, PhD participated in the session as the representative in the Coordination Committee.

3. Skerki Bank, 4th meeting of the Coordination Committee, Tunisia / Skerki Bank, 4. sastanak Koordinacijskog odbora, Tunis (Photo: UNESCO)

Workshop on Mobilizing Civil Society and the Scientific Community for the Cultural Heritage of the Oceans and UN-SDG 14

UNESCO and Akdeniz University organized a workshop on Mobilizing Civil Society and the Scientific Community for the Cultural Heritage of the Oceans and UN-SDG 14 from 21 to 24 May 2022 in Kemer-Antalya, Turkey. A two-day workshop brought together UNESCO, ICUCH, UNITWIN, CMAS, Ocean Decade and accredited NGOs to discuss underwater culture heritage. As a part of this workshop the 11th UNITWIN network meeting was organized as well.

novovjekovna keramika u Europi. Roko Surić bio je jedan od 74 sudionika kongresa s predavanjem pod nazivom ,,Razotkrivanje odlagališta iz dubina'' u kojem je predstavio nalazišta novovjekovnih balastnih hrpa iz hrvatskog podmorja. Kongres je bio mjesto razmjene novih saznanja i ideja o novovjekovnoj keramici iz raznih dijelova Europe, a portugalski kolege pobrinuli su se da sudionici osim teorijskih predavanja dožive i praktični dio u kojem su imali priliku pregledati brojne tipove portugalske novovjekovne keramike u depou interpretacijskog centra Santa Clara-a-Velha u Coimbri.

Četvrti sastanak Koordinacijskog odbora za zaštitu podvodne kulturne baštine nalazišta *Skerki Bank* i trinaesti sastanak STAB-a

Četvrti sastanak Koordinacijskog odbora za zaštitu podvodne kulturne baštine nalazišta *Skerki Bank-a* održan je od 5. do 6. svibnja 2022. g. u Gammarthu, Tunisu, kao nastavak multilateralne podvodne arheološke misije u okviru UNESCO-a. Trinaesti sastanak Znanstvenog i tehničkog savjetodavnog tijela 2001. Konvencije (STAB) održan je dana 7. svibnja 2022. g. Sastanci su pripremljeni u organizaciji Ministarstva kulture Tunisa i u partnerstvu s Tajništvom UNESCO-a. Na sastanku je sudjelovao ravnatelj MCPA Zadar dr. sc. Mladen Pešić, imenovan od strane Ministarstva kulture i medija kao hrvatski predstavnik u Koordinacijskom odboru.

Radionica o mobilizaciji civilnog društva i znanstvene zajednice za kulturnu baštinu oceana i UN-SDG 14

UNESCO i Sveučilište Akdeniz organizirali su radionicu o mobiliziranju civilnog društva i znanstvene zajednice za kulturnu baštinu oceana i UN-SDG 14 od 21. do 24. svibnja 2022. g. u Kemer-Antalya, Turska. Dvodnevna radionica okupila je UNESCO, ICUCH, UNITWIN, CMAS, Ocean Decade i akreditirane nevladine organizacije kako bi razgovarali o podvodnoj kulturnoj baštini. U sklopu ove radionice organiziran je i jedanaesti sastanak UNITWIN mreže za podvodnu arheologiju.

Godišnji kongres podvodnih arheologa DEGUWA održan u Puli

Od 16. do 22. svibnja 2022. g. u Puli je održano je 27. izdanje međunarodnog kongresa podvodne arheologije u organizaciji njemačkog društva DEGUWA te u suradnji s Arheološkim muzejom Istra (DEGUWA ,,U Posjedonovom carstvu''). Ovogodišnja tema kongresa ,,Pomorski

5.UNESCO workshop Kemer-Antalya, Turkey / UNESCO radionica Kemer-Antalya, Turska (Photo: UNESCO)

DEGUWA - annual underwater archaeology meeting held in Pula

The 27th annual meeting organised by the German association DEGUWA and in cooperation with the Archaeological Museum in Istria was held in Pula from 16 – 22 May 2022 (DEGUWA e.V. on Underwater Archaeology IN POSEIDONS' REALM XXVII). This year's theme of the congress "Maritime Landscapes" included coastal and underwater sites. Among the representatives from ten countries were ICUA's archaeologists with lectures: Luka Bekić, PhD, *The beginning of research of the post medieval shipwreck near cape Franina, Pula*, Roko Surić *"Exposing Dumpsites from the Depths"* and Maja Kaleb "*Saint Peter shipwreck"*. The underwater archaeologist Maja Kaleb, together with Vesna Zmaić from Croatian Conservation Institute, presented a poster.

IKUWA 7 - International Congress for Underwater Archaeology

The 7th international congress for underwater archaeology IKUWA 7 was staged in Helsinki, Finland from 6 to 9 June 2022 under the theme "Delivering the Deep". During the Congress, over 100 scientific and technical krajolici" uključivala je obalne i podvodne lokalitete. Među predstavnicima iz deset zemalja predavanja su održali arheolozi MCPA Zadar: dr. sc. Luka Bekić ,,Početak istraživanja novovjekovnog brodoloma kod rta Franina, Pula'', Roko Surić ,,Otkrivanje odlagališta iz dubina'' i Maja Kaleb ,,Brodolom sv. Petar''. Podvodna arheologinja Maja Kaleb predstavila je poster zajedno s Vesnom Zmaić iz Hrvatskog restauratorskog zavoda.

6. 27th annual meeting DEGUWA, Pula, Croatia / 27. međunarodni kongres DEGUWA, Pula, Hrvatska (Photo: M.Kaleb)

IKUWA 7 – Međunarodni kongres o podvodnoj arheologiji

Sedmi međunarodni kongres za podvodnu arheologiju IKUWA 7 održan je u Helsinkiju, Finska od 6. do 9. lipnja 2022. pod temom Delivering the Deep. Tijekom održavanja kongresa organizirano je preko 100 znanstvenih i tehničkih izlaganja na 24 teme vezane uz pomorsku arheologiju i podvodnu kulturnu baštinu. Kao predstavnice MCPA Zadar sudjelovale su s predavanjima Anita Jelić (Odjel za konzervaciju i restauraciju) i Maja Kaleb (Odjel za edukaciju i dokumentaciju) te s posterom Zdenka Vrgoč i Martina Ćurković Madiraca (Odjel za konzervaciju i restauraciju). UNESCO je organizirao okrugli stol s nacionalnim i regionalnim dionicima i stručnjacima na temu ,,Najvažniji izazovi u očuvanju ili promicanju podvodne kulturne baštine" na kojem se kao jedna od predavačica priključila podvodna arheologinja Maja Kaleb. Kongresu IKUWA7 prisustvovalo je više od 200 sudionika, a sljedeći će se održati u Ostendeu, Belgija u listopadu 2024. godine.

Radni posjet istraživanjima u jezeru Lednica u Poljskoj

U sklopu ovogodišnjeg posjeta Poljskoj djelatnici MCPA Zadar sudjelovali su na istraživanjima u podmorju jezera Lednica pored otoka Ostrów Lednicki od 8. do 10. srpnja 2022. g. Istraživanje provodi Odjel za podvodnu arheologiju Sveučilišta Nikola Kopernik u Toruńu u

7. ICUA Zadar representatives Maja Kaleb and Anita Jelić / MCPA Zadar predstavnice Maja Kaleb i Anita Jelić (Photo: ICUA Zadar)

presentations were organized on 24 themes relating to maritime archaeology and underwater cultural heritage. The ICUA's staff members Anita Jelić (Conservation and Restoration Department) and Maja Kaleb (Education and Documentation Department) participated with lectures and Zdenka Vrgoč and Martina Ćurković Madiraca (Conservation and Restoration Department) with poster. UNESCO organized a round table with national and regional stakeholders and experts on the theme "Most important challenges for the preservation or promotion of Underwater Cultural Heritage", during which as one of the speaker was an underwater archaeologist Maja Kaleb. The IKUWA7 Congress was attended by over 200 participants and the next is scheduled to take place in Ostend, Belgium, in October 2024.

Working visit to research in Lake Lednica in Poland

NICOLAUS COPERNICUS UNIVERSITY IN TORUŃ

As part of this year's visit to Poland, the employees of ICUA Zadar participated in the seabed research of Lake Lednica next to the island of Ostrów Lednicki from 8 to 10 July 2022. The research was carried out by the Department of Underwater Archaeology at Nicolaus Copernicus University in Toruń, in cooperation with the Museum of the First Piasts in Lednica, and was led by Andrzej Pydyn, PhD, with whom the Centre often and gladly cooperates. In Lake Lednica a diving took place at the position of the probe where the wooden pylons of the former wooden bridge were discovered, and at the position of the probe next to the island of Ostrów Lednicki itself. This working visit was also an opportunity for a tour of the new building of the Museum of the First Piasts which is still under construction.

8. Diver next to the remains of wooden pylons at the bottom of Lake Lednica / Ronilac pored ostataka drvenih pilona na dnu jezera Lednica (Foto: R. Surić)

suradnji s Muzejem Prvih Piasta na Lednici, a voditelj istraživanja je dr. sc. Andrzej Pydyn s kojim Centar često i rado surađuje. U jezeru Lednica ronilo se na položaju sonde u kojoj su otkriveni drveni piloni nekadašnjeg drvenog mosta te na položaju sonde uz sam otok *Ostrów Lednicki*. Radni posjet Poljskoj bila je prilika i za obilazak nove zgrade Muzeja Prvih Piasta koja je još uvjek u izgradnji.

Prva znanstvena misija na Skerki Bank-u

Ravnatelj MCPA Zadar dr.sc. Mladen Pešić i arheolog Roko Surić sudjelovali su na prvoj znanstvenoj misiji nalazišta *Skerki Bank* od 22. kolovoza do 6. rujna 2022. g. Arheološka misija pod pokroviteljstvom UNESCO-a provela je 14-dnevno istraživanje na francuskom istraživačkom brodu *Alfred Merlin* u međunarodnim vodama. To je najveća i najambicioznija međunarodna misija ikada provedena pod okriljem UNESCO-a za zaštitu podvodne kulturne baštine. Nakon što je Italija 2018. godine obavijestila Tajništvo UNESCO-a o otkriću nekoliko nalazišta podvodne kulturne baštine na *Skerki Bank* lokalitetu, pokrenut je međunarodni projekt u okviru 2001. Konvencije u kojem sudjeluje osam mediteranskih

9. French scientific vessel Alfred Merlin / Francuski istraživački brod Alfred Merlin (Photo: UNESCO)

First UNESCO scientific mission at Skerki Bank

ICUA Zadar Director Mladen Pešić, PhD and an archaeologist Roko Surić participated at the 1st scientific mission at *Skerki Bank* site from 21 August to 6 September 2022. The archaeological mission under the auspices of UNESCO conducted its 14-day exploration aboard the French scientific vessel *Alfred Merlin* in international waters. It is the largest and most ambitious international mission ever conducted under the aegis of UNESCO to protect underwater cultural heritage. After Italy notified UNESCO's secretariat in 2018 of the discovery of several sites comprising underwater cultural heritage on the *Skerki Bank*, the international project was launched in the framework of the 2001 Convention involving eight Mediterranean countries (Algeria, Egypt, Spain, France, Italy, Morocco, Tunisia and Croatia). During 2020 and 2021 several meetings of the coordination Committeee were held.

Official visit of the UNESCO representative to ICUA Zadar

On 26 September 2022, Ms Chihiro Nishikawa, Program Specialist in the Secretariat of the Convention on the Protection of Underwater Cultural Heritage, held a public lecture entitled *Public access to underwater cultural heritage & UNESCO Best Practices* at the Centre's lecture hall. The presentation was included in Ms Nishikawa programme of ICUA's official visit as part of which she participated in the international underwater course - Introduction to Foreshore and Underwater Archaeology and NAS Part I.

ICUA's status as a UNESCO category 2 centre renewed

Following the positive ICUA's evaluation undertaken in 2021 which specifically reviewed whether the Centre makes important contributions to the strategic goals of UNESCO and whether the activities pursued in the Centre are in conformity with the agreement, the UNESCO Executive Board renewed the ICUA's status of the category 2 centre on its 215th session held on 14 October 2022 and confirmed entering into a bipartite Agreement for next eight years. Furthermore, UNESCO and ICUA Zadar will sign a Memorandum of understanding regarding the renewal of ICUA Zadar as a category 2 centre under the auspices of UNESCO.

zemalja (Alžir, Egipat, Španjolska, Francuska, Italija, Maroko, Tunis i Hrvatska). Tijekom 2020. i 2021. godine održano je nekoliko sastanaka Koordinacijskog odbora.

Službeni posjet predstavnice UNESCO-a MCPA Zadar

Gđa. Chihiro Nishikawa, programska stručnjakinja u Tajništvu Konvencije o zaštiti podvodne kulturne baštine održala je javno predavanje pod nazivom ,,Javni pristup podvodnoj kulturnoj baštini & UNESCO-ve najbolje prakse'' dana 26. rujna 2022. g. u učionici Centra. Predavanje je dio službenog posjeta gđe. Nishikawe MCPA-u, a u sklopu kojeg je sudjelovala na međunarodnom tečaju podvodne arheologije – Početni tečaj podvodne arheologije i NAS I.

▶ 10. Chihiro Nishikawa public lecture in ICUA Zadar / Javno predavanje Chihiro Nishikawa u MCPA Zadar (Photo: D.Kurtov)

Obnovljen status MCPA Zadar kao UNESCO-vog centra 2. kategorije

Nakon pozitivne evaluacije rada MCPA Zadar provedene u 2021. godine, koja je posebno razmatrala doprinos Centra strateškim ciljevima UNESCO-a i da li su aktivnosti koje se provode u skladu s ugovorom, Izvršni odbor UNESCO-a obnovio je status MCPA Zadar kao centra 2. kategorije na svojoj 215. sjednici održanoj dana 14. listopada 2022. g. te potvrdio sklapanje dvostranog Ugovora za naredno osmogodišnje razdoblje. Nadalje, UNESCO i MCPA Zadar potpisat će Memorandum o razumijevanju u vezi s nastavkom djelovanja MCPA Zadar kao centra 2. kategorije pod pokroviteljstvom UNESCO-a.

Znanstveni skup HAD-a, Zadar, Hrvatska

Znanstveni skup pod nazivom ,,Od Kornata do Velebita - Arheologija sjeverne Dalmacije i Like'' održan je u

Scientific conference of the Croatian Archaeological Society, Zadar, Croatia

The scientific conference entitled “From Kornati to Velebit - Archaeology of Northern Dalmatia and Lika” was held in Zadar from 10 to 14 October 2022. The annual conference was participated by the ICUA’s representatives Mladen Pešić, PhD and Luka Bekić, PhD with lecture while the conservators Antonija Jozić, Martina Ćurković Madiraca i Zdenka Vrgoč took part with the poster. The Conference was organized by the Archaeological Museum of Zadar, Croatian Archaeological Society, Department of Archaeology of the University of Zadar and Museum of Ancient Glass to honor of marking the 190th anniversary of the founding of the Zadar Archaeological Museum.

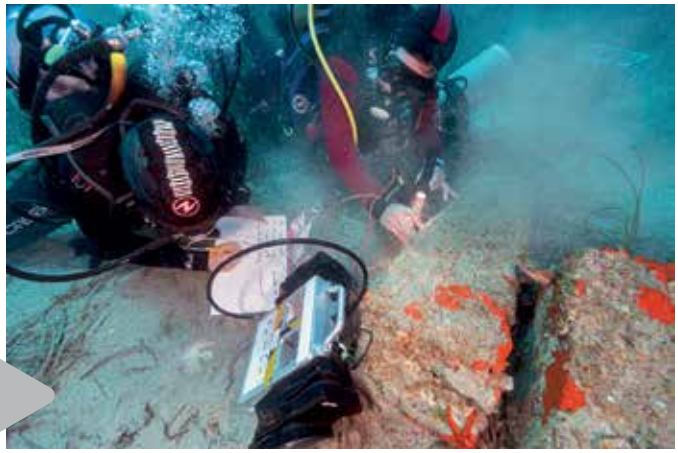
Inter-institutional research program on Letavica site

Underwater archaeologist Roko Surić as the ICUA Zadar representative participated in the inter-institutional research program of the ancient shipwreck located near Cape Letavica close by the place Šimuni on the island of Pag on 11 November 2022. The team of researchers (Croatian Conservation Institute, University of Zadar, Archaeological Museum of Zadar and ICUA Zadar) conducted daily research, and this year archaeological probes were investigated on two sides of the site.

Cooperation related to the pilot project of the application of potential measurements in underwater archaeological research

ICUA conservator Zdenka Vrgoč participated in the pilot project “Application and potential of non-destructive methods of underwater archaeological research on the example of the modern shipwreck Otočac on Korčula”. The project was carried out from 12 to 18 June 2022 in

14. Pilot project on the island of Korčula / Pilot-projekt na otoku Korčuli (Photo: A.Kiss)



Zadru od 10. do 14. listopada 2022. g. Kao predstavnici MCPA Zadar na skupu su sudjelovali s predavanjima dr.sc. Mladen Pešić i dr.sc. Luka Bekić, te posterom i konzervatorice Antonija Jozić, Martina Ćurković Madiraca i Zdenka Vrgoč. Znanstveni skup organizirali su Arheološki muzej Zadar, Hrvatsko arheološko društvo, Odjel za arheologiju Sveučilišta u Zadru i Muzej antičkog stakla u čast obilježavanja 190. obljetnice osnutka Arheološkog muzeja Zadar.

Međuinstitucionalni program istraživanja lokaliteta Letavica

Podvodni arheolog Roko Surić, kao predstavnik MCPA Zadar, sudjelovao je u međuinstitucionalnom programu istraživanja antičkog brodoloma pored rta Letavica blizu mjesta Šimuni na otoku Pagu dana 11. studenog 2022. g. Istraživački tim (Hrvatski restauratorski zavod, Sveučilište u Zadru, Arheološki muzej Zadar i MCPA Zadar) vršio je svakodnevna ispitivanja, a ove su godine istražene arheološke sonde na dvije strane nalazišta.

13. Research of the Letavica site / Istraživanje nalazišta Letavica (Photo: R. Surić)

Suradnja na pilot-projektu primjene mjerenja potencijala na podvodnih arheološkim istraživanjima

Konzervatorica MCPA Zdenka Vrgoč sudjelovala je u pilot-projektu ,,Primjena i potencijali nedestruktivnih metoda podvodnih arheoloških istraživanja na primjeru novovjekovnog brodoloma Otočac na Korčuli”. Projekt se provodio od 12. do 18. lipnja 2022. godine u organizaciji Sveučilišta u Zadru pod vodstvom dr.sc. Katarine Batur, a financiran je sredstvima Sveučilišta u Zadru, NGO *Women Divers Hall of Fame* i Hrvatske elektroprivrede (HEP). Na projektu je uz podvodna arheološka istraživanja održan i trening za konzervatore i arheologe kojeg je vodio dr. Ian MacLeod, a tijekom kojeg su sudionici imali priliku usvojiti teorijska i praktična znanja o *in situ* mjerenjima potencijala različitih arheoloških materijala na nalazištu i procjeni korozijskog stanja brodoloma.

the organization of the University of Zadar, under the leadership of Katarina Batur, PhD and was financed by the University of Zadar, *Women Divers Hall of Fame* non-profit organisation and the Croatian energy company Hrvatska elektroprivreda (HEP). In addition to underwater archaeological research, the project also included training for conservators and archaeologists led by Dr. Ian MacLeod, during which participants had the opportunity to acquire theoretical and practical knowledge about *in situ* measurements of the potential of various archaeological materials at the site and assessment of the corrosion state of the shipwreck.

Croatian and Italian ministers of culture signed the Executive programme of cooperation in the fields of culture and education between the Government of the Republic of Croatia and the Government of the Italian Republic for the years 2022-2026

The Croatian Minister of culture and media Nina Obuljen Koržinek, PhD and the Italian Minister of culture Dario Franceschini signed the Executive programme of cooperation in the fields of culture and education between the Government of the Republic of Croatia and the Government of the Italian Republic for the period 2022-2026, in Venice on 23 April 2022. In the framework of the Executive Programme, the Parties shall, within their financial capacities, encourage the mutual exchange of conservation experts and underwater archaeologists of ICUA Zadar and the Central Institute for Restoration and the National Administration for Underwater Cultural Heritage of the Ministry of Cultural Heritage, Activities and Tourism. The cooperation will be realized on the basis of individual agreements between cultural institutions.

Underwater survey of the river Cetina and Ruda

On the initiative of the employees of Trilj Regional Museum, and in cooperation with the Museum of Cetina Region - Sinj and the Alka of the Sinj Museum, the employees of the ICUA Zadar conducted an underwater archaeological inspection and documentation, as well as an aerial survey of the Cetina and Ruda riverbeds on October 25 and 26, 2023. The purpose of the survey was to map and locate potential archaeological sites. The underwater survey concentrated on four positions where archaeological finds dated were discovered to the Bronze Age and Antiquity. Remains of wooden elements - pylons and ceramic finds that could be connected to the pile dwelling settlements in the area of Ruda and Cetina were also recorded at all inspected locations. Various metal and glass finds from the Antiquity were also collected, testifying to an intense life during different time periods.

Ministri kulture Hrvatske i Italije potpisali su Izvršni program suradnje u području kulture i obrazovanja između Vlade Republike Hrvatske i Vlade Talijanske Republike za godine 2022. – 2026.

Ministrica kulture i medija dr. sc. Nina Obuljen Koržinek i talijanski ministar kulture Dario Franceschini potpisali su Izvršni program suradnje u području kulture i obrazovanja između Vlade Republike Hrvatske i Vlade Talijanske Republike za godine 2022. – 2026., u Veneciji dana 23. travnja 2022. g. U okviru Izvršnog programa stranke će, sukladno svojim financijskim mogućnostima, poticati međusobnu razmjenu stručnjaka konzervatora i podvodnih arheologa MCPA Zadar te Središnjeg instituta za restauraciju i Nacionalne uprave za podvodnu kulturnu baštinu Ministarstva kulturne baštine, aktivnosti i turizma. Suradnja će se realizirati na temelju pojedinačnih sporazuma između kulturnih institucija.

15. Croatian Minister of culture and media Nina Obuljen Koržinek and Italian minister of culture Dario Franceschini / Hrvatska ministrica kulture i medija Nina Obuljen Koržinek i talijanski ministar Dario Francheschini (Photo: Ministry of Culture and Media)

Podvodni pregled rijeke Cetine i Rude

Ministrica kulture i medija dr. sc. Nina Obuljen Koržinek i talijanski ministar kulture Dario Franceschini potpisali su Izvršni program suradnje u području kulture i obrazovanja između Vlade Republike Hrvatske i Vlade Talijanske Republike za godine 2022. – 2026., u Veneciji dana 23. travnja 2022. g. U okviru Izvršnog programa stranke će, sukladno svojim financijskim mogućnostima, poticati međusobnu razmjenu stručnjaka konzervatora i podvodnih arheologa MCPA Zadar te Središnjeg instituta za restauraciju i Nacionalne uprave za podvodnu kulturnu baštinu Ministarstva kulturne baštine, aktivnosti i turizma. Suradnja će se realizirati na temelju pojedinačnih sporazuma između kulturnih institucija.

HOW I WOUND UP ON ŠOLTA

DOPALA ME ŠOLTA

Maja Kaleb mkaleb@icua.hr

During a chance meeting with a former professor from the University of Zadar I was asked how things were going and whether I had opted to undertake a solo project. “I have,” I replied proudly, “haven’t you heard? We investigated a wooden ship’s structure at Potkamenica.” To which the professor replied, “So … you wound up on Šolta!” With a confused look I ventured to ask “what does that mean?” The professor smiled and said, “once upon a time mothers would admonish their daughters by saying ‘God willing, you’ll wind up on Šolta,’ meaning that they could look forward to a life of hardship and struggle.” And indeed, along with the Hvar, Korčula and Vis islands, I had, in fact, wound up on Šolta. I wasn’t the one who discovered the wreck, but I knew of it and could not sleep knowing decay would soon be the end of it. The year after our investigation of the wreck (which was neither hard nor a struggle) we were back at the site to check on its condition. We met Marko, a professional diver with an enviable career and an underwater archaeology enthusiast, who had informed us of his recent discovery of an interesting wreck. So, there was no turning back; I would wind up on Šolta.

This year archaeologists of the International Centre for Underwater Archaeology in Zadar were on the island of Šolta from 7 to 14 September. Part of our work in the field included an advanced underwater archaeology

1. The position of the Duboka cove in relation to the whole of Šolta island / Položaj uvale Duboka u odnosu na cijeli otok Šoltu (http://preglednik.arkod.hr/, 25.11.2022.)

2. Archaeologists at the wreck site in the Duboka cove / Arheolozi na poziciji brodoloma u uvali Duboka (Photo: R. Surić)

Jednom sam slučajno srela svog nekadašnjeg profesora sa Sveučilišta u Zadru. Uz pitanje kako sam, pitao me jesam li odlučila imati samostalan projekt. „Jesam!“ Kažem ponosno. „Zar niste čuli? Istražili smo drvenu brodsku konstrukciju u Potkamenici.“ Na to će mi on „znači… dopala te Šolta!“. Zbunjeno ga gledam no ipak sramežljivo pitam „a što to znači?“. Profesor se nasmije pa mi kaže „nekad su majke svoje kćeri klele izrekom *Dabogda te Šolta dopala* što je značilo da ih čeka težak i mukotrpan život.“ Pored Hvara, Korčule i Visa, mene je zaista dopala Šolta. Nisam ja našla brodolom, ali sam znala za njega i nisam mogla spavati znajući da propada. Kad smo ga istražili (nije bilo ni teško ni mukotrpno!), vratili smo se iduće godine provjeriti u kojem je stanju. Tada smo upoznali Marka, profesionalnog ronioca sa zavidnom karijerom i zaljubljenika u podvodnu arheologiju koji nam je rekao da je nedavno otkrio teret jednog zanimljivog brodoloma. I sad – nema natrag. Dopala me Šolta.

Ovogodišnji boravak arheologa Međunarodnog centra za podvodnu arheologiju u Zadru na otoku Šolti, od 7. do 14. rujna, obilježio je napredni tečaj podvodne arheologije u sklopu kojeg je započeto istraživanje brodoloma u uvali Duboka (Sl.1,2). Brodolom je otkrio profesionalni ronilac Marko Hranilović iz Rogača, a potvrdili su ga arheolozi MCPA 2021. godine podvodnim arheološkim pregledom.[1] Istraživačku ekipu činili su djelatnici MCPA; Maja Kaleb, Luka Bekić, Roko Surić i Zdenka Vrgoč, zatim Pavle Dugonjić iz Hrvatskog restauratorskog zavoda, Marko Hranilović te polaznici naprednog tečaja podvodne arheologije; Alexandra Tyas iz Velike Britanije, Eleonore Besnard iz Francuske, Mihai Duca iz Rumunjske i Jade Reis Monteiro iz Brazila.

Polaznici dvotjednog tečaja, koji se sastoji od teorijskog i praktičnog dijela, dobili su priliku usvojiti metodološka načela struke u teoriji, a onda i u praksi sudjelovanjem na arheološkom istraživanju od faze planiranja i pripreme do iskopavanja i dokumentiranja pod morem te s morskog

course that included the launch of investigative work at a wreck site in the Duboka cove (Fig. 1,2). The wreck site was discovered by professional diver Marko Hranilović, a resident of the island settlement of Rogač. The find was confirmed in 2021 by an underwater archaeological survey performed by archaeologists with ICUA.1[1] The investigative team included ICUA specialists Maja Kaleb, Luka Bekić, Roko Surić and Zdenka Vrgoč, Pavle Dugonjić of the Croatian Conservation Institute, Marko Hranilović, and participants of the advanced underwater archaeology course Alexandra Tyas from the United Kingdom, Eleonore Besnard from France, Mihai Duca from Romania, and Jade Reis Monteiro from Brazil.

The participants of the two-week course comprised of theoretical and practical components had the opportunity to learn the methodological principles of the profession in theory, and then to participate hands-on in an archaeological investigation from the planning and preparation phase to underwater excavation and documentation and to recover a small part of a forgotten history from the seabed (Fig. 3). Along with the underwater archaeology aspect, the participants were also provided a demonstration of a Kirby Morgan dive helmet and a lecture on diving safety when working underwater (Fig. 7).

The cargo of the wreck at the Duboka cove site is concentrated in two areas. One part of the cargo has fused into a conglomerate in the south end of the cove, while the other part is scattered in a field of Mediterranean tapeweed (Fig. 4). The site lies on inclined terrain at depths ranging from five to 15 metres. The conglomerate, which has a length of about four and a width of about three metres, consists of numerous sherds of transport and cooking ware. The precise number of individual artefacts is unknown. The conglomerate was photographed for the production of a 3D model (Fig. 5), and has been linked to the other part of the site with a series of fixed points. Two trenches were investigated (A and B) in the Mediterranean tapeweed field. Although only eight square metres have been excavated, the dig yielded the finds of a significant quantity of artefacts. Only diagnostic sherds were collected (vessels with preserved rim, handle, or handle and base), while belly sherds and all other non-diagnostic sherds were deposited at the edge of the trench so that they could be restored to their original position upon the completion of excavation work. (Fig. 8) This method was applied in light of the very abundant quantity of potsherds: recovering them all would entail conservation, restoration treatment and analysis at significant cost without a justifiable expectation of results. Each diagnostic artefact was assigned a special find designation with its position in a trench indicated on the site plan.

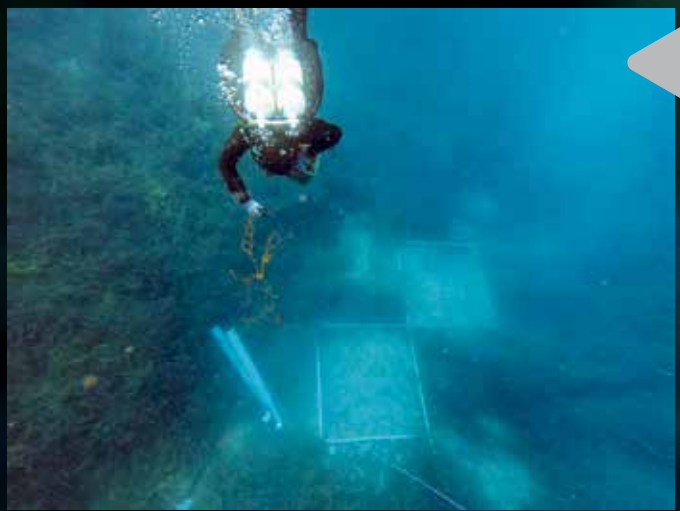
1 Kaleb 2021, 33–34.

3. Pre-dive planning / Dogovor prije zarona (Photo: P. Dugonjić)

dna izroniti djelić izgubljene povijesti (Sl. 3). Osim same podvodne arheologije, polaznicima je demonstrirana Kirby Morgan ronilačka kaciga te održano predavanje o sigurnosti ronjenja prilikom obavljanja podvodnih radova (Sl. 7).

Teret brodoloma u uvali Duboka koncentriran je na dva dijela. Jedan dio tereta slijepljen je u konglomerat na južnom dijelu uvale dok je drugi dio razasut među poljem posidonije (Sl. 4). Nalazište se nalazi na padini, na dubini od pet do 15 metara. Konglomerat, duljine oko četiri i širine oko tri metra, sastoji se od mnogobrojnih ulomaka transportnog i kuhinjskog posuđa, ali točan broj predmeta nije poznat. Konglomerat je dokumentiran fotografiranjem u svrhu izrade 3D modela (Sl. 5), a serijom fiksnih točaka doveden je u odnos s drugim dijelom nalazišta. Istražene su dvije sonde, A i B, postavljene među posidonijom. Iako je iskopana površina od tek 8m², pronađena je velika količina arheoloških nalaza. Prikupljali su se samo dijagnostički ulomci (posuđe koje ima sačuvan obod, ručku ili ručke te dno), dok su ulomci trbuha posuda i svi ostali nedijagnostički ulomci deponirani uz rub sonde kako bi se po završetku iskopavanja vratili na prvobitni položaj (Sl. 8). Ova metoda je primijenjena zbog izrazito obilne količine keramičkih ulomaka koja bi u slučaju vađenja zahtijevala konzervatorsko-restauratorsku te znanstvenu obradu bez opravdanih i očekivanih rezultata uz velike

4. An archaeologist dives at the site / Arheolog zaranja na nalazište (Photo: R. Surić)



5. Documenting the conglomerate / Dokumentiranje konglomerata (Photo: R. Surić)

Trenches A and B were fully investigated. Given that they are set very close one to the other, their stratigraphy is almost identical, with the notable difference that the bedrock has a slightly higher elevation, i.e., is shallower, in Trench B, which is nearer the shore and thereby of lesser depth. In all, the investigative work yielded the recovery of 150 special finds, each assigned a numerical designator and for which the precise position in Trenches A and B was recorded. These are largely parts of transport ware such as amphorae, and cooking ware such as pots, mortars, jugs, and bowls. Along with the ceramic ware, we also documented one metal find.

Amphorae are the most frequent find from the cargo. The best preserved are diagnostic parts such as necks with handles, and bases; certain forms can be identified on the basis of these sherds. The bulk of the cargo consists of amphorae of the *Agora P-14078* and/or *Agora P-29339* form, prototypes of *Late Roman 1 (LRA 1) amphorae* (Fig. 6). One of the key characteristics of these forms is a rim folded outwards and downwards with a small undercut. The handles are notable for the deep groove to the outside, while the body of the amphora is thin-walled. The most significant difference between the two types is the base. As indicated in the literature[2] *Agora P-14078* amphorae have a hollow conical spike, while

2 Opait 2010, 1018, Fig. 4 a & b, Fig. 5 a & b.

financijske troškove. Svakom dijagnostičkom predmetu dodijeljena je oznaka posebnog nalaza te mu je ucrtana pozicija unutar sonde.

Sonde A i B istražene su u cijelosti.

6.
Prototype of the LRA1 amphora / Prototip LRA1 amfore (Photo: E. Besnard)

S obzirom da se nalaze jako blizu jedna druge, stratigrafski su gotovo identične, osim što je kamen živac nešto viši, odnosno plići u sondi B, zbog toga što je sonda B postavljena bliže obali, a samim time

7. Hranilović demonstrates a Kirby Morgan dive helmet / Hranilović demonstrira Kirby Morgan kacigu (Photo: P. Dugonjić)

8. Tyas upon the find of a bronze handle / Tyas po pronalasku brončane ručke (Photo: M. Kaleb)

the *Agora P-29339* form has a rounded base without a spike. Both of these base variants were found in the Duboka cove. One of the amphora types is the unusual and rare *San Lorenzo 7 form* (Fig. 9).[3] This form is characterised by a massive rim from which the handles extend. The neck of this amphora is ribbed, while the handles are contoured with a central rib to the outside, although there are specimens with a groove. This year we identified another amphora type, currently not typologically defined but referred to in the literature as an *"Aegean area amphora"* (Fig. 10).[4] This type is characterised by small handles on a broad neck and a cylindrical body terminating in a mushroom-shaped spike. These amphorae are of eastern Mediterranean origin.

9.
San Lorenzo 7 amphora / San Lorenzo 7 amfora (Photo: M. Duca)

i pliće. Ukupno je tijekom istraživanja pronađeno 150 posebnih nalaza kojima je dodijeljena numerička oznaka i kojima je uzeta točna pozicija unutar sondi A i B. Riječ je uglavnom o dijelovima transportnog posuđa kao što su amfore te kuhinjskog posuđa kao što su lonci, tarionici, vrčevi i zdjele. Osim keramičkih, dokumentiran je i jedan metalni nalaz.

Najzastupljeniji teret ovog brodoloma su amfore. Najbolje su sačuvani dijagnostički dijelovi kao što su grla s ručkama i dna i na temelju takvih ulomaka moguće je determinirati određene tipove. Najveći udio u teretu su amfore tipa *Agora P-14078 i/ili Agora P-29339*, prototipovi *Late Roman 1 amfore (LRA 1) (Sl. 6).* Jedna od važnih karakteristika ovih tipova je obod izrađen presavijanjem vrha oboda prema van i dolje s malim podrezom. Na ručkama se ističe duboki žlijeb na vanjskoj strani, a tijelo amfore je tanjih stjenki. Najveća razlika među

3 Arthur & Oren 1998, 200, Fig. 5. 4,5, 203.
4 Arthur & Oren 1998, 200, Fig. 5. 8, 201.

Found along with the amphorae were sherds of a variety of cooking and table ware. In the category of cooking ware, we see pots with horizontal handles and mortars of multiple sizes; these do not constitute a significant percentage of the total number of ceramic finds. Notable among the tableware are small jugs with handles running directly off a broad rim to the transition to the broadest part of the pyriform body. Along with the ceramic finds we also recovered one metal find, a bronze cauldron or pot handle.

10.
Aegean area amphora / Amfora s Egejskog područja (Photo: J. Monteiro)

The artefacts recovered from the cargo of the ship that sank in the Duboka cove are rare types in the eastern Adriatic, and are generally not frequent in the western Mediterranean, which opens the question of dating. Tentatively, and based on analogies in the eastern Mediterranean, we date the wreck at the Duboka cove site to the second half of the 3rd and the first half of the 4th c.

Archaeological sites are not (or should not be) places where one comes, takes what they need, and leaves. I see them more as places we ought to come back to. In my case, that's how I wound up on Šolta. We'll carry on in the coming year.

Bibliography / Literatura

- Arthur & Oren, 1998. - The North Sinai survey and the evidence of transport amphorae for Roman and Byzantine trading patterns, Journal of Roman Archaeology, Volume 11, 193–212.
- Kaleb, M., 2021. - Back to Šolta / Povratak na Šoltu, Submerged Heritage 11 / Potopljena Baština 11, Zadar, 31–35.
- Opait, A. 2010. - On the origin of Carthage LR amphora 1, BAR S2185 (II) LRCW3 Late Roman Coarse Wares, Cooking Wares and Amphorae in the Mediterranean: Archaeology and archaeometry. Comparison between western and eastern Mediterranean, Volume II, 1015–1022.

dva navedena tipa je dno. Amfore tipa *Agora P-14078*, sudeći po literaturi[2], imaju konični, šuplji šiljak, a one tipa *Agora P-29339* imaju zaobljeno dno bez šiljka. U uvali Duboka pronađene su obje navedene varijante dna. Jedan od tipova amfora je neobičan i rijedak tip *San Lorenzo 7* (Sl. 7). [3] Odlika ovog tipa je masivan obod s kojeg se nastavljaju ručke. Vrat amfore je narebren, a ručke su profilirane središnjim rebrom s vanjske strane iako ima i primjeraka sa žlijebom. Ove godine je utvrđeno da postoji još jedan tip amfore kojem za sada nije definiran tip, ali u literaturi se naziva „amfora s Egejskog područja" (Sl. 10).[4] Odlike ovog tipa su male ručkice na širokom vratu te cilindrično tijelo koje završava gljivastim šiljkom. Porijeklo ovih amfora je područje istočnog Mediterana.

Osim amfora, pronađeni su i ulomci raznovrsnog kuhinjskog i stolnog posuđa. U kategoriji kuhinjskog posuđa imamo lonce s horizontalnom ručkom i tarionike u nekoliko dimenzija, iako brojčano ne čine veliki postotak od ukupnog broja keramičkih nalaza. Od stolnog posuđa, ističu se vrčevi manjih dimenzija kojima ručka počinje na samom proširenom obodu, a završava na prijelazu u najširi dio piriformnog tijela. Pored keramičkih nalaza, pronađen je i jedan metalni nalaz - brončana ručka kotla ili lonca.

S obzirom da pronađeni nalazi tereta broda koji je potonuo u uvali Duboka predstavljaju rijetke tipove za područje istočnog Jadrana, a ni općenito nisu učestali na zapadnom Mediteranu, ostalo je definirati pitanje datacije. Za sada, temeljem analogija na istočnom Mediteranu, brodolom u uvali Duboka datira se u drugu polovicu 3. i u prvu polovicu 4. stoljeća.

Arheološka nalazišta nisu (ili barem ne bi trebala biti) mjesta gdje dođeš, uzmeš što ti treba i odeš. Ja ih nekako više doživljavam kao mjesta na koja se moram vratiti. Dopalo me tako. Nastavak dogodine.

A REMARKABLE DISCOVERY AT THE CAPE FRANINA WRECK SITE

IZVANREDNO OTKRIĆE PRI ISTRAŽIVANJU BRODOLOMA KOD RTA FRANINA

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Rt (cape) Franina, a small headland, lies at the east end of the Kamenjak peninsula, to the south of Pula. Iron cannons and anchors lie on the seabed just off the cape. Among divers the presence of a wreck here had been known of for some time, but it had long been out of the focus of archaeological interest. Over the decades, unfortunately, the site was often visited by irresponsible and even ill-intentioned divers, who looted the artefacts on the seabed. Spurred by this threat the archaeologists of the International Centre for Underwater Archaeology in Zadar organised a multi-year project aimed at investigating this fascinating site. The investigative effort is supported by funding provided through the Croatian Ministry of Culture and Media, with ICUA Zadar staffers joined by specialists from the Romano-Germanic Commission of the German Archaeological Institute (RGK-DAI) and the Croatian Conservation Institute (HRZ). Luka Bekić PhD served as the campaign principal investigator, joined by deputy investigator Maja Kaleb. Archaeologists and restoration specialists participating in this year's work were Roko Surić, Zdenka Vrgoč, Ivan Vidulić (ICUA Zadar), Roman Scholz (RGK-DAI), Igor Mihajlović (HRZ) and Barbora Machova (IA CAS Praha). They were assisted by technical divers Danijel Petrinjak, Dragan Ždralović, Mark Jurić (Croatian Ministry of the Interior), Borna Krstulović, Sandra Kamerla and Robert Lehotkai. Logistical support for the investigative work was provided by the Diving Indie centre in Banjole.

Systematic archaeological investigation of the post-medieval wreck at the Franina cape was launched in 2020. That year saw the production of the initial photogrammetric plan of the site and the excavation of a number of micro trenches that helped us assess the future scope of the investigation. The following year saw the start of the first major investigative campaign, which saw the complete investigation of the first two by two metre trench. 2021 also saw the production of a new plan of the site and the initiation of an experimental

Na istočnom dijelu poluotoka Kamenjaka, južno od grada Pule, nalazi se omanji rt Franina. Nedaleko od njega, na morskom dnu, nalaze se željezni topovi i sidra. O postojanju brodoloma na tom mjestu u ronilačkim krugovima se znalo dugo vrijeme, ali lokacija nije pobuđivala poseban interes arheologa. Na žalost, tijekom tih desetljeća, nalazište su često pohodili neodgovorni, pa čak i zlonamjerni ronioci, koji su pljačkali predmete s morskog dna. Upravo iz razloga ugroženosti, arheolozi Međunarodnog centra za podvodnu arheologiju u Zadru, organizirali su višegodišnji projekt istraživanja ovog zanimljivog nalazišta. Istraživanja se provode uz financijsku potporu Ministarstva kulture i medija RH, a osim djelatnika MCPA Zadar, u njemu sudjeluju i stručnjaci Njemačkog arheološkog instituta (RGK - DAI) i Hrvatskog restauratorskog zavoda. Voditelj istraživanja je doc.dr.sc. Luka Bekić, a zamjenica voditelja je Maja Kaleb. U istraživanju su ove godine sudjelovali stručnjaci arheolozi i restauratori Roko Surić, Zdenka Vrgoč, Ivan Vidulić (MCPA Zadar), Roman Scholz (RGK-DAI), Igor Mihajlović (HRZ) i Barbora Machova (IA CAS). Njima su pomagali vanjski suradnici, tehnički ronioci Danijel Petrinjak, Dragan Ždralović, Mark Jurić (MUP RH), Borna Krstulović, Sandra Kamerla i Robert Lehotkai. Logističku potporu istraživanju pružao je ronilački centar Indie u Banjolama.

Sustavna arheološka istraživanja novovjekovnog brodoloma kod rta Franina započela su 2020. g. Te godine izrađen je početni fotogrametrijski nacrt nalazišta te iskopano nekoliko mikro sondi, koje su služile za procjenu opsega istraživanja u budućnosti. Naredne godine, započeta je prva veća istraživačka kampanja, prilikom koje je u cijelosti istražena prva sonda, dimenzija 2 x 2 metra. Ujedno je 2021. g. izrađen novi nacrt nalazišta te je započet eksperimentalni projekt čišćenja i konzerviranja željeznog topa na dnu mora. Rezultati su bili ohrabrujući, pa se za narednu godinu isplanirala opsežnija kampanja.

1. The underwater team working concurrently on multiple tasks / Podvodna ekipa radi paralelno na više zadataka (Photo: R. Surić)

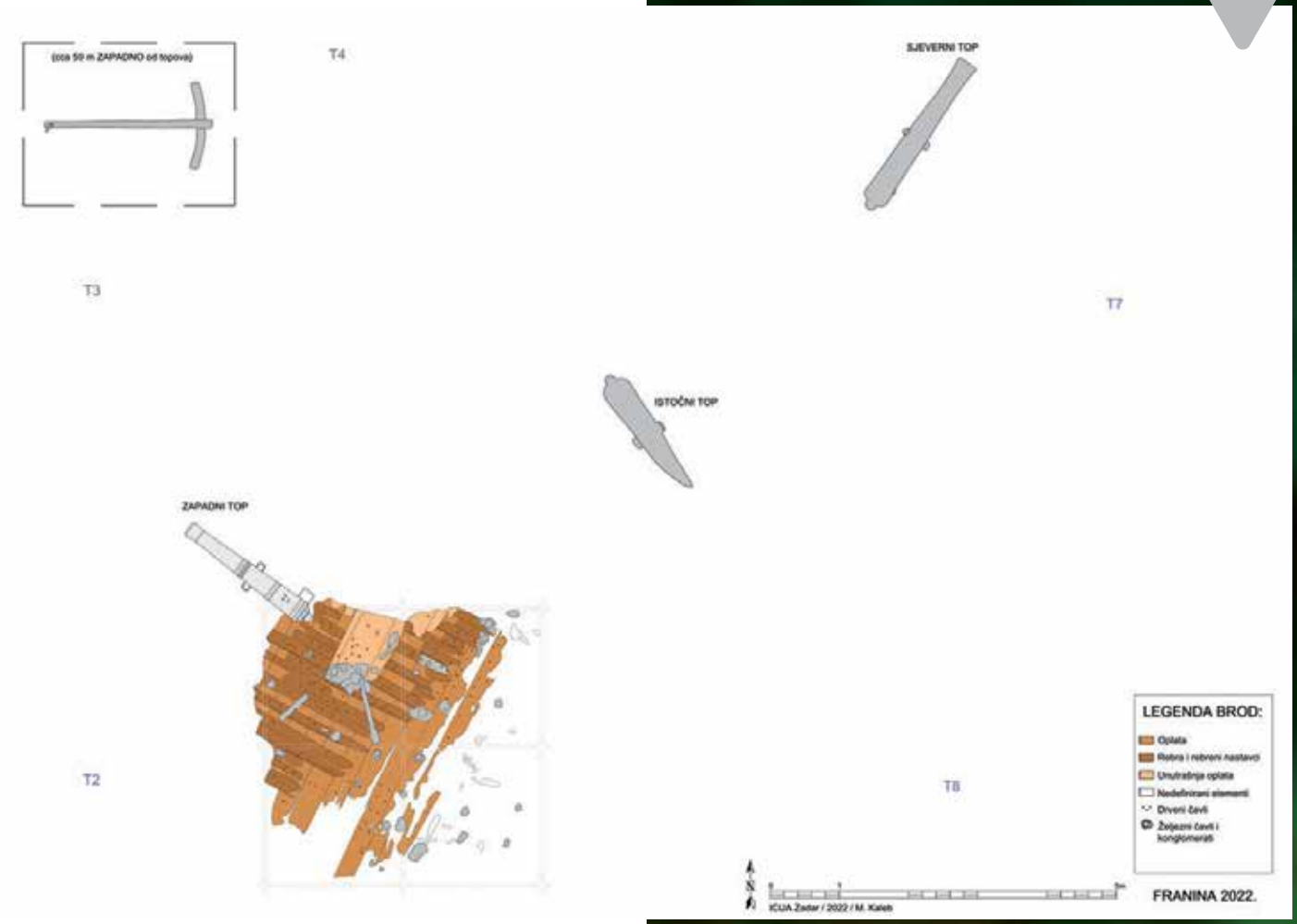
project aimed at the cleaning and conservation of the iron cannons on the seabed. The results were encouraging, and a more comprehensive campaign was planned for the following year.

Following monitoring of the site's condition and of the existing coordinate system this year saw the installation of an aluminium grid as a frame for future trenches in the area designated for investigation. Excavation work at the site was assisted by a water pump-powered dredge, with nets installed at the end of the suction tube to catch sediment. All special finds observed in a trench were individually documented, determining their measured location, and photographed. Sediment was continually extracted to the surface where it was sifted in order to identify very small finds like glass beads. Three new trenches were excavated in the course of the 2022 campaign, each covering an area of four square metres. They were set adjacent to Trench A, excavated in 2021. Trench B was set to the east, and Trenches C and D to the north of the earlier trench.

The wooden structure of the wrecked ship was investigated last year in most of Trench A and more of

Ove godine se nakon kontrole zatečenog stanja i postojećeg koordinatnog sustava, prvo položila aluminijska mreža kao okvir za buduće sonde na mjesto određeno za istraživanje. Iskopavanje nalazišta se obavlja uz pomoć vodene pumpe i "mamut sisaljki", tako da se na kraju usisne cijevi montiraju mrežice koje zadržavaju sediment. Svi posebni nalazi koji se zamijete u sondi se pojedinačno dokumentiraju, izmjerom i fotografiranjem. Sediment se kontinuirano izvlači na površinu gdje se

2. Marking part of the discovered structure of the wrecked vessel / Dio otkrivene brodske konstrukcije prilikom označavanja (Photo: R. Surić)



3. The ship's structure in relation to the entire site / Brodska konstrukcija u odnosu na cijelo nalazište (By: M. Kaleb)

the wreck was discovered in the three new trenches. The wooden structure runs on to the north, towards the western cannon, and is no longer present as one moves eastward. It is currently unclear why this interruption in the body of the wreck is present here; whether the wooden structure has fully deteriorated from this point on, or if it continues further to the east (Fig. 3). Where it has survived, the wooden structure is in good condition. Outer planking and frames have survived, as have parts of the inner planking in places. It is not yet clear which part of the wreck is being investigated, nor has its alignment been established.

The level of preservation of the ship's wooden structure is greater in Trenches A and D than it is in Trenches B and C (Fig. 2). Given that only a small part of the ship's structure has been thus far investigated what we can say for now is that only a part of the wrecked ship has been uncovered, comprising several structural elements: the outer planking, frames, and the inner planking. Joint elements of metal (iron) and treenails have been found. In all 11 strakes, the continuous lines of planks that form the outer planking of the ship, were identified in the course of 2021 and 2022. We also identified 27 futtocks. The futtocks are joined to the outer planking with treenails having a diameter of 2.7 cm. Remains of the

prosijava, u potrazi za sitnijim nalazima poput staklenih perlica. Tijekom kampanje 2022. g. iskopane su čak tri nove sonde, svaka dimenzije 4 m2. One su postavljene tik uz sondu A iz 2021. g. Sonda B postavljena je istočno, a sonde C i D sjeverno od stare sonde.

S obzirom da je prošle godine u većem dijelu sonde A bila istražena drvena konstrukcija broda, njen nastavak pronađen je i u tri nove. Drvena konstrukcija nastavlja se u pravcu sjevera, prema "zapadnom" topu, dok nestaje prema istoku. Za sad nije jasno iz kojeg razloga je ovdje prekid, da li je drvena konstrukcija propala ili je odvojena i nastavlja se negdje dalje prema istoku. Na mjestima gdje je očuvana, drvena konstrukcija je u dobrom stanju. Sačuvana je vanjska oplata i rebra, a ponegdje i unutarnja oplata. Za sada nije jasno koji dio broda se istražuje, a nepoznata mu je i orijentacija.

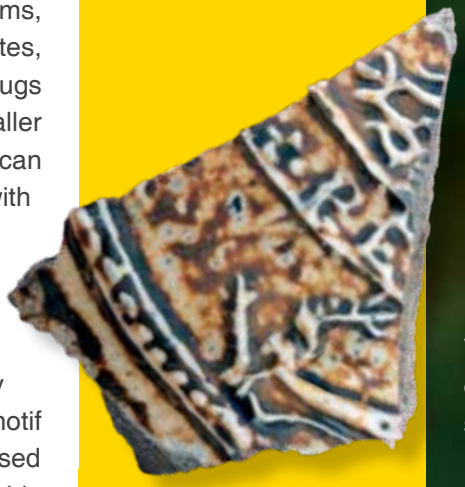
U sondama A i D brodska konstrukcija je sačuvana znatno bolje nego u sondama B i C. S obzirom da je istražen tek manji segment brodske konstrukcije, za sada se može reći da je otkriven tek dio broda koji se sastoji od nekoliko konstruktivnih dijelova: vanjske oplate, rebrenica i unutrašnje oplate. Pronađeni su i elementi za spajanje, metalni (željezni) i drveni čavli. Tijekom 2021. i 2022. g. ukupno je definirano 11 vojeva – redova platica koji čine vanjsku oplatu broda. Definirano je i ukupno 27 rebrenih nastavaka. Rebreni nastavci su za vanjsku

ship's inner planking have also survived. Although only a small segment has been investigated thus far, we have identified a number of planks having this function. Along with the mentioned treenails, totalling 162, we also see conglomerates of iron nails.

This year we identified 97 special finds, all individually documented. In general, there is an observable increase in the number of ceramic finds at the remains of the wrecked ship near the Franina cape. Most of the sherds are fragmentary, with only one find of a complete bowl. All of the finds can be characterised as tableware, with most exhibiting traces of painted, engraved or relief decoration. When comparing the forms of the finds we see that the represented vessels include open forms, such as bowls, small bowls, and plates, while restricted vessels, such as jugs and pots, are represented by a smaller number of sherds. Most of the finds can be characterised as engobed ware with painted and engraved decoration executed with a sharp pointed tool. In three cases we see sherds glazed only on the interior surface; this glaze features painted and finely engraved decoration. A common motif is a characteristic edge band comprised of rectangular fields, where blank fields alternate with fields filled out with a stylised scale pattern (Fig. 4). These sherds are from Renaissance period engraved ware, with this decoration appearing on vessels coming out of the workshops of the Veneto and Emilia Romagna regions in the first half of the 16th c.

One of the recovered sherds is from a white maiolica plate. It is characterised by a thick white tin glaze on both the interior and exterior surface. The only surviving decoration is a letter S, flanked to both sides by a star or stylised crown. The decoration is painted in blue. Based on similar examples we can justifiably posit that the letter S refers to the title *sanctus* before the name to which the title is attached. Vessels with similar motifs were popular from the last third of the 16th through to the 18th c., and were manufactured at pottery workshops in Rome.

4.
Engraved pottery with the robbiana pattern / Gravirana keramika s motivom "A robbiana" (Photo: M. Kaleb)



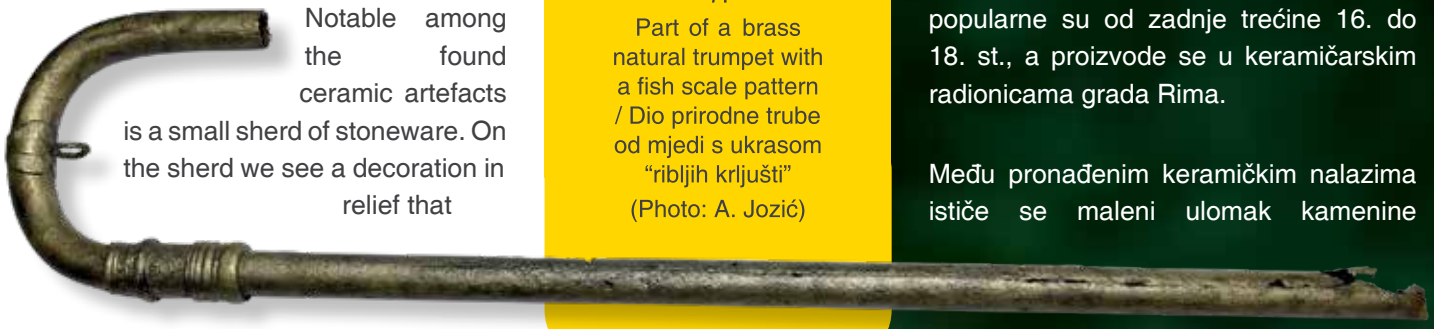
5.
A potsherd with an inscription, perhaps part of a bartmannkrug type jug / Ulomak keramike s natpisom, možda djelić vrča tipa "Bartmannkrug" (Photo: L. Bekić)

oplatu povezani drvenim čavlima promjera 2.7 cm. Sačuvani su i ostaci gornje, odnosno unutrašnje oplate broda. Iako je za sada istražen tek manji segment, otkriveno je nekoliko dasaka u navedenoj funkciji. Osim navedenih drvenih čavala, njih ukupno 162, vidljivi su i konglomerati željeznih čavala.

Ove godine je dokumentirano čak 97 posebnih nalaza, koji su dokumentirani zasebno. Općenito je zamjetan porast broja keramičkih nalaza na ostacima brodoloma pored rta Franina. Za većinu ulomaka se može reći da su fragmentirani, a samo jedan nalaz predstavlja cjelovito sačuvanu zdjelu. Svi keramički nalazi mogu se okarakterizirati kao stolno posuđe, od čega većina na sebi sadrži tragove ukrašavanja izvedenog oslikavanjem, graviranjem ili reljefom. Uspoređujući forme otkrivenih nalaza dolazi se do zaključka kako su zastupljeniji nalazi posuda otvorenih formi, poput zdjela, zdjelica i tanjura, a posude zatvorenih formi, poput vrčeva i lonaca, zastupljene su manjim brojem ulomaka.

Većina otkrivenih nalaza može se okarakterizirati kao engobirano posuđe s oslikanim i graviranim ukrasom izvedenim oštrim šiljkom. U tri slučaja radi se o ulomcima koji su glazirani samo s unutrašnje strane, a ta glazura ukrašena je oslikavanjem i graviranim ukrasom s finim urezom. Motiv koji im je zajednički je karakteristična rubna traka koju čine pravokutna polja u kojima se prazna polja izmjenjuju s onima ispunjenim stiliziranim ljuskama. Ovi ulomci pripadaju tzv. renesansnoj graviranoj keramici, a takav ukras javlja se na posuđu iz radionica s venetskog područja i iz Emilije Romagne iz prve polovice 16. st.

Pronađen je jedan ulomak bijelog majoličkog tanjura. Karakterizira ga gusta kositrena bijela glazura s obje strane. Jedini sačuvani ukras je slovo „S" uz koje se sa svake strane nalazi zvjezdica ili stilizirana kruna. Ukras je izveden oslikavanjem plavom bojom. Na osnovu sličnih primjera može se s opravdano pretpostaviti da se slovo „S" odnosi na titulu svetosti (*sanctus*) prije imena na koje se titula odnosi. Posude sa sličnim motivom



7.
Part of a brass natural trumpet with a fish scale pattern / Dio prirodne trube od mjedi s ukrasom "ribljih krljušti"
(Photo: A. Jozić)

Notable among the found ceramic artefacts is a small sherd of stoneware. On the sherd we see a decoration in relief that most likely depicts a combination of vegetal and figural motifs (the hand of a figure is visible). Due to the small size of the surviving surface, however, we cannot confidently determine the type of depicted image (Fig. 5). Notable along with this image is part of an inscription of which we can make out only two letters (P and E). Due to the small dimensions and the insufficient details, we cannot for now draw any precise conclusions with regard to a date for the vessel this sherd is from.

Of particular interest is a group of potsherds characterised by fragmentation and a high degree of wear at the edges. The presence of sherds of this kind at the site of the remains of a post-medieval wreck has to date been recorded at two other sites in the waters of the Istrian peninsula; the Veruda and Uljeva C wrecks. At these two sites their presence has been attributed to the remnant ballast the wrecked ships carried, which came to the seabed with the sinking vessel. Highly fragmented potsherds in combination with construction debris and other municipal waste were loaded on ships to stabilise them when making journeys unladen, i.e., without cargo. Upon arrival at the port of destination, prior to the loading of heavy cargo, this ballast was jettisoned. The find of sherds of this kind may indicate that the ship was weighed down with some quantity of refuse ballast at the time it sank, but it is also possible that—as is the case with the Veruda wreck—that these are the remnants of previous ballast loads. The rectangular bricks that are scattered across the site may also have served as ballast. Some of the bricks bear traces of plaster, ruling out the possibility that they were part of the ship's (commercial) cargo.

A very frequent find made in the course of the excavation work are fragments of opaque red glass. Judging by the quantity this was evidently part of the ship's cargo. Some of the fragments indicate that the vessels in question were various small ring-footed bowls. Although we do know of a number of similar small bowls from other contemporaneous sites, it remains unclear where they were manufactured. Glass beads are the most frequent find made when sifting sediment. They appear in about ten groups, from the smallest to mid-sized specimens. The greatest quantity are small and black, with a flattened cross-section, followed by mid-sized dark blue beads

popularne su od zadnje trećine 16. do 18. st., a proizvode se u keramičarskim radionicama grada Rima.

Među pronađenim keramičkim nalazima ističe se maleni ulomak kamenine ("Stoneware"). Na ulomku se raspoznaje reljefni ukras koji najvjerojatnije prikazuje kombinaciju vegetabilnog i figuralnog motiva (vidljiva je ruka figure), no zbog male sačuvane površine ne može se ustanoviti o kojem prikazu se radi. Uz taj prikaz ističe se i dio natpisa od kojeg su prepoznatljiva samo dva slova („P" i „E"). Zbog malih dimenzija i nedovoljne količine detalja teško se u ovom trenutku može iznijeti preciznija datacija posude kojem je ulomak pripadao.

Posebno je zanimljiva skupina keramičkih ulomaka koju odlikuje fragmentiranost i izražena izlizanost rubova. Prisutnost takvih ulomaka na ostacima brodoloma iz novovjekovnog perioda do sad je zabilježena u još dva slučaja u Istri, na brodolomu Veruda i brodolomu Uljeva C. Na ta dva lokaliteta njihova prisutnost pripisana je ostacima nekadašnjeg brodskog balasta koji je potonućem broda dospio na morsko dno. Usitnjeni ulomci keramike u kombinaciji s građevinskim otpadom te ostalim komunalnim otpadom krcani su u brodove radi stabilizacije broda prilikom besteretnih putovanja. Dolaskom na destinaciju, prije ukrcaja teškog tereta, takav balast bacao se u more. Nalazi ovakvih ulomaka mogu indicirati da se u trenutku potonuća brod otežao određenom količinom otpadnog balasta, ali moguće je da se, kao u slučaju brodoloma Veruda, radi o zaostacima nekadašnjeg balasta. U funkciji balasta mogle su biti i pravokutne opeke koje se rasprostiru duž nalazišta. Pojedine opeke na sebi sadrže tragove žbuke, što isključuje mogućnost da su opeke bile dio brodskog (trgovačkog) tereta.

Tijekom iskopavanja vrlo čest nalaz su ulomci neprozirnog crvenog stakla. Sudeći po količini, ovo je očito bio dio brodskog tereta. Poneki ulomci ukazuju kako su to bile različite male zdjelice, na prstenastoj nozi. Mada je poznato nekoliko sličnih zdjelica s drugih istodobnih nalazišta, za sada nije jasno gdje su se proizvodile. Najčešći nalaz prilikom prosijavanja sedimenta su staklene perlice. Od najsitnijih, do srednje velikih, pojavljuju se u desetak skupina. Najviše ima sitnih crnih, plosnatog presjeka, zatim srednje velikih, tamnoplavih sa sjajnom površinom te nešto većih, svijetloplavih, hrapave površine. Postoje i višebojne perle, posebice one crvene s bijelo plavim crtama. Ovakve perle obično se pripisuju mletačkoj proizvodnji i posebno su čest nalaz tijekom 16. st.

with a glossy surface, and by somewhat larger light blue beads with a rough surface. There are also polychrome beads, in particular red beads with white and blue lines. Beads of this kind are usually attributed to Venetian production and are a particularly frequent 16th c. find.

Among the metal finds many are conglomerates of iron corrosion products. All such conglomerates are continually recovered and later examined using radiography to ascertain the nature of the object. For the most part these are large iron nails, but there are also a number of more specific parts of the ship's fittings, including rings and pulley blocks. Notable among the lead finds are numerous pieces of shot of multiple calibres, and one weight formed as a curled lead plate. Also found was a large brass colander (Fig. 6).

6. The find of a brass colander / Mjedeno cjedilo u trenutku pronalaska (Photo: R. Surić)

The most interesting finds are numerous parts of brass trumpets. Given that many separate parts of trumpets were recovered it appears that they were transported disassembled (in parts), perhaps in wooden boxes. Given the number of identified mouthpieces there were at least ten trumpets on the ship. Recovered along with the mouthpieces were the tubes, ferrules, balls (knops), loops, and the bell (i.e., all the parts of a trumpet). Natural trumpets manufactured in the 16th or early 17th c. are very rare and are kept at a handful of museums around the world. The decoration visible on one of the trumpet parts (Fig. 7) may indicate that they were manufactured in late 16th c. Nuremberg workshops. The fish scale pattern is most reminiscent of the decorations on a trumpet of the master craftsman Schnitzer dated to 1599 and kept at a museum in Paris. Given that we know of less than ten surviving 16th c. trumpets in the world, the find of a cargo of natural trumpets at the Franina cape site is truly remarkable.

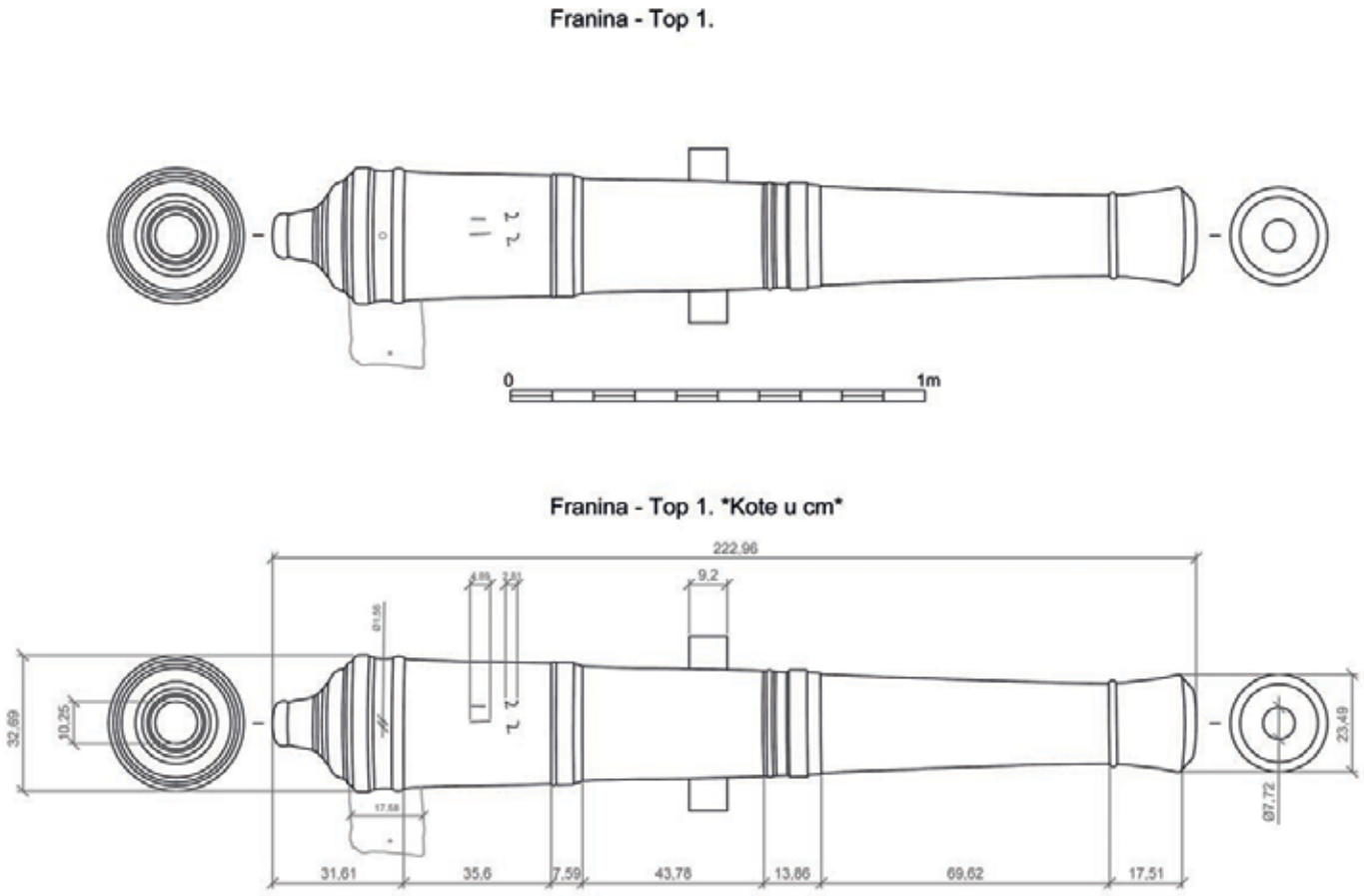
The previous year the western cannon had been cleaned of thick corrosion deposits and a sacrificial anode was

Od metalnih nalaza, velik broj pripada konglomeratima korozije željeza. Svi takvi konglomerati se kontinuirano prikupljaju, a naknadno ih se provjerava rendgenom, kako bi se ustanovilo o čemu je riječ. Uglavnom su to veliki željezni čavli, ali nekoliko komada pripada konkretnijim dijelovima brodske opreme poput alki i kolotura. Od olovnih nalaza ističu se brojne puščane kugle u više kalibara i jedan uteg izrađen od zamotane pločice olova. Pronađeno je i jedno veće mjedeno cjedilo.

8. Measuring corrosion potential with a new underwater device / Mjerenje korozijskog potencijala novim podvodnim uređajem (Photo: R. Surić)

Najzanimljiviji nalaz su brojni ulomci mjedenih truba. S obzirom da je pronađeno mnoštvo zasebnih dijelova truba, čini se da su prevožene rastavljene, možda u nekim drvenim kutijama. Sudeći po broju pisaka, na brodu je bilo najmanje deset truba. Osim pisaka, pronađene su i njihove cijevi, ojačanja, lopte, prstenje za ovjes, kao i zvona (sve dijelovi truba). Sve tzv. "prirodne trube", proizvedene u 16. st. ili početkom 17. st., vrlo su rijetke i čuvaju se u tek nekolicini muzeja na svijetu. Sudeći po ukrasu koji je vidljiv na jednom od dijelova truba može se naslutiti da su proizvedene u nirnberškim radionicama krajem 16. st. Ukras u vidu ribljih ljuski najviše nalikuje ukrasima trube majstora Schnitzera iz 1599. g. koja se čuva u muzeju u Parizu. S obzirom da je sačuvanih truba iz 16. st. poznato manje od deset na cijelom svijetu, nalaz tereta "prirodnih truba" s Franine je uistinu nešto posebno.

Prethodne godine "zapadni" top je očišćen od debelih naslaga korozije i na njega je postavljena žrtvena anoda koja ga je trebala čuvati od daljnjeg propadanja. Cinkova se anoda postavljena na top 2021. godine potrošila, što dokazuje da je zaštita djelovala, a navedeno su potvrdila i mjerenja korozijskog potencijala topa. Potencijal je mjeren uz pomoć multimetra s referentnom elektrodom od srebrovog klorida (AgCl) smještenog zajedno s pH metrom u mjernu kutiju prilagođenu podvodnoj uporabi. Na tretiranom topu s potrošenom anodom izmjeren je



▶ 9. Drawing of the western cannon with markings / Crtež "zapadnog" topa s oznakama (M. Kaleb)

installed with the aim of preserving it against further deterioration. The zinc anode installed in 2021 has been consumed, demonstrating that the protection has been effective, which was also corroborated by the measurement of the cannon's corrosion potential. The potential was measured using a multimeter with a silver chloride (AgCl) reference electrode, installed jointly with a pH meter in a measurement enclosure adapted to underwater use (Fig. 8). A potential of -0.614 volts was measured on the treated cannon with the consumed anode. This year the zinc anode was replaced with two larger aluminium anodes, each having a diameter of 80 mm and a length of 300 mm. Following the installation of the aluminium anodes the potential measured at three different points ranged from -0.760 to -0.805 volts. The measured potential demonstrates that the cathodic protection of the cannon is operating very well. Corrosion potential and pH value measurements were also taken of the other two cannons at the site (the northern and the eastern cannons). The measurements show that all three of the cannons at the Franina cape site are in an almost identical state of preservation, which significantly facilitates the cathodic protection of the remaining two cannons at the site.

Cleaning corrosion from the cannon was necessary ahead of its protection, and for the purposes of its investigation. In the course of the corrosion cleaning the

potencijal od -0.614 volti. Ove godine cinkova anoda zamijenjena je s dvije veće aluminijske anode promjera 80 mm, dužine 300 mm. Nakon postavljanja aluminijskih anoda, na tri različita mjesta na topu izmjeren je potencijal koji je iznosio između -0.760 i -0.805 volti. Izmjereni potencijali pokazuju da katodna zaštita na topu odlično djeluje. Na preostala dva topa na Franini (sjevernom i istočnom) također su izmjereni korozijski potencijali i pH vrijednost. Mjerenja su pokazala da su sva 3 topa na Franini u gotovo identičnom stanju sačuvanosti što uvelike pomaže pri planiranju katodne zaštite na preostala dva topa na Franini.

Čišćenje topa od korozije bilo je potrebno zbog provođenja njegove zaštite, ali i zbog samog istraživanja. Tek čišćenjem od korozije, top je bio uspješno proučen i dokumentiran. Za sada nije jasno u koju klasu bi spadao ovaj top. Njegova dužina je 223 cm, a prema otvoru cijevi kalibar bi bio oko 78 mm. Po obliku i značajkama topa može se zaključiti da je riječ o engleskog proizvodnji iz kraja 16. ili početka 17. st. Preko rupe za fitilj bila je priljubljena olovna ploča, koja je prilikom plovidbe služila da se fitilj ne namoči. Kada je uklonjena, iz rupe su izvučeni i dijelovi fitilja, koji će se analizirati. Svi detalji na topu su sačuvani, pa čak i plitko urezane oznake proizvođača. Na gornjem dijelu topa je vidljiva brojčana

cannon was successfully examined and documented. It is currently not evident what class of cannon this is. It has a length of 223 cm, and based on the mouth of the bore the calibre would be approximately 78 mm. Based on its form and characteristics this is likely a cannon of late 16th or early 17th c. English production. A lead plate covers the vent (touch hole); when at sea it protected the fuse against wetting. Parts of the fuse were removed upon the removal of the vent cap for analysis. All the details on the cannon have survived, including the shallow carved maker's mark. At the top of the cannon, we see a numerical mark (2 2), and below it a pair of lines (I I). It is possible that the Franina cannon was manufactured in the English workshop of John Johnson or Tomas Jones (marks I I and T I), which were active in the late 16th c. Given the shallow carving of the marks and the damage to the surface we cannot confidently assert the integrity of the marks.

The multiannual archaeological investigation of this late 16th or early 17th c. sunken commercial sailing ship at the Franina cape site continues. This year's campaign, the third such effort, broadened the area of systematic excavation. Recorded among the artefacts are numerous iron ship's fittings, lead rifle shot, glass beads and small bowls, and small and large parts of ceramic ware. A remarkable find is that of many parts of brass trumpets, pointing to yet another aspect of the ship's valuable cargo. Parts of the wooden ship's structure were identified in the new trenches in very good condition. The outer planking, frames, and parts of the inner planking have survived. The underwater cleaning and conservation of the cannons—further enhanced this year with the installation of new and larger aluminium sacrificial anodes—is proving to be a conservation project that will be consequential over the long term. In this respect this site may become a model for the *in situ* protection of underwater cultural heritage.

oznaka 2 2, a ispod nje dvije crte, I I. Moguće da je top s Franine izrađen u engleskoj radionici ili Johna Johnsona ili Tomasa Jonesa (oznake I I ili T I), koji su djelovali na kraju 16. st. S obzirom na plitko urezivanje oznaka i oštećenost površine, ne možemo biti sigurni da je to cjelovita oznaka.

Kod rta Franina nastavlja se višegodišnje arheološko istraživanje potonulog trgovačkog jedrenjaka iz kraja 16. ili početka 17. stoljeća. U ovogodišnjoj, trećoj kampanji, prošireno je područje sustavnog iskopavanja. Od pokretnih nalaza zabilježeni su mnogi željezni dijelovi opreme broda, olovne puščane kugle, staklene perlice i zdjelice, manji ili veći dijelovi keramičkih posuda. Izvanredan nalaz su brojni dijelovi mjedenih truba, koji ukazuju na još jedan segment vrijednog brodskog tereta. Drvena brodska konstrukcija pronađena je i u novim sondama i u vrlo dobrom je stanju. Sačuvana je vanjska oplata, rebra te djelomično i unutarnja oplata. Podvodno čišćenje i konzerviranje topa, koje je ove godine podignuto na novu razinu, u vidu postavljanja novih, većih aluminijskih žrtvenih anoda se pokazuje kao dalekosežni konzervatorski projekt. Na taj način, ovo nalazište moglo bi postati ogledan primjer zaštite podvodne kulturne baštine *in- situ*.

Bibliography / Literatura

- Bekić, L., 2020. - Shipwreck with cannons at Franina cape / Brodolom s topovima kod rta Franina, Submerged Heritage / Potopljena baština 10, Zadar, 25–31.
- Bekić, L., 2021. - The systematic investigation of a wreck with cannons off the Franina cape / Sustavno istraživanje brodoloma s topovima kod rta Franina, Submerged Heritage / Potopljena baština 11, Zadar, 13–19.

10. The 2022 Franina cape team, left to right: / Ekipa Franina 2022., s lijeva na desno: Mark Jurić, Dragan Ždralović, Danijel Petrinjak, Robert Lehotkai, Maja Kaleb, Andrea Battistin, Zdenka Vrgoč, Borna Krstulović, Barbora Machova, Luka Bekić, Roman Scholz, Roko Surić, Sandra Kamerla, Ivan Vidulić (Photo: A. Ribić)

NASTAVAK ISTRAŽIVANJA BRODSKE KONSTRUKCIJE U ANTIČKOJ LUCI BARBIR

CONTINUED INVESTIGATION OF A SHIP'S STRUCTURE AT THE ANTIQUITY PERIOD HARBOUR AT BARBIR

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1. Initiating the cleaning of the ship's structure / Početak čišćenje brodske konstrukcije (Photo: L. Bekić)

Underwater archaeology investigative work at the antiquity period harbour at Barbir in Sukošan in 2022 focused on the ship's structure discovered in 2021. This broadens the area under investigation around Trenches C, N and I. The two week campaign covered ten archaeological trenches with a total area of 40 square metres. The fact that the structure lies at a depth of just two metres in a cove that is currently used for anchorage—posing a potential threat that could destroy it—was a further impetus to investigate and document the wooden remains that have lain here since antiquity. Joining ICUA specialists Mladen Pešić (principal investigator), Luka Bekić, Roko Surić, Maja Kaleb, Zdenka Vrgoč and Ivan Vidulić, were Roman Scholz of the Romano-Germanic Commission of the German Archaeological Institute (RGK-DAI), assistant professor Mate Parica of the University of Zadar, archaeology students Lucija Topolko and Ivana Pavišić, and diver Goran Josifovski.

Excavation work was done by strata in the individual trenches, and found that the stratigraphy was uniform,

Podvodna arheološka istraživanja unutar antičke luke Barbir u Sukošanu tijekom 2022. godine koncentrirala su se na brodsku konstrukciju koja je otkrivena tijekom 2021. godine. Radi se o proširenju područja istraživanja koje se nalazi uokolo sondi C, N i I. Dvotjedna istraživanja su se provodila na području 10 arheoloških sondi ukupne površine od 40 m2. Činjenica da se nalazi na samo dva metra dubine u uvali koja se i danas koristi za sidrenje brodova koji potencijalno ugrožavaju i prijete njegovim uništenjem, dala nam je dodatni poticaj za istraživanjem i dokumentiranjem drvenih ostataka broda koji tu leže još od antičkih vremena. Uz djelatnike MCPA Zadar - voditelja dr. sc. Mladena Pešića, doc. dr. sc. Luku Bekića, Roka Surića, Maju Kaleb, Zdenku Vrgoč i Ivana Vidulića, na istraživanju su sudjelovali i Roman Scholz iz Rimsko – Germanske komisije Njemačkog arheološkog instituta, doc. dr. sc. Mate Parica sa Sveučilišta u Zadru, studentice arheologije Lucija Topolko i Ivana Pavišić te ronioc Goran Josifovski.

Iskopavanje se vršilo stratigrafski po pojedinim sondama te je utvrđeno da su slojevi ujednačeni, što ni ne čudi budući da je njihova sedimentacija unutar brodske konstrukcije na tako malom području bila uvjetovana istim razlozima (Sl.1). Možemo razlikovati 5 slojeva koja su definirana unutar brodske konstrukcije. Prvi je površinski sloj debljine 10-ak cm, drugi sloj sadrži mekši pijeska, veće ili manje kamenje te keramičke nalaza iz kasne antike koji većinom imaju zaobljene stijenke. Ispod njega je sloj s tvrđim pijeskom, dosta organskog materijala kao što su grančice i koštice maslina, a u velikoj količini nalaze se ljušture školjaka kamenica i periski te manja količina sitnijeg kamenja. Posljednji sloj je sloj koji sadrži manju količinu keramike i naliježe direktno na brodsku konstrukciju. Na SZ dijelu broda u području samog kraja broda zamijećen je sloj koji se sastoji isključivo od koncentriranih koštica maslina koje su se ovdje nataložile.

which is not unexpected given that sedimentation within the small area of the ship's structure occurred under the same conditions (Fig. 1). Five layers were identified within the area of the ship's structure. The first is a surface layer of about 10 cm. The second layer contains softer sand, stones of various sizes, and late antiquity period pottery, most exhibiting rounded walls. Beneath this is a layer with harder sand, a significant quantity of organic material such as olive tree branches and pits and an abundance of oyster and fan mussel shells, and a small quantity of pebbles. The final layer contains a small quantity of pottery and lies directly atop the ship's structure. To the northwest, at the very end of the ship, we observed a layer consisting entirely of a concentration of olive pits.

The surviving part of the ship has a breadth of 3.23 m, while the total length documented in 2022 was 7.32 m, which we estimate may account for about half of the ship's former length.

Among the ship's elements present in situ we see the keel (K), outer planks (P), floor timbers (FT), futtocks (FU), stringers (S; some were preliminarily identified as inner planking with the designation C), an element that may be part of the sternpost or the stem (ST/SP), tenons, treenails, and metal nails. All of the identified ship's elements were individually marked with unique identifiers based on the terms used to name them (Fig. 2,3).

The ship's keel has survived to a length of 4.37 m. It is sided eight centimetres at the broader part nearer the end of the ship, and 7.6 cm along the remainder of the ship. The top side of the keel is entirely covered by a layer of pitch to which various organic and inorganic materials have adhered (pebbles, branches, olive pits). There is an interesting concentration of olive pits observed between the end of the ship and frame FT1. Here we found a large number of olive pits in a heap mixed with small branches, sand, and the shells of bivalves and snails. Across most of the ship the upper surface of the keel runs level to the inner planking, however in the part between frames FT3 and FT4 and towards the stern or the bow it rises one centimetre above the level of the planking. Very likely this marks the beginning of the sternpost or the stem. Lying alongside the keel is a thick element that may be the vertical part of the sternpost or stem.

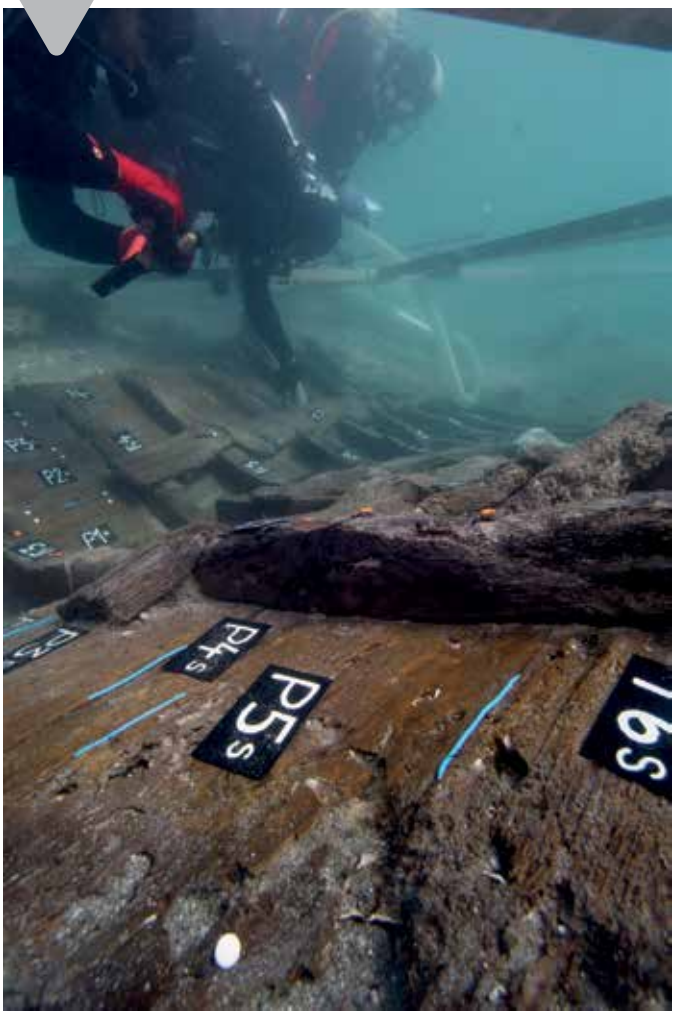
The ship's outer planking is comprised of longitudinal lines of planks (strakes). As we could not fully identify the joints of individual planks in each strake and designate them as individual elements due to the other elements of the ship that cover the planks to the inside, the strakes were assigned the working identifier P along with the strake number and the relevant compass point, starting from the keel and working towards the outer sides of the ship's structure. In the course of the investigative work,

2. Investigating the ship's structure / Tijekom istraživanja brodske konstrukcije (Photo: M. Pešić)

Brod je očuvan u širini od 3,23 m, a ukupna dokumentirana dužina tijekom 2022. godine iznosila je 7,32 m, što bi prema procjeni moglo biti oko polovice dužine broda.

Od brodskih elemenata koji se nalaze in situ mogu se prepoznati kobilica (K), vanjske platice (P), rebrenice (FT), rebreni nastavci (FU), proveze (S; pojedine su preliminarno definirane kao unutrašnja oplata s oznakom C) te jedan element koji bi mogao pripadati krmenoj ili pramčanoj statvi (ST/SP), kao i jezičci, drveni čavli i metalni čavli. Svi prepoznati brodski elementi su označeni

3. Orthophoto of the ship's structure during the investigative work / Ortofotografija brodske konstrukcije tijekom istraživanja (By: R. Surić)



4. Final cleaning and marking the elements of the ship's structure / Završno čišćenje i označavanje elemenata brodske konstrukcije (Photo: R. Surić)

we identified eleven strakes to the south side and five to the north side (Fig. 4). The wood of the planking is in a very good state of preservation, with the exception of the parts along the top edge of the wreck which have been exposed to marine organism activity, with these parts being bored through with large channels, rendering the edges quite fragile. The planks are joined using the mortise and tenon method. This technique involves cutting a cavity into each plank that receives a tenon (TE), which joins adjacent planks, while from the top side a hole is drilled through the plank and the tenon into which a treenail is inserted (PEG) to join the plank and the tenon. These treenails (pegs) have a width of about seven millimetres.

The floor timbers and futtocks lie directly atop the outer planking. The floor timbers (FT) are elements that lie directly on the ship's keel, while the futtocks (FU) are elements that run off the floor timbers and were assigned an identifier based on the relevant compass point. In all we identified twelve floor timbers. Their lengths, thicknesses, and levels of preservation differ. Their sided dimensions range from four to eight centimetres, and their moulded dimension from seven to nine centimetres. At their lowest point, above the keel, some of the floor

posebnim oznakama sukladno njihovom nazivu (Sl. 2,3).

Brodska kobilica je sačuvana u dužini od 4,37 m. Njena širina iznosi 8 cm na širem dijelu bliže kraju broda i 7,6 cm u ostatku broda. Kobilica je s gornje strane u potpunosti prekrivena slojem smole u koju je zalijepljen različiti organski i anorganski materijal, kao što su kamenčići, grančice i koštice masline. Zanimljiva je koncentracija koštica maslina koju nalazimo između završnog dijela brod i rebra FT1. Tu je nađena veća količina koštica nakupljenih na jednu hrpu i pomiješana sa sitnim grančicama, pijeskom te ljušturama školjaka i puževa. Gornja površina kobilice se u većem dijelu broda nalazi u ravnini unutrašnje oplate, no na dijelu između rebara FT3 i FT4 te prema krmenom ili provenom dijelu ona je za centimetar uzdignuta iznad razine oplate. Vrlo vjerojatno se radi o početku nastavka kobilice koji predstavlja statvu. Uz kobilicu leži jedan deblji element koji bi mogao predstavljati vertikalni dio krmene ili pramčane statve.

Vanjsku oplatu broda čine platice složene u uzdužnim redovima (vojevima). Budući da radi ostalih elemenata broda koji pokrivaju platice s unutrašnje strane nije bilo u potpunosti moguće definirati spojeve pojedinih platica u svakom voju i označiti ih kao pojedinačne elemente, vojevi su radno dobili oznaku P uz koju se nalazi broj voja i oznaka strane svijeta na kojoj se nalaze počevši od kobilice prema vanjskim stranama brodske konstrukcije. Ukupno je tijekom istraživanja zabilježeno 11 vojeva sa južne strane i 5 vojeva sa sjeverne strane. Drvo oplate je u vrlo dobrom stanju očuvanosti, osim na dijelovima uz sam gornji rub broda koji je bio izložen djelovanju morskih organizama te su ti dijelovi izbušeni većim kanalićima, što same rubove čini dosta krhkim. Platice su međusobno spajane metodom utora i jezičaca. Radi se o spajanju na način da je u svakoj platici oblikovan utor u koji je umetnut jezičac (oznaka TE) koji spaja svaku platicu s nasuprotnom platicom, a s gornje strane je kroz platicu i pripadajući jezičac ubušena rupa kroz koju prolazi drveni čavao (oznaka PEG) i povezuje platicu i jezičac. Širina drvenih čavala iznosi oko 7 mm.

Direktno na vanjskoj oplati leže rebrenice i rebreni nastavci. Rebrenice (oznaka FT) su elementi koji leže direktno na kobilici broda, a rebreni nastavci (FU) su elementi koji se nastavljaju na rebrenice i označeni su prema stranama svijeta oznakama. Ukupno je otkriveno 12 rebrenica. Njihova duljina, debljina i očuvanost se razlikuje od jednog do drugog. Širina im se kreće od 4 do 8 cm, a njihova visina između 7 i 9 cm. Pojedine rebrenice imaju na najnižem dijelu, nad kobilicom, pravokutni utor koji je služio za slobodnu cirkulaciju vode koja se nalazila u donjem djelu broda. Rebreni nastavci podijeljeni su prema stranama svijeta i dobili su brojčane oznake prema rebrenicama na koje se nastavljaju. Na južnoj je strani definirano 17 rebrenih nastavaka, dok je na sjevernoj

5. View of the 3D model of the ship's structure / Pogled na 3D model brodske konstrukcije (By: R. Surić)

timbers exhibit a rectangular limber hole which allowed for the free circulation of water accumulating in the lower part of the ship. The futtocks were divided in terms of compass point and were assigned numerical identifiers based on the floor timber from which they run off. We identified 17 futtocks to the south side, and six futtocks to the north. The floor timbers and futtocks are connected to the ship's planking with longer treenails (designated TN).

strani definirano 6 rebrenih nastavaka. Rebrenice i rebreni nastavci su s oplatom broda povezana nešto dužim drvenim čavlima (oznaka TN).

Osim vanjske oplate, s gornje strane rebara brod je imao elemente koji su prilikom prošlogodišnjih istraživanja definirani kao unutarnja oplata broda. Novija analiza daje nam za pretpostavku da je moguće da se ne radi o unutrašnjoj oplati već o provezama, točnije uzdužnim elementima koji povezuju rebra i stvaraju dodatnu

6. Aerial image of the trenches during the investigative work / Zračni snimak sondi tijekom istraživanja (Photo: R. Surić)

Besides the outer planking, to the top side of the frames the ship had elements identified in the course of last year's investigative work as the inner planking. Our latest analysis, however, indicates that it is possible that this is not the inner planking, but rather the stringers, i.e., the longitudinal members that connect the frames and provide additional strength to the ship. These elements were also assigned identifiers based on their orientation and their position relative to the keel as the starting point. On this ship we see two different stringer elements, and they have thus been assigned differing identifiers. The stringers were attached to the frames with iron nails, some of which have survived, although in a highly corroded state, while on some elements where the inner planking is now absent, they are identifiable only by the dark grey holes in the frames.

7.
Base sherd from a North African stamp impressed vessel / Ulomak dna sjevernoafričke pečatirane posude (Photo: M. Kaleb)

Throughout the entire course of the investigation the ship's structure was documented, and the course of cleaning was monitored on a daily basis (Fig. 6). Several orthophoto models were produced with the aid of a great number of photographs, as was a 3D model of the investigated ship's structure (Fig. 5).

8.
Corinthian relief ware sherd / Ulomak korintske reljefne keramike (Photo: M. Kaleb)

A small number of artefacts were discovered in the course of this year's investigation; about fifty of these were assigned unique identifiers in light of their characteristics and were collected for further analysis. The greatest number of finds are sherds from amphorae and from coarse and fine ware, followed by bronze and iron nails (likely from the ship's structure), fragments of lead, and a large quantity of organic material. Along with the significant number of olive pits, walnut husks, and small branches, the most interesting find is that of a thin and long leather artefact, found lying directly on the ship's structure, for which we have yet to identify a purpose. There are several very interesting ceramic finds, in particular a significant number of sherds from cooking and sigillata ware originating from the north of Africa. One of these bears a stamp impressed decoration on the interior surface of the base. The decoration has only survived in part; we do, however, see a sequence comprised of a palmette and a square mesh pattern (Fig. 7). This decoration appears on ware dated to the period following the mid-4th and

čvrstoću broda. I ovi elementi su dobili oznake prema njihovoj orijentaciji na osnovu njihovog položaja počevši od kobilice. Na brodu možemo razlikovati dva različita elementa proveza te su stoga i dobili drugačije oznake. Proveze su za rebra bile pričvršćene željeznim čavlima, pojedini od njih su očuvani, ali su vrlo korodirani, dok se na nekim dijelovima gdje nedostaje unutarnja oplata prepoznaju tek po tamnosivim rupama na rebrima.

Za vrijeme čitavog vremena istraživanja brodska se konstrukcija dokumentirala i na dnevnoj bazi se pratilo stanje čišćenja (Sl. 6). Uz pomoć velikog broja fotografija izrađeno je nekoliko ortofoto modela, a u konačnici je izrađen i 3D model brodske konstrukcije koja je istraživana (Sl. 5).

Tijekom ovogodišnjih istraživanja otkrivena je manja količina pokretnih arheoloških nalaza, no ipak je pedesetak nalaza radi svojih karakteristika dobilo posebne oznake te su prikupljeni radi daljnjih analiza. Najveću količinu nalaza čine fragmenti amfora ili grubog i finog posuđa, zatim brončani i željezni čavli koji vjerojatno pripadaju brodskoj konstrukciji, ulomci olova te veća količina organskog materijala. Osim većeg broja koštica maslina, ljuski oraha ili sitnog granja, najzanimljiviji je nalaz tanjeg izduženog predmeta od kože za kojeg za sada ne možemo definirati namjenu, a nađen je da leži direktno na brodskoj konstrukciji. Od keramičkih nalaza nekoliko ih je vrlo zanimljivih te treba prvenstveno istaknuti veći broj ulomaka kuhinjskog i sigilatnog posuđa porijeklom iz sjeverne Afrike. Jedan od njih na dnu s unutrašnje strane nosi ukras izveden pečatiranjem. Ukras je djelomično očuvan, ali se prepoznaje niz koji čine list palmete i mrežasti kvadratni ukras (Sl. 7). Takav se ukras javlja na posudama koje se datiraju u period nakon polovine 4. stoljeća pa do prve trećine 5. stoljeća.[1] Još jedan zanimljiv keramički ulomak pripada korintskoj reljefnoj keramici (Sl. 8). Iako je prikaz na njoj vidljiv, tek će daljnje analize pokazati o kakvom se motivu radi. Korintska je keramička posuda izrađena od fine gline u kalupu, a nakon izrade se na njih aplicirao reljefni ukras koji najčešće prikazuju različiti ritualni prikazi, prikazi lova, prikazi bitki ili scene iz priča o

9. The find of an antiquity period coin minted under the emperor Trajan / Pronalazak antičkog novčića iz vremena cara Trajana (Photo: M. Kaleb)

through to the first third of the 5th c.[1] Another potsherd of interest is from Corinthian relief ware (Fig. 8). Although the decorative feature is visible, further analysis will be required to identify the motif. The Corinthian ware was made of fine clay cast in a mould, whereupon a relief decoration was applied, usually depicting various ritual images, hunting scenes, battle scenes, or scenes from the mythological Heracles narratives. This ware was manufactured at Corinthian workshops from the mid-2nd to the end of the 3rd c.[2] Also notable is the find of a coin minted under the emperor Trajan (98–117). The coin is a bronze sestertius, quite worn due to age and marine activity, on which we see the bust of Trajan on one side and the bridge over the Danube on the other (Fig. 9). The coin was found above the ship's structure, but cannot be directly associated with the wreck as it was found at a quite shallow point in the sand layer, about 20 cm beneath the surface and not lying directly on the ship's structure.

Samples were taken for further analysis from all the wooden elements upon completion of work on the documentation of the ship's structure. In all, 75 wood

1 Atlante 1, 123, T. LVI 49-51, T. LVII, 125.
2 Ilkić, Pešić 2012, 643.

Heraklu. Inače se ovakvo posuđe proizvodilo na području korintskih radionica od sredine 2. do kraja 3. stoljeća.[2] Svakako treba istaknuti i pronalazak novčića iz vremena cara Trajana (98-117). Radi se o brončanom sesteciju koji je uslijed djelovanja mora i starosti poprilično izlizan, ali se uspijeva vidjeti glava cara Trajana s jedne strane i most preko Dunava na drugoj strani novčića (Sl. 9). Novčić je nađen iznad brodske konstrukcije, ali se ne može s njom direktno povezati budući da je nađen dosta plitko u sloju pijeska, 20-ak cm ispod površine i nije direktno ležao na brodskoj konstrukciji.

Po završetku dokumentiranja brodske konstrukcije uzeti su uzorci svih drvenih elemenata broda radi daljnjih analiza. Ukupno je prikupljeno 75 uzoraka drva radi analize vrste drva i dva uzorka radi dendrokronoloških analiza koji su poslani na dendrokronološke i ksilološke analize u Institut Méditerranéen de Biodiversité et d'Ecologie marine etcontinentale (I.M.B.E.), Aix-en-Provence u Francuskoj a analizirati će ih Frédéric Guibal.

Budući da je brodska konstrukcija ove godine nije u cijelosti istražena, planirano je da se tijekom sljedeće godine otvori u većem opsegu i do kraja detaljno dokumentira nakon čega će se donijeti i zaključak o daljnjem postupanju s ovim zanimljivim nalazom (Sl. 10).

samples were taken for wood species analysis, while two samples taken for dendrochronological and xylological analysis have been submitted to the Mediterranean Institute of Marine and Terrestrial Biodiversity and Ecology (IMBE) in France's Aix-en-Provence, where they will be analysed by Frédéric Guibal.

As the entirety of the ship's structure was not fully investigated this year, we plan in the coming year to broaden the scope of the investigation area in order to fully document the wreck in detail (Fig. 10). This will be followed by our conclusions concerning further steps aimed at safeguarding this interesting site.

Bibliography / Literatura:

- Atlante I - Carandini, A. (ur.), Anselmino, L., Pavolini, C., Sagui, L., Tortorella, S., Tortorici, E., 1981. - Atlante delle forme ceramiche I. Ceramica fine romana nel bacino Mediterraneo (Medio e tardo Impero), Enciclopedia dell´arte antica, Classica e Orientale, Roma.

- Ilkić, M, Pešić, M., 2012. - Prilog poznavanju rimske luke na položaju Bošana nedaleko od Biograda na moru, Histria Antiqua 21, Pula, 639-647.

10. Final orthophoto of the ship's structure / Završna ortofotografija brodske konstrukcije (By: R. Surić)

11. Participants of the Barbir 2022 archaeological investigation campaign from left to right: / Sudionici istraživanja na Barbiru 2022. s lijeva na desno: Mladen Pešić, Marko Meštrov, Roman Scholz, Mate Parica, Roko Surić, seated / sjede: Lucija Topolko, Ivana Pavišić, Goran Josifovski, Luka Bekić i Maja Kaleb (Photo: R. Surić)

THE SUBMERGED MEDIEVAL PORT IN PUCK

ZATOPIONY PORT ŚREDNIOWIECZNY W PUCKU

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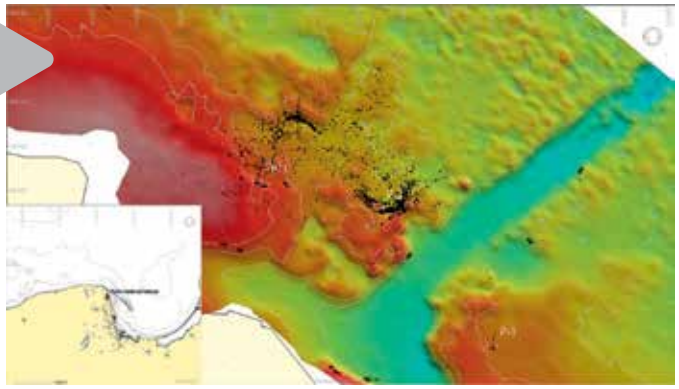


1. Plan of the site with wreck locations / Plan stanowiska z zaznaczonymi miejscami znalezienia wraków (By: P. Litwinienko, NMM Archives)

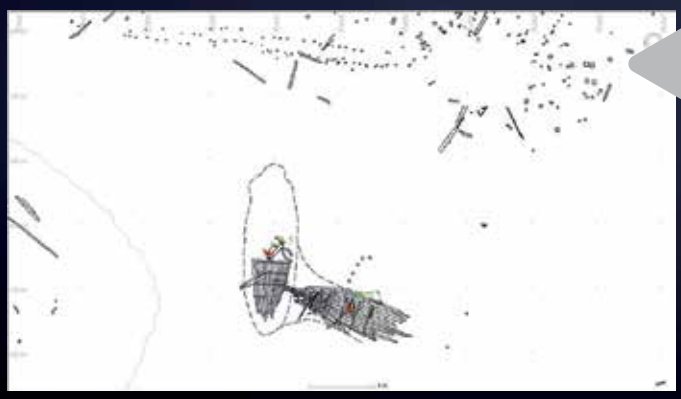
Puck, a small town in Northern Poland counting approximately 11,000 inhabitants lies by the Puck Bay, the innermost part of the Gulf of Gdańsk. In summertime the town becomes the Polish capital of sailing and other water sports; there is also a fishermen's harbour and a small shipyard specializing in wooden yachts. The history of Puck is inseparably connected with the sea: it was a haven for Kashubian fishermen for centuries, and in 1500s and 1600s it even served as a base for Polish royal privateers and fleet. In early 1900s it housed a base for German and later Polish seaplanes. In 1920 a special ceremony of marrying the newborn Polish state with the sea was conducted in Puck.

In 1977 three amateur divers began searching for the privateering harbour in the Puck Bay north-west from the town. Their findings turned out to be far more interesting for Polish archaeology. They stumbled upon the relics of wooden constructions and medieval pottery covering a large area (fig. 1). They reported their discovery to the local museum (today the Florian Ceynowa Puck Land Museum), which began the archaeological research, conducted – by different institutions and with numerous pauses – to this very day. First years of works were spent on preparing the surface documentation of the site. Among wooden structures wrecks of four vessels were found – three lapstrake boats and a logboat. The artefacts found on the site (mostly pottery, animal bones and a couple of metal objects) indicated the medieval chronology; attempts of radiocarbon dating the site and wrecks were also made. In 1989, due to its' deteriorating state of a preservation, the logboat was salvaged.

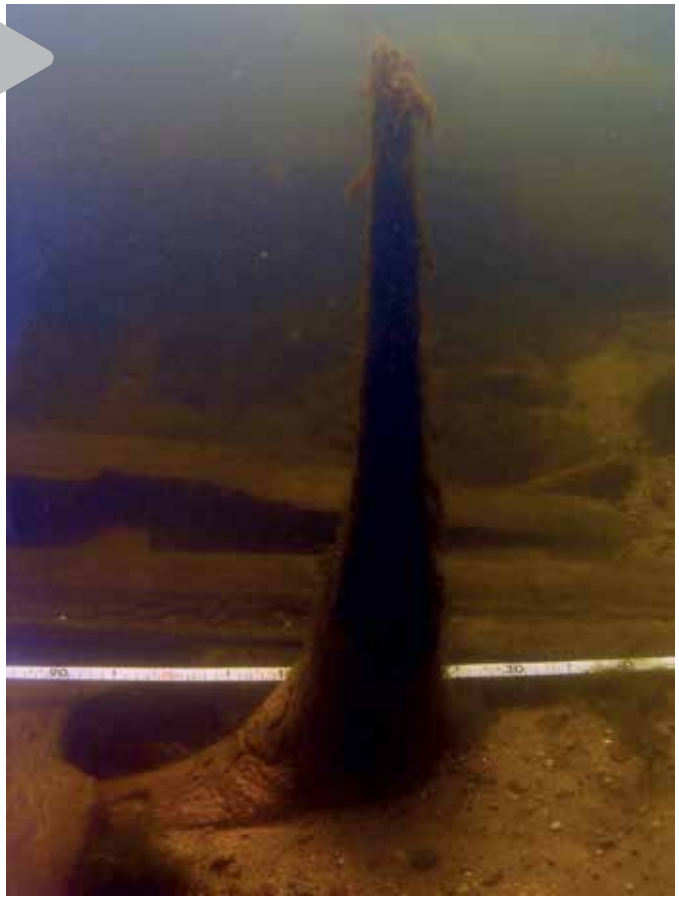
Puck to niewielkie, liczące ok. 11 tys. mieszkańców miasto w północnej Polsce, leżące nad Zalewem Puckim, najbardziej osłoniętą od Bałtyku częścią Zatoki Gdańskiej. Latem miasto zamienia się w polską stolicę żeglarstwa i innych sportów wodnych, funkcjonuje tu także port rybacki oraz niewielka stocznia budująca i remontująca drewniane jachty. Historia Pucka jest nierozerwalnie związana z morzem: od stuleci swoją przystań mieli tu kaszubscy rybacy, a w XVI i XVII wieku miasto kilkukrotnie pełniło funkcję portu królewskich kaprów, a także stoczni i bazy królewskich okrętów wojennych. W XX wieku znajdowała się tu najpierw niemiecka, a potem polska baza wodnosamolotów, a w 1920 r. doszło w Pucku do ceremonii zaślubin nowo odrodzonej Polski z Morzem Bałtyckim.

W 1977 roku trójka płetwonurków-amatorów poszukiwała w wodach Zatoki Puckiej na północny- zachód od miasta reliktów portu kaperskiego z XVI-XVII wieku. To, co znaleźli, okazało się znacznie bardziej interesujące dla polskiej archeologii. Natknęli się bowiem na rozciągające się na dużej powierzchni relikty konstrukcji drewnianych oraz średniowieczną ceramikę (il. 1). Swoje znalezisko zgłosili do lokalnego muzeum (dziś Muzeum Ziemi Puckiej im. Floriana Ceynowy), które postanowiło rozpocząć badania archeologiczne, prowadzone – przez różne instytucje i z licznymi przerwami – aż po dziś dzień. Pierwsze lata prac spędzono na sporządzeniu powierzchniowej inwentaryzacji stanowiska. Wtedy to, oprócz konstrukcji drewnianych, odkryto także wraki czterech jednostek pływających – trzech łodzi klepkowych oraz dłubanki, które zostały wstępnie zadokumentowane.

2. Wrecks P3 and P5 as in 1990 / Wraki P3 i P5 w 1990 r. (NMM Archives)



In early 1990s the team from the Nicolaus Copernicus University in Toruń (UMK) started to study the site working on commission from the National Maritime Museum in Gdańsk (NMM). During the several research seasons they managed to precisely geolocalize the site, define its area on 16 hectares and, above all, salvage one of the wrecks (P3) and dig several test trenches in its vicinity to study the site's stratigraphy. During the exploration and salvage of the P3 wreck, another vessel, marked as P5 was found, lying just under the seabed (fig. 2).



3. Wreck P2 in 2005 / Wrak P2 w 2005 r. (Photo: I. Pomian)

Following years were marked with the intensification of the research, led by the NMM in cooperation with numerous other institutions. One of the main tasks was to reconstruct the historical natural environment and the process of sea level changes that eventually led to the abandonment of the harbour. The site was still surveyed and numerous samples for dendro-dating were collected. In 2005 the NMM salvaged the P2 wreck (fig. 3). In 2017-2019 the UMK team returned to the site in order to create a digital reconstruction of the port. In 2019-2022 the NMM archaeologists studied the P1 and P5 wrecks, documenting them with photogrammetry and securing them in situ (fig. 4).

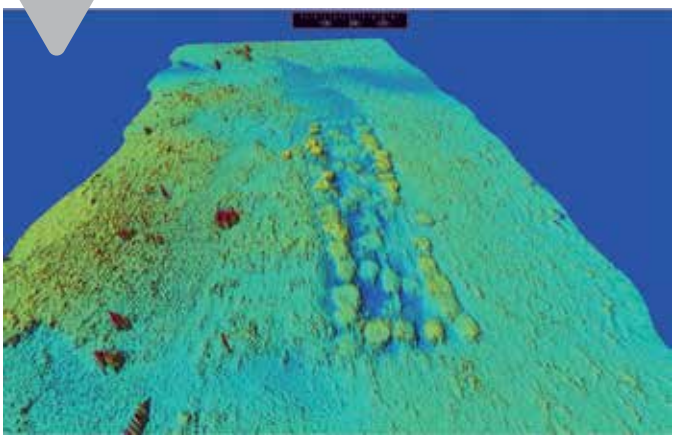
The submerged medieval port in Puck is located close to the Płutnica river mouth, approximately 250 m from the contemporary shoreline, stretching parallel to the coast in an area approximately 400 m long and 100 m wide. The central part of the site is destroyed by the fairway

Odnajdywane wśród reliktów pomostów zabytki (głównie ceramika, kości zwierzęce oraz nieliczne zabytki metalowe) wskazywały na średniowieczne datowanie stanowiska, podejmowano także próby datowania wraków oraz konstrukcji drewnianych metodą radiowęglową. W 1989 r. ze względu na coraz gorszy stan zachowania, na powierzchnię wydobyto dłubankę.

Na początku lat 90. XX wieku na stanowisku badania rozpoczął zespół Uniwersytetu Mikołaja Kopernika w Toruniu (dalej UMK), pracującego na zlecenie Narodowego Muzeum Morskiego w Gdańsku (dalej NMM). W ciągu kilku sezonów badań udało się dokonać precyzyjnej geolokalizacji stanowiska, określić zasięg stanowiska na ok. 16 hektarów oraz, przede wszystkim, wydobyć jeden z wraków (P3) i wykonać w jego okolicy serię głębokich sondaży, mających na celu prześledzenie stratygrafii stanowiska. Podczas eksploracji i wydobywania wraka P3 doszło do odkrycia kolejnej jednostki pływającej oznaczonej jako P5, spoczywającej tuż pod powierzchnią dna (il. 2.).

W następnych latach nastąpiła intensyfikacja badań, prowadzonych pod egidą NMM we współpracy z wieloma innymi instytucjami. Jednym z głównych celów była próba zrekonstruowania dawnego środowiska oraz procesu zmian linii brzegowej, która doprowadziła do ostatecznego opuszczenia portu. Wciąż inwentaryzowano stanowisko oraz pobierano liczne próby do datowania dendrochronologicznego. W 2005 r. NMM wydobyło wrak P2 (il. 3). W latach 2017-2019 na stanowisko powrócił zespół UMK, pracujący nad stworzeniem cyfrowej rekonstrukcji portu, natomiast w latach 2019-2022 archeolodzy z NMM przeprowadzili badania wraków P1 oraz P5, wykonując dokumentacje fotogrametryczną oraz zabezpieczając je in situ (il. 4).

Zatopiony średniowieczny port w Pucku znajduje się niedaleko ujścia Płutnicy, w odległości około 250 metrów od obecnej linii brzegowej i rozciąga się wzdłuż niej w pasie o długości ok. 400 m i szerokości ok. 100 m. W centralnej części stanowiska przebiega tor wodny wiodący do dawnej bazy wodnosamolotów (współcześnie Puckie Zakłady Mechaniczne Amex) – jego budowa bezpowrotnie zniszczyła wszelkie znajdujące się tam zabytki archeologiczne. Głębokość wody na stanowisku wacha się od 1,5 do 2,5 m. Na relikty konstrukcji składają się przede wszystkim wbite w dno pale, często w wiązkach, układające się w ciągi o długości nawet do 25 m, wskazujące na przebieg dawnych pomostów (il. 5). Oprócz nich wyszczególnić można także umocnienia nabrzeży – drewniane konstrukcje skrzyniowe (il. 6), faszynowe, a także nasypy kamienno-ziemne. Liczbę pali czy belek liczyć można w tysiącach. Dzięki badaniom geologicznym, datowaniu drewnianych konstrukcji oraz analizie przestrzennej reliktów wiemy, że relikty portu nie



4. P1 wreck under geotextile / Wrak P1 pod geowłókniną (Maritime Office in Gdynia)

leading to the former seaplane base (today the place is occupied by the Puck Amex Mechanical Works). The water depth on the site fluctuates between 1,5 to 2,5 m. The wooden construction relics are mostly piles driven into the seabed, often in bundles, arranged in lines that indicate the location of former piers, sometimes even 25 m long (fig. 5). Other remains are those of shoreline strengthening – wooden boxes (fig. 6), fascines and earth-stone embankments. There are thousands of piles and timbers. Today, thanks to the geological research, the dating of wooden constructions and the spatial analysis we know that the harbour relics are not simultaneous. The oldest constructions, dated on early 900s, are located in the north-western part of the site. The relics further south-east, partially damaged by the fairway are dated on the 12th century. The 14th century constructions are located closer to the shore and are probably relics of a small fishermen haven.

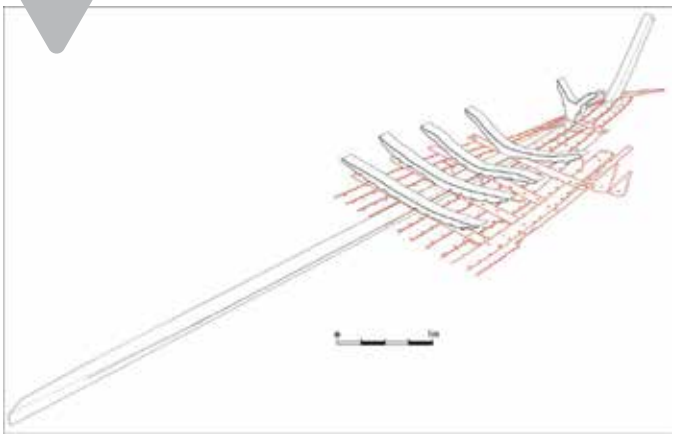
5. A bundle of piles driven into the bottom / Wiązka pali wbitych w dno (Photo: P. Litwinienko)

są jednoczasowe. Najstarsze konstrukcje znajdują się w północno-zachodniej części stanowiska i datowane są na początek X wieku. Konstrukcje znajdujące się dalej na południowy wschód są zniszczone przez współczesny tor wodny – ich relikty udało się wydatować na XII stulecie. Konstrukcje z XIV wieku znajdują się już bliżej brzegu i wydają się być pozostałościami niewielkiej przystani rybackiej.

Odnalezione wraki łodzi klepkowych reprezentują taką samą rozpiętość czasową co samo stanowisko – od X do XIV wieku, natomiast dłubanka (P4) została datowana radiowęglowo na VIII stulecie. Pucki port jest największym jak do tej pory skupiskiem wczesnośredniowiecznych wraków w Polsce.

Pierwszy z wraków, odkryty już w 1979 r. (P1) znajduje się we wschodniej części stanowiska, przy reliktach konstrukcji datowanych na XII wiek. Sam wrak został

6. A box construction / Konstrukcja skrzyniowa (Photo: P. Litwinienko)



7. Reconstruction of the P1 wreck remains / Rekonstrukcja pozostałości wraka P1 (By: J. Rozycki)

The lapstrake vessels wrecks represent the same dating span as the harbour – from the 10th to the 14th century, while the logboat (P4) is radiocarbon dated on the 8th century. The Puck harbour has by far the largest cluster of early-medieval wrecks in Poland.

The first of the wrecks, discovered as early as 1979 (P1) is located in the eastern part of the site, nearby the 14th century constructions. The wreck itself was dated on approximately 1380s. These are the remains of a small vessel approx. 12 m long, probably equipped with a stern rudder. The wreck, preserved in a critically bad condition (fig. 7) was secured in situ by the NMM team using the geotextile and sandbags in 2019.

The second wreck (P2) lied in the central part of the site, probably on the 11th century shoreline. The vessel was dendro-dated on approx. 970 – the times when the Eastern Pomerania was conquered by the newly formed Polish state. The wreck combines shipbuilding traditions considered as traditionally Slavic (connecting planks with wooden pegs) and Scandinavian (characteristic keelson). The vessel was probably a combat boat, unusually slender (21 m long, 2,5 m wide), adapted for cruising on shallow waters of the Puck Bay and its small rivers (fig. 8). The crew might count as many as 30 warriors-oarsmen and a helmsman. The sail served as an auxiliary propulsion. The war-like character is further evidenced by a special board used to hang warriors' shields by the shipside, preserved in few fragments.

The third wreck (P3) was found in the western part of the site, close to the constructions dated on 14th century. The vessel's construction is traditionally „Slavic" – planks joined with wooden pegs and caulked with moss. The hull was dendro-dated on 1155. The vessel is reconstructed to be 15 m long and 3,5 m wide. These proportions indicate a cargo vessel – the hull was quite wide, with a cargo hold in midships. The ship was probably a sailing one. The P3 wreck is the largest of the 12th century lapstrake vessels found in Poland (fig. 9).

wydatowany na ok. 1380 r. Są to pozostałości niewielkiej jednostki pływającej o długości nieprzekraczającej 12 metrów, najprawdopodobniej wyposażonej już w ster zawiasowy. Zachowany w bardzo złym stanie wrak (il. 7) został w 2019 roku zabezpieczony przez zespół NMM in situ za pomocą geowłókniny i worków z piaskiem.

Drugi odnaleziony wrak (P2) spoczywał w centralnej części stanowiska, prawdopodobnie na linii brzegowej dawnej przystani z XI stulecia. Badania dendrochronologiczne pozwoliły ustalić, iż łódź została zbudowana w najprawdopodobniej ok. 970 roku, czyli w czasie zajęcia terenów Pomorza przez formujące się państwo polskie. Wrak ten łączy w sobie cechy konstrukcyjne uważane za tradycyjnie słowiańskie (łączenie klepek za pomocą drewnianych kołków) oraz skandynawskie (charakterystyczna nadstępka). Była to najprawdopodobniej łódź o przeznaczeniu bojowym, niezwykle smukła (21 m długości, 2,5 m szerokości), przystosowana do żeglugi po płytkich wodach Zatoki Puckiej i niewielkich wpadających do niej rzek (il. 8). Załogę łodzi mogła stanowić drużyna licząca nawet do 30 wojowników-wioślarzy i sternika. Dodatkowym napędem był żagiel. O bojowym charakterze łodzi świadczy także zachowana w kilku fragmentach listwa, służąca do mocowania tarcz na burcie.

Trzeci z wraków (P3) odnaleziono w zachodniej części stanowiska, niedaleko konstrukcji datowanych na XIV wiek. Konstrukcja kadłuba jest tradycyjnie „słowiańska" – klepki łączone na drewniane kołki i uszczelniane mchem. Datowanie dendrochronologiczne wraka pozwoliło ustalić, że jednostka została zbudowana po 1155 r. Rekonstruowane wymiary wraka to 15 metrów długości i 3,5 metra szerokości. Proporcje kadłuba wskazują na towarowe przeznaczenie jednostki – była ona dość szeroka, a na śródokręciu znajdowała się ładownia. Za napęd służył prawdopodobnie żagiel. Wrak P3 to jak do tej pory największy ze znanych przykładów łodzi klepkowych z XII wieku odnalezionych w Polsce (il. 9).

W 1990 roku, podczas eksploracji i przygotowywania do wydobycia wraka P3 dokonano odkrycia kolejnego

8. Visualisation of the P2 combat vessel / Wizualizacja łodzi bojowej P2 (By: P. Litwinienko)

In 1990, during the exploration and salvage of the P3 wreck, another one was found, marked as the P5. The new object was uncovered and partially documented, with the intention of salvage in the next year; yet the operation never succeeded. The wreck was dendro-dated on 1248. Thirty years after the discovery, in 2021-2022 the wreck was explored by the NMM team and secured in situ with geotextile and sandbags (fig. 10). The hull of a 12-m long boat is lying on a steep shoreline by the former Płutnica estuary – its stern is buried over 2 m deep into the sediment (fig. 11).

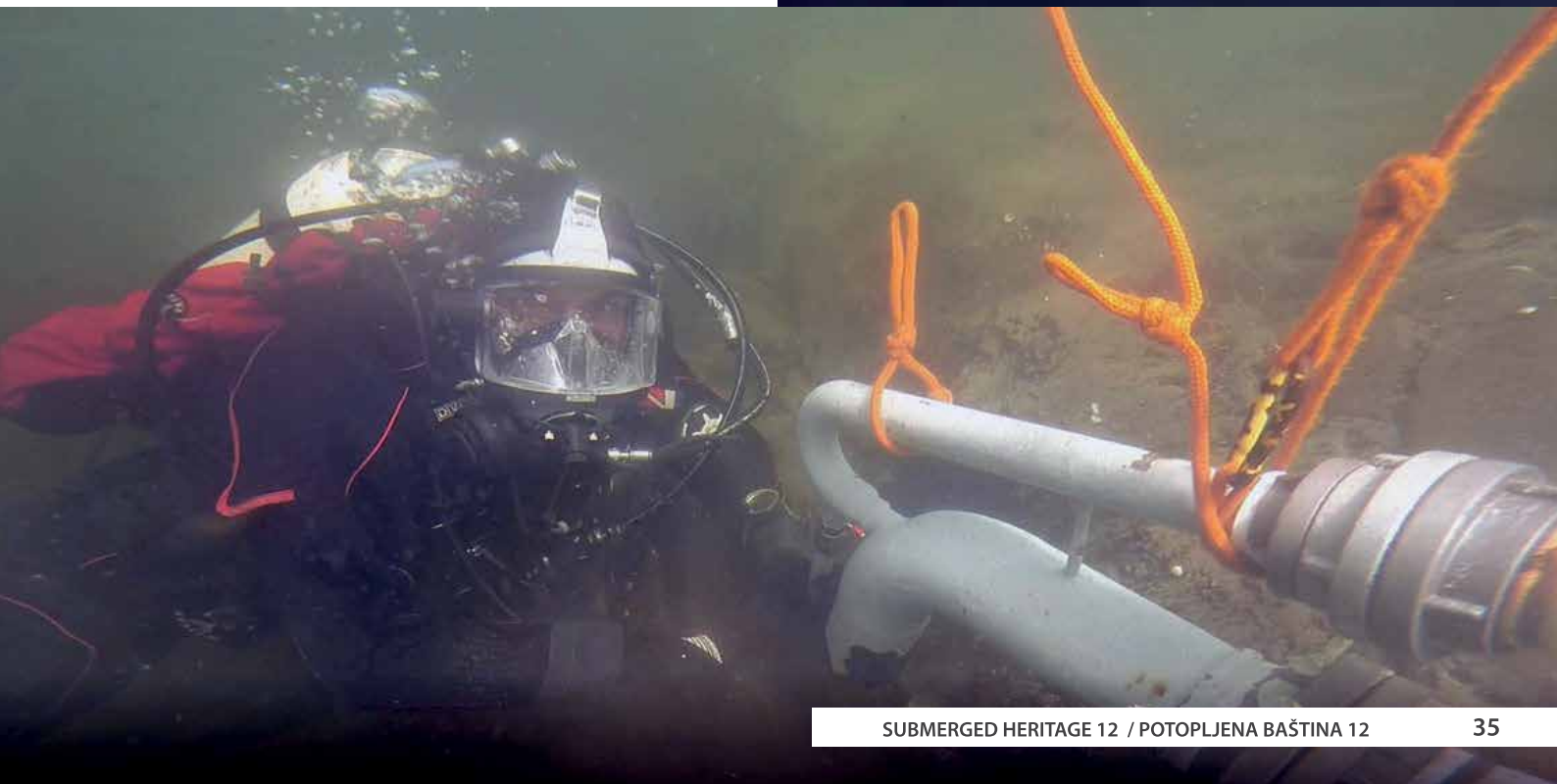
The discovery of such a large site, remains of a former port located in the bend of the Gulf of Gdańsk, sheltered from the sea, has begun a 40-years long discussion between the Polish scholars on its interpretation. Several thought it was one of the largest southern Baltic entrepots. However, no such emporium – believed to be active since the 10th century – is present in the written sources from those times. Puck itself is mentioned for the first time in 1220, in a document confirming its bestowal to the Cistercian monks by the Pomeranian governor Sambor on the turn of 12th and 13th century. Interestingly, the document describes Puck as a marketplace. The markets being held in early medieval Puck would well correspond with the harbour. In 13th century the town was a seat of castellany, with a fisheries station nearby. After the Teutonic Knights took over the province in the early 1300s, a fishermen's office was installed in Puck, while the town gained city rights in 1348. The Teutonic Knights, though, usually located their cities away from the older settlement centres – this might be one of the reasons that the town is now at some distance from the medieval harbour. The dendro-dating and the analysis of constructions leads to conclusion, that the most probable story is that there were several smaller havens one after

▶ 9. Reconstruction of the P3 wreck / Rekonstrukcja wraka P3 (By: P. Litwinienko)

obiektu, oznaczonego jako P5. Wrak został wówczas odsłonięty i częściowo zadokumentowany; miał on zostać wydobyty w następnym roku, jednak nigdy do tego nie doszło. Pobrane próby pozwoliły ustalić datę powstania jednostki na około 1248 r. W trzydzieści lat po odkryciu, w latach 2021-2022 wrak został odsłonięty i przebadany przez zespół archeologów podwodnych NMM, po czym zabezpieczony in situ za pomocą geowłókniny i worków z piaskiem (il. 10). Kadłub tej długiej na ok. 12 metrów łodzi spoczywa na dawnym brzegu przy ujściu Płutnicy, na dość stromym zboczu – jego rufowa część jest zagłębiona ponad dwa metry w osadach dennych (il. 11).

Odkrycie tak dużego stanowiska będącego pozostałościami dawnej przystani w osłoniętym od morza zakolu Zatoki Gdańskiej wywołało trwającą już od ponad 40 lat żywą dyskusje między polskimi naukowcami dotyczącą jego interpretacji. Niektórzy badacze uważali go za jedno z większych emporiów handlowych na

▶ 10. Exploration of the P5 wreck in 2021 / Eksploracja wraka P5 w 2021 r. (Photo: J. Rozycki)



each other, gradually displaced during the perpetual struggle with the increasing sea level.

The archaeological research has been conducted for 44 years now, but the site still seems barely touched by archaeologists – except from the 1990s test trenches and the exploration of wrecks, almost no excavation works which may answer many questions on the site were conducted there. What's interesting, relatively small number of artefacts was found – especially those that may shed some light on the 10th-12th century function of the harbour. Still, no settlement connected with the port was found – perhaps it was located on the site of the seaplane base or is still buried under the seabed on shallows between the site and the shore. The site itself is being endangered by the destructive sea activity, which gradually destroys the constructions and the peat sediments. One form of protection of the underwater heritage would be to conduct a large-scale archaeological excavation there, which would be a massive logistic challenge for the next few years.

Bibliography / Literature:

- Litwin J.,1995. - The Puck Bay wrecks - an opportunity for a "Polish Skuldelev", in: O. Olsen, J. Skamby Madsen, F. Rieck (eds), Shipshape. Essays for Ole Crumlin-Pedersen, Roskilde, Viking Ship Museum, p. 135-160.
- 2003 The Boat Puck 3 in the Light of Investigation of Other Slavic Boats from 9-14th Century, in: Beltrame, C. (ed.) Boats, Ships and Shipyards: Proceedings of the 9th ISBSA, Venice 2000, p. 261-265
- Litwinienko, P.; Różycki, J., 2021. - An attempt to create a digital reconstruction of the Puck 2 wreck hull, in: G. Boetto, P. Pomey, P. Poveda (eds) Open Sea, Closed Sea. Local and Inter-Regional Traditions in Shipbuilding. Proceedings of the Fifteenth International Symposium on Boat and Ship Archaeology, Marseilles 2018, p. 309-314
- Pomian I., Litwin J., 2009. - Attempt at evaluating the scientific value of the P-2 boat originating from the Early Middle Ages, in: R. Bockius (ed.), Between the Seas. Transfer and Exchange in Nautical Technology, Proceedings of the 11th ISBSA, Mainz 2006, Mainz, Römisch-Germanischen Zentralmuseums, p. 421-428.
- Pydyn, A., Popek, M., Kubacka, M., Janowski, Ł., 2021. - Exploration and reconstruction of a medieval harbour using hydroacoustics, 3-D shallow seismic and underwater photogrammetry: A case study from Puck, southern Baltic Sea, Archaeological Prospection, 28(4), p. 527-542.
- Stępień, W., 1984. - Archaeological excavations in Puck Harbour, Gdansk District, Poland, INJA 13.4, p. 311-321.

południowym wybrzeżu Bałtyku. Emporium to – mające funkcjonować od co najmniej X stulecia – nie występuje jednak w żadnych źródłach historycznych z tych czasów. Sam Puck pojawia się w źródłach historycznych dopiero w roku 1220, w dokumencie potwierdzającym jego nadanie cystersom przez pomorskiego namiestnika Sambora na przełomie XII i XIII wieku. Co ciekawe, dokument wspomina o Pucku jako miejscu targowym. Fakt odbywania się tam targów we wczesnym średniowieczu dobrze zgrywałby się z funkcjonowaniem przystani lub portu. W XIII stuleciu Puck został siedzibą kasztelana, a w pobliżu miasta miała znajdować się jedna ze stacji rybackich. Po przejęciu władzy na Pomorzu przez Zakon Krzyżacki w XIV wieku funkcjonował tutaj urząd rybickiego, a sam Puck otrzymał prawa miejskie w 1348 roku. Krzyżacy mieli jednak zwyczaj lokować nowe osiedla z dala od dotychczasowego osadnictwa – być może jest to jedna z przyczyn odsunięcia się miasta od wczesnośredniowiecznej przystani. Datowanie metodą dendrochronologiczną oraz analiza konstrukcji pozwala dzisiaj uznać, że najbardziej prawdopodobną wersją wydarzeń jest funkcjonowanie w tym miejscu kilku niewielkich, następujących po sobie przystani, stopniowo przesuwanych w trakcie ciągłej walki z podnoszącym się poziomem wód morskich.

Badania archeologiczne puckiego portu trwają już od 44 lat, a stanowisko wciąż wydaje się ledwie tknięte przez archeologów – z wyjątkiem sondaży z lat 90. oraz eksploracji wraków nie prowadzono tu w zasadzie prac wykopaliskowych, które mogłyby przynieść odpowiedzi na wiele pytań dotyczących stanowiska. Zastanawia stosunkowo niewielka ilość odnalezionych zabytków, które mogłyby pozwolić określić funkcje przystani, zwłaszcza w okresie X-XII wieku. Wciąż dużym problemem jest nieodnalezione zaplecze osadnicze portu – być może znajdowało się na terenie bazy wodnosamolotów lub pozostaje zagrzebane w morskim piasku na płyciznach między reliktami pomostów a brzegiem. Samo stanowisko pozostaje także zagrożone przez destrukcyjną działalność morza, które stopniowo niszczy relikty oraz torfowe nawarstwienia. Formą ochrony podwodnego dziedzictwa byłoby zatem przeprowadzenie tutaj szeroko zakrojonych badań archeologicznych, co wiązałoby się z dużym wyzwaniem logistycznym i technicznym na najbliższe lata.

11. P5 wreck in 2022 / Wrak P5 w 2022 r. (By: J. Rozycki)

THE BARON GAUTSCH: CROATIA'S TITANIC IN DANGER

BARON GAUTSCH - HRVATSKI TITANIK U OPASNOSTI

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The implementation of a multiannual programme to inspect and monitor protected underwater cultural property aims to determine their current condition. One of the sites that has justifiably garnered the greatest attention is the wreck of the Baron Gautsch. The wreck is listed in the Register of cultural property of the Republic of Croatia under number Z-98 as immovable cultural property.

One of the most attractive diving locations in the Adriatic Sea serves as an inspiration to many marine and history enthusiasts. The Baron Gautsch was the pride of the Austrian passenger fleet, plying the Trieste to Kotor line for the Österreichischer Lloyd steamship company (Fig. 1, 2). It was built in the Scotland's Dundee in 1908, having a length of 84.5 metres and a beam just shy of 12 metres.[1] On 13 August 1914 it hit an underwater mine between Pula and Rovinj enroute to Trieste with passengers on board. Many died as it sank into the dark waters of the northern Adriatic. Since then, the ship has laid upright on the seabed, as if at anchor in some

1 Pocedić 2014, 30.

Provedbom višegodišnjeg programa pregleda i monitoringa zaštićenih podvodnih kulturnih dobara nastoji se definirati njihovo trenutno stanje. Jedan od lokaliteta na koji se opravdano stavlja najveća pozornost je olupina broda „Baron Gautsch". Olupina je uvedena u Registar kulturnih dobara Republike Hrvatske pod registarskim brojem „Z-98" kao nepokretno kulturno dobro.

Jedna od najatraktivnijih ronilačkih lokacija na Jadranu predmet je inspiracije brojnim zaljubljenicima u podmorje i povijest. Brod „Baron Gautsch" bio je ponos austrijskog putničkog prometa i za parobrodsko društvo „Austrijski Lloyd" je plovio na liniji Trst – Kotor (Sl. 1, 2). Izgrađen je u škotskom gradu Dundee 1908. godine, a dimenzije su mu bile 84,5 metara dužine i gotovo 12 metara širine. Prilikom prijevoza putnika na putu za Trst naletio je 13. kolovoza 1914., između Pule i Rovinja, na podvodnu minu. Prilikom potonuća u mrak sjevernog Jadrana sa sobom je odnio brojne žrtve. Od tog dana brod je položen uspravno na morskom dnu, naizgled, kao da je usidren u nekoj mističnoj luci, u iščekivanju ukrcaja putnika koje će povesti na još jednu plovidbu. Osim dužnog poštovanja koje iskazujemo zbog njegove monumentalne ljepote, ne smijemo zaboraviti da se radi o jednoj od najtragičnijih žrtava Prvog svjetskog rata u kojoj počivaju ostaci žrtava poginulih u kobnom događaju iz 1914. godine.

1. The Baron Gautsch at sea / Brod Baron Gautsch za vrijeme plovidbe (From: K. Pocedić 2014, 10-11)

Dužnost današnje generacije je sačuvati ovaj podvodni kulturni spomenik za buduće generacije. Upravo iz tog razloga Međunarodni centar za podvodnu arheologiju u Zadru pokrenuo je višegodišnji projekt sustavnog monitoringa koji je započeo 2021. godine u sklopu kojeg se vrše istraživanja i ispitivanja s ciljem utvrđivanja trenutnog stanja i pronalaženja rješenja za dugotrajnu zaštitu od daljnjeg propadanja olupine broda.

mystical haven, awaiting the boarding of passengers for yet another journey. With due regard for its monumental beauty, we should never forget that this was one of the most tragic moments of the First World War and the final resting place of the many victims of the calamitous 1914 event.

It is incumbent upon us to preserve this underwater cultural monument for future generations. Motivated by this intention the International Centre for Underwater Archaeology in Zadar launched a multiannual systematic monitoring project in 2021[2] that includes investigation and tests aimed at determining the current condition of the wreck and identifying solutions for long-term protection against the further deterioration of the wreck. This year's implementation of the monitoring programme at the Baron Gautsch site involved a detailed inspection of the wreck. One of the objectives of this inspection was to produce photographic documentation of parts of the site.

Ten samples of metal were taken from the wreck in the course of the first survey of the condition of the Baron Gautsch in 2021 (Fig. 7). The samples were taken from multiple places on the wreck, most from the various metal structures of the ship's upper deck.[3] Individual samples were removed with ease, which evidently indicated that the metal has been very highly degraded. Parts of the ship's plating and of the upper deck railing were in somewhat better condition and were more difficult to sample, indicating that the metal of these parts is in a somewhat better state of preservation. The samples were analysed at the ReCorrTech laboratory of the University of Zagreb's Faculty of Chemical Engineering and Technology. The objective of the analysis was to determine the remaining thickness of the walls and to assess the corrosion damage of the samples. The analysis showed severe degradation of the metal, in particular caused by the action of anaerobic sulphate-reducing bacteria. The metal walls covered by fouling have been highly thinned in places, i.e., significantly consumed by corrosion processes.

In the following inspection of the ship (Fig. 3), in 2022, data was collected from the Baron Gautsch wreck by measuring corrosion potential and pH values at four different points on the metal parts of the wreck, with these values also measured on the seabed (Fig. 4). Each measurement was attended by a record of the precise depth and temperature of the sea. Corrosion potential was measured using a multimeter with a silver chloride (AgCl) reference electrode, while pH values were recorded using a calibrated pH flat surface electrode.

2 Surić 2021, 23.
3 Ibid.

Tijekom prvog pregleda stanja Baron Gautscha u 2021. godini uzeto je ukupno 10 uzoraka metala s olupine (Sl. 7). Uzorci su uzimani na nekoliko mjesta na brodu, najvećim dijelom s različitih metalnih struktura na gornjoj palubi broda. Pojedini uzorci vrlo su se lako otkidali što je naočigled pokazivalo da je metal izrazito degradiran. U nešto boljem stanju bili su dijelovi oplate broda i ograde na gornjoj palubi koje je bilo teže uzorkovati što je ukazivalo da je na tim dijelovima metal ipak nešto bolje sačuvan.

2. The crest (logo) of the Österreichischer Lloyd (Austrian Lloyd) steamship company of Trieste / Grb parobrodskog društva „Austrijski Lloyd" iz Trsta (From: K. Pocedić 2014, 23)

Uzorci su analizirani u ReCorrTech laboratoriju na Fakultetu kemijskog inženjerstva i tehnologije u Zagrebu. Cilj analiza bilo je utvrditi preostalu debljinu stijenki i ocijeniti korozijska oštećenja na uzorcima. Analize su pokazale ozbiljno degradirano stanje metala posebice potaknuto djelovanjem anaerobnih sulfat reducirajućih bakterija. Metalna stijenka pod obraštajem mjestimično je vrlo stanjena, odnosno značajno konzumirana korozijskim procesima.

U sljedećem pregledu broda (Sl. 3), u 2022. godini, na olupini Baron Gautsch prikupljeni su podaci mjerenja korozijskog potencijala i pH vrijednosti na 4 različita mjesta na metalnim dijelovima broda kao i iste vrijednosti morskog dna (Sl. 4). Prilikom svakog mjerenja zabilježena je točna dubina i temperatura mora. Za

3. A diver inspects the condition of the wreck / Ronilac za vrijeme pregleda stanja olupine (Photo: R. Surić)

mjerenje korozijskog potencijala korišten je multimetar s referentnom elektrodom od srebrovog klorida (AgCl), a podaci o pH vrijednostima zabilježeni su korištenjem kalibrirane pH elektrode s ravnom površinom. Oba su instrumenta bila smještena u mjernu kutiju izrađenu od aluminijske legure prilagođenu podvodnoj uporabi. U tablici (Sl. 5) su prikazane izmjerene vrijednosti.

Both instruments were housed in an aluminium alloy measurement enclosure adapted for underwater use. Figure 5 shows the measured values.

Drawings of the Baron Gautsch found at the archives of the City of Dundee in Scotland, where the ship was built, were also very helpful in determining the wreck's current conservation condition (Fig. 6). From the drawings we see that the thickness of the plating amidships averaged from 7.62 to 11.43 mm, while at lower parts of the ship it was somewhat thicker, averaging 12.70 mm.

Lokacija / Location	Dubina / Depth, m	pH	E_{corr}	Temp. °C	Komentar / Comment
Baron Gautsch 01	34.5	4.90	-0.603	13.0	Pramčana oplata / *Bow hull plating*
Baron Gautsch 02	33.0		-0.396	13.0	Sredina broda - oplata / *Amidship - hull plating*
Baron Gautsch 03	30.4	4.45	-0.594	13.0	Krmena paluba / *Stern deck*
Baron Gautsch 04	30.4		-0.596	13.0	Unutrašnjost broda – nedefinirani metalni objekt / *The interior of the ship - undefined metal part*
Baron Gautsch 05	39.0	5.15	-0.352	15.4	Morsko dno - mulj / *Sea bottom - silt*

5. Corrosion potential and pH values / Tablica s izmjerenim potencijalima (By: Z. Vrgoč)

Corrosion of iron in the marine environment is dependent on water movement and the concentration of dissolved oxygen. Together these variables combine to create a flux of dissolved oxygen which has been shown to drop off with depth, so that there is a logarithmic lowering of rates of deterioration with water depth.[4] If we compare the Baron Gautsch wreck with an example of WWII shipwrecks in Chuuk Lagoon, Federated States of Micronesia we can get some estimations on the state of the site.

After more than 75 years in the marine environment the Chuuk wrecks have largely lost their deck plates and at

4 MacLeod, 2016.

4. Measurements are taken with a multimeter at the bow plating / Mjerenje multimetrom na pramčanoj oplati (Photo: R. Surić)

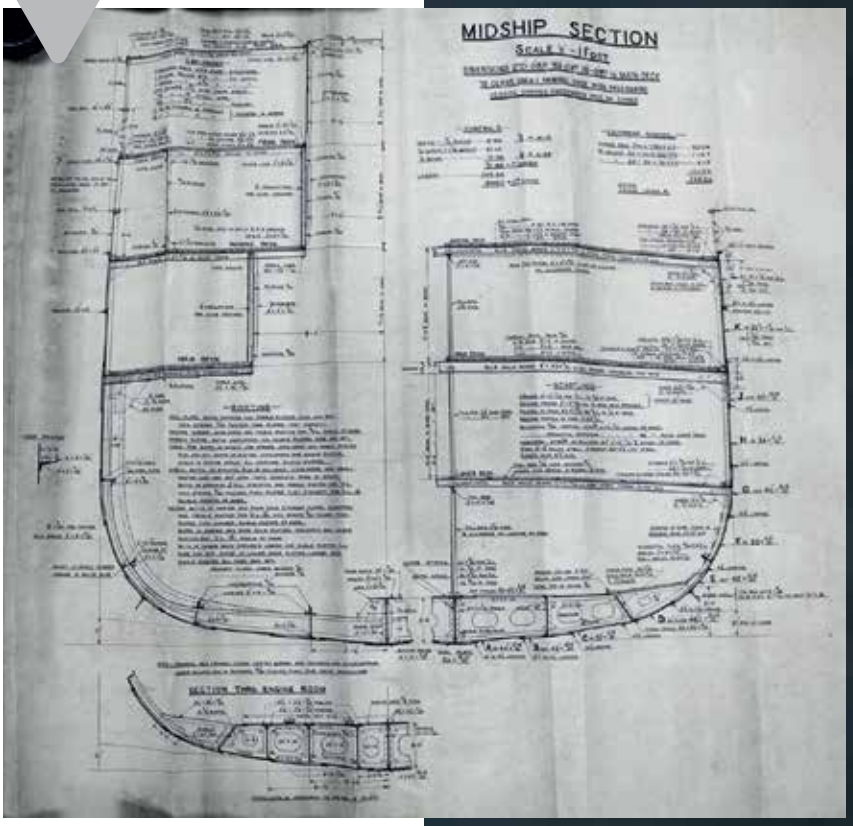
Nacrti broda Baron Gautsch pronađeni u Gradskom arhivu škotskog grada Dundee gdje je brod sagrađen također su uvelike pomogli utvrditi postojeće konzervatorsko stanje olupine (Sl. 6). Iz nacrta se može iščitati da je debljina oplate gornjeg i središnjeg dijela broda iznosila između 7,63 i 11,43 mm dok je u donjem dijelu broda oplata nešto deblja te u prosjeku iznosi 12,70 mm.

U morskom okruženju korozija željeza ovisi o strujanju vode i koncentraciji otopljenog kisika. Zajedno se kombiniraju te varijante kako bi se dobio tok otopljenog kisika za koji se pokazalo da opada s dubinom, pa vidimo logaritamsko opadanje stopa propadanja kako se povećava dubina. Ako usporedimo olupinu Baron Gautsch s brodovima potopljenim za vrijeme Drugog svjetskog rata u laguni Chuuk (Savezna Država Mikronezija), možemo na neki način procijeniti stanja nalazišta.

Nakon više od 75 godina u morskom okruženju olupine u laguni Chuuk su uglavnom izgubile palubnu oplatu; na tipičnim dubinama od 20 metara, gdje je stopa korozije 0,08 mm/godišnje, veći dio nadgrađa oplate zapovjedničkih mostova je korodirao (Sl. 8). Poznata olupina broda Fujikawa Maru nalazi se na dnu lagune na dubini od 29 metara, a stopa raspadanja približno je ista kao izračunata vrijednost za Baron Gautsch od 0,055 mm/godišnje. Razlog zbog čega olupina u Jadranskom moru korodira brže od olupine u laguni Chuuk je mnogo slabije strujanje vode unutar tropske lagune i znatno manji pokrov inkrustiranih morskih organizama u dubljem i hladnijem Jadranskom moru.

Prema specifikacijama broda Baron Gautsch paluba je na 30 metara, a oplata na ovom dijelu je imala debljinu od 7,6 mm, tako da je pri izračunatoj stopi gubitka od 0,08 mm/

typical water depths of 20 metres the corrosion rates are 0.08 mm/year much of the superstructure of the bridge plating has corroded away (Fig. 8). The iconic Fujikawa Maru is located on the floor of the lagoon at a depth of 29 metres and the decay rate is much the same as the calculated value for the Baron Gautsch at 0.055 mm/year. The reason why the Adriatic wreck is corroding faster than the Chuuk wrecks is due to the much lower water movement inside the tropical lagoon and to the much reduced cover of encrusting marine organisms in the deeper and colder Adriatic Sea.



6. Drawings of the Baron Gautsch / Nacrt broda Baron Gautsch (From: Dundee City Archives, Scotland)

From the specifications of the Baron Gautsch the deck is at 30 metres and the plating at this location was 7.6 mm so at the calculated rate of 0.08 mm/year it is expected that most of the metal thickness has gone and so all that is left on some areas of the wreck are just a matrix of corrosion products and marine encrustations. The good management news is that the observed rates of decay match those calculated using equations developed for iron corrosion in open ocean waters. At present the awning deck and stiffeners between the decks are at risk but the deeper waters around the bottom of the vessel should still have a few mm of solid metal left in them. The data reported from this year's measurements are all consistent with the corrosion model for this culturally significant object.

Plots of the pH versus water depth shows that the acidity, which is a direct measure of the corrosion rate, fell by 0.08 per metre, which is consistent with the lowered amount of flux of dissolved oxygen. Data on the corrosion potentials are more limited but the voltages show as systematic decrease for the bow plating, the stern deck and the ship's interior as the water depth increases. The fall in the voltage is due to the corrosion rate dropping off as the flux of dissolved oxygen decreases with increasing water depth. The good news is that the in-situ data on the Baron Gautsch exhibits standard behaviour which means those charged with its protection and management can proceed with proposed interventions with confidence.

godišnje za očekivati da je veći dio debljine metala nestao, te da na nekim dijelovima olupine nije ostalo drugo doli matrice korozijskih produkata i morskih inkrustacija. Povoljna činjenica glede vođenja brige o olupini jest ta da promatrane stope propadanja odgovaraju onima izračunatim pomoću jednadžbi razvijenih za koroziju željeza u otvorenim oceanskim vodama. Natkrivenoj palubi s ukrepama prijeti potpuno propadanje, no na većoj dubini oko dna plovila još bi trebalo biti nekoliko milimetara čvrstog metala. Svi podaci iz ovogodišnjih mjerenja su u skladu s modelom korozije za ovaj kulturno značajan objekt.

Grafički prikaz pH vrijednosti u odnosu na dubinu pokazuje da kiselost—koja predstavlja izravan pokazatelj brzine korozije—pada za 0,08 po metru, što je u skladu sa smanjenom količinom toka otopljenog kisika. Manje je podataka o korozijskom potencijalu, ali izmjereni naponi pokazuju sustavno smanjenje kod pramčane oplate, krmene palube i unutrašnjosti broda kako se dubina povećava.

Kako tok otopljenog kisika pada s povećanjem dubine tako pada i stopa korozije, a posljedično i napon. Povoljna činjenica je ta da *in-situ* podaci o brodu Baron Gautsch pokazuju standardno ponašanje, što znači da oni koji su zaduženi za upravljanje i zaštitu olupine mogu s pouzdanjem nastaviti s predloženim intervencijama.

Katodna zaštita žrtvenim anodama je relevantna alternativa u nastojanjima da se zaustavi korozija metalnih potopljenih brodova.[5] Između 2019. i 2023. godine francuske institucije i laboratoriji DRASSM, LAPA, IPREM i A-CORROS udružili su snage u provedbi istraživačkog programa S.O.S. čiji je cilj proučavanje učinaka katodne zaštite na usporavanje korozije i njezin utjecaj na okoliš.[6]

Odabrane su dvije olupine iz dva različita morska

7. Samples of metal elements from the Baron Gautsch wreck / Uzorci metalnih elemenata s olupine Baron Gautsch (Photo: S. Martinez)

In order to stop corrosion of metallic shipwrecks, cathodic protection by sacrificial anodes is a relevant alternative.[5] Between 2019 and 2023, the French institutions and laboratories DRASSM, LAPA, IPREM and A-CORROS have joined forces to carry out the S.O.S research programme, which aims to study the effects of cathodic protection on the slowing of corrosion and its influence on the environment.[6]

Two wrecks were selected from two different marine environments: the *HMS Daffodil*, a 110-metre long train-ferry built in 1918, which was sunk by an underwater mine in 1946 off Dieppe (north Atlantic coast of France), and the *Liban*, a 92-metre long cargo ship built in 1882, which was wrecked in 1903, near the Marseille harbour (Mediterranean sea) (Fig. 9). The interest of these wrecks also lies in the fact that they are cut in two distinct bodies, thus allowing a comparative study between a part of the hull placed under cathodic protection and another left free, without any protection.

Even if the results on the two wrecks are different, this research programme has validated cathodic protection as a sustainable method of protection of wrecks against collapsing. The first results show that the quantity of anodes placed on the superstructure of *Le Liban* is perfectly effective. The anodes work correctly, the electrical current sent is well sized and the metal protected. On the other hand, on the bow of the *HMS Daffodil*, although it was found that the wreck reacted well to its cathodic protection, the quantity of current injected into the wreck is too low to ensure permanent protection. This can be explained by an underestimation of either the

5 MacLeod, 2018.
6 Mercier-Bion, 2018.

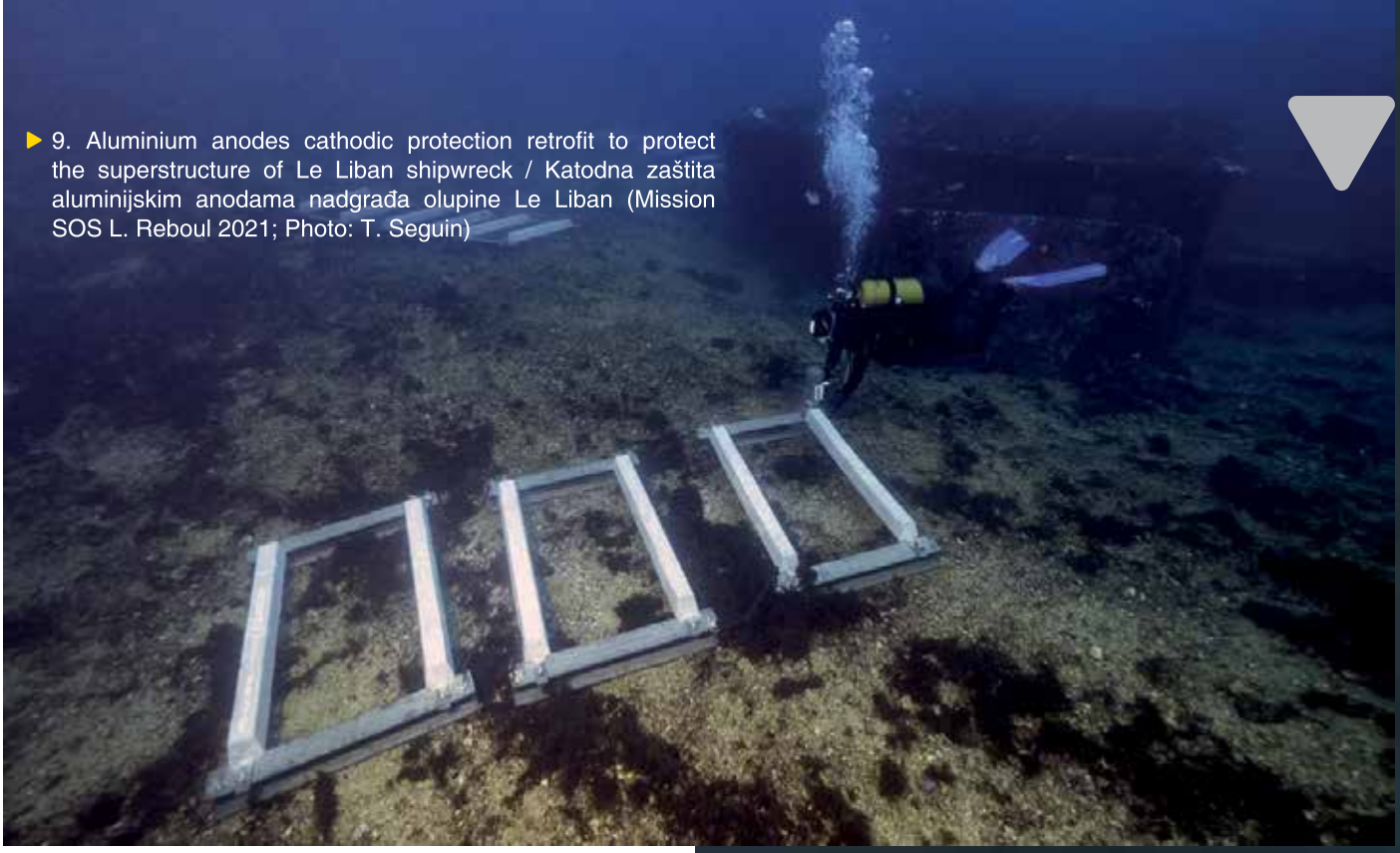
8. Shinkoku Maru showing loss of hull plating after 75 years of corrosion / Gubitak oplate trupa olupine Shinkoku Maru nakon 75 godina korodiranja (Photo: A. Selman)

okruženja: HMS Daffodil, željeznički trajekt dužine 110 metara izgrađen 1918. te potopljen u vodama blizu Dieppea (sjevernoatlantska obala Francuske) 1946. godine nakon udara u podvodnu minu, te Le Liban, teretni brod dužine 92 metra izgrađen 1882. te potopljen 1903. godine blizu luke u Marseilleu (Sredozemno more) (Sl. 9). Dodatni razlog zbog čega su nam ove olupine zanimljive jest činjenica da su obje presječene u dva zasebna dijela, što omogućuje usporedno proučavanje dijela trupa koji je pod katodnom zaštitom i dijela ostavljenog bez ikakve zaštite.

Bez obzira na različite rezultate kod ove dvije olupine, istraživački je program potvrdio katodnu zaštitu kao održiv način zaštite olupina od urušavanja. Prvi rezultati pokazuju da je količina anoda postavljenih na nadgrađe Le Libana savršeno učinkovita. Anode rade ispravno, električno strujanje je dobro dimenzionirano i metal je zaštićen. S druge strane, na pramcu broda HMS Daffodil-iako je utvrđeno da je olupina dobro reagirala na svoju katodnu zaštitu - količina struje koja teče u olupinu je premala da bi se osigurala trajna zaštita. To se može objasniti preniskom procjenom ili površine trupa koju treba zaštititi, ili debljine i utjecaja korozijskih produkata. Istodobno, proučavanje okoliša, živih vrsta i sedimenata ispod anoda dviju olupina ne pokazuje značajan porast koncentracije anodnog metala prije i nakon implementacije katodne zaštite. Može se pretpostaviti da je anodni metal razrijeđen u beskonačno velikom mediju.

Ovogodišnjom provedbom programa monitoringa na Baronu potvrdile se se naše sumnje: stanje ove slavne olupine vrlo je dramatično.

Uzorkovanjem i *in situ* mjerenjem korozijskog potencijala dobiveni su zabrinjavajući podaci. Na gornjim dijelovima broda i palubi gdje je oplata tanja, metal je u potpunosti konzumiran korozijom te je ostala samo matrica produkata korozije i morskih inkrustacija. Dobra vijest je da još uvijek ima “zdravog” metala na donjim dijelovima broda



▶ 9. Aluminium anodes cathodic protection retrofit to protect the superstructure of Le Liban shipwreck / Katodna zaštita aluminijskim anodama nadgrađa olupine Le Liban (Mission SOS L. Reboul 2021; Photo: T. Seguin)

hull surface to be protected or the thickness and infuence of corrosion products. At the same time, the study of the environment, living species and sediments under the anodes of the two wrecks does not show a significant increase in the concentration of anode metal, before and after the implementation of cathodic protection. One can imagine that the anode metal is diluted in this infinitely large medium.

This year's implementation of the monitoring programme at the Baron confirmed our suspicions; the very worrisome condition threatens this famous wreck.

Sampling and in situ measurement of corrosion potential and pH values yielded data that are cause for worry. At the upper parts of the ship and the deck, where the plating is thinner, the metal has been entirely consumed by corrosion and what remains is simply a matrix of corrosion products and marine encrustations. The good news is that there is still "healthy" metal at the lower parts of the ship, where the metal structural elements are thicker, and that in situ measurements have shown that the wreck is decaying in the standard manner.

This means that it is technically feasible to develop a suitable system to protect Baron Gautsch from the ravages of time and decay. The cathodic protection by sacrificial anodes method could be effectively applied to this invaluable shipwreck.

If measures are not taken to halt the further deterioration of the wreck, we can at some time in the not too distant future expect to hear the news that the "Titanic of the Adriatic" is little more than a heap of metal scattered across the seabed.

gdje je veća debljina metalnih konstruktivnih elemenata te da su in-situ mjerenja pokazala da olupina propada na standardan način.

Ne poduzme li se nešto da se zaustavi daljnje propadanje broda, može se u skoro vrijeme očekivati vijest da je od „Titanika Jadranskog mora" ostala samo hrpa metala rasuta po morskom dnu.

Bibliography / Literatura:

- MacLeod, I.D., 2016. - In-situ corrosion measurements of WWII shipwrecks in Chuuk Lagoon, quantification of decay mechanisms and rates of deterioration, in Frontiers in Marine Science 30 March 2016 http://dx.doi.org/10.3389/fmars.2016.00038
- MacLeod, I.D., 2018. - Sacrificial anodes preserve HMAS AE2 (1915) in the Sea of Marmara, Turkey, Corrosion and Materials 43(3) 38-41.
- Mercier-Bion, F. and Al, 2018. - The SOS project: Save Our Shipwrecks, description of the project, AAP ANR 2018.
- Pocedić, K., 2014. - Baron Gautsch: prva žrtva Prvog svjetskog rata u Istri: 1914.-2014. / das erste Opfer des Ersten Weltkriegs in Istrien / la prima vittima della Grande Guerra in Istria / the first victim of the Great War in Istria, Pula, 2014.
- Surić, R., 2021. - Inspecting and Monitoring Croatia's Protected Underwater Sites / Pregled i monitoring zaštićenih podvodnih nalazišta u Hrvatskoj, in Submerged Heritage / Potopljena baština, 11, Zadar, 20–24.

ROMAN WRECK INVESTIGATION AT SESTRICA ISLAND OFF ROVINJ WRAPS UP

ZAVRŠETAK ISTRAŽIVANJA RIMSKOG BRODOLOMA KOD ROVINJSKIH OTOKA SESTRICE

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The site of a wrecked Roman ship near Velika Sestrica island was discovered in 2013, with archaeological excavation work initiated in 2018. This year saw continued site excavation work and marked the accomplishment of the envisaged investigative objectives. The investigation of the Sestrica wreck is part of the Shipwrecks of Rovinjproject, a broad and long-term joint effort of the International Centre for Underwater Archaeology and the Bavarian Society for Underwater Archaeology (BGfU), working in collaboration with Rovinj's tourism board and heritage museum. The project aims to locate sunken ships and investigate the most promising among them. Taking part in this year's campaign were ICUA Zadar archaeologist divers Luka Bekić (field director), Maja Kaleb, and Roko Surić, joined by Michael Heinzelmeie rand Jochen Hägeleof BGfU, and by outside associate Tina Bertetić. This year's campaign ran for ten days in late September and early October. Once again the weather did not work in our favour, but by the end of the second week the archaeological team had successfully wrapped up its work.

1. An aerial view of the Sestrica site / Pogled iz zraka na nalazište kod Sestrice (Photo: R.Surić)

Nalazište ostataka rimskog brodoloma kod otočića Velika Sestrica prvi puta je uočeno 2013. g., a arheološka iskopavanja traju od 2018. godine. I ove godine nastavljena su iskopavanja nalazišta te su konačno ostvareni ciljevi predviđeni istraživanjem. Istraživanje brodoloma kod Sestrica dio je većeg, dugoročnog projekta pod imenom "Rovinjski brodolomi" koji već duži niz godina provode Međunarodni centar za podvodnu arheologiju Zadar i Bavarsko društvo za podvodnu arheologiju u suradnji s Turističkom zajednicom grada Rovinja i Gradskim muzejom Rovinja. Cilj projekta je pronaći pozicije potonulih brodova, te istražiti najzanimljivije među njima. U ovogodišnjoj istraživačkoj kampanji sudjelovali su arheolozi - ronioci MCPA Zadar, Luka Bekić, (voditelj istraživanja), Maja Kaleb, Roko Surić, te Michael Heinzelmeier i Jochen Hägele iz Bavarskog društva za podvodnu arheologiju (BGfU) kao i vanjska suradnica Tina Bertetić. Ovogodišnja kampanja trajala je deset dana, krajem rujna i početkom listopada. I ove godine vremenske prilike nisu bile naklonjene arheološkoj ekipi, ali do kraja drugog tjedna sve je uspješno završeno.

Iskopavanje brodoloma na Sestricama je tijekom ove kampanje bilo moguće provoditi samo tijekom dva dana, početkom listopada, kada su vjetrovi bili povoljni. Položaj je otvoren prema pučini s južne i zapadne strane, a s obzirom da je nalazište u pličini, jači valovi onemogućuju rad u potpunosti (Sl. 1). Istraživanja se provode na način da se uz pomoć vodene pumpe i podvodne sisaljke (tzv. mamuta) iskopavaju rupe u kamenitom dnu, gdje se zadržava sitniji sediment i arheološki nalazi. Svi posebni nalazi, metal i staklo, zatim dijelovi ručaka, oboda, dna amfora i drugog posuđa, se pojedinačno dokumentiraju na morskom dnu i potom prevoze u laboratorij na daljnju obradu. Preostali nalazi (uglavnom dijelovi trbuha amfora) se iznose na površinu samo kako bi se izbrojali i izvagali, a potom se vraćaju u već istražene jame.

Ove godine istraženo je sveukupno 14 jama i polupećina.

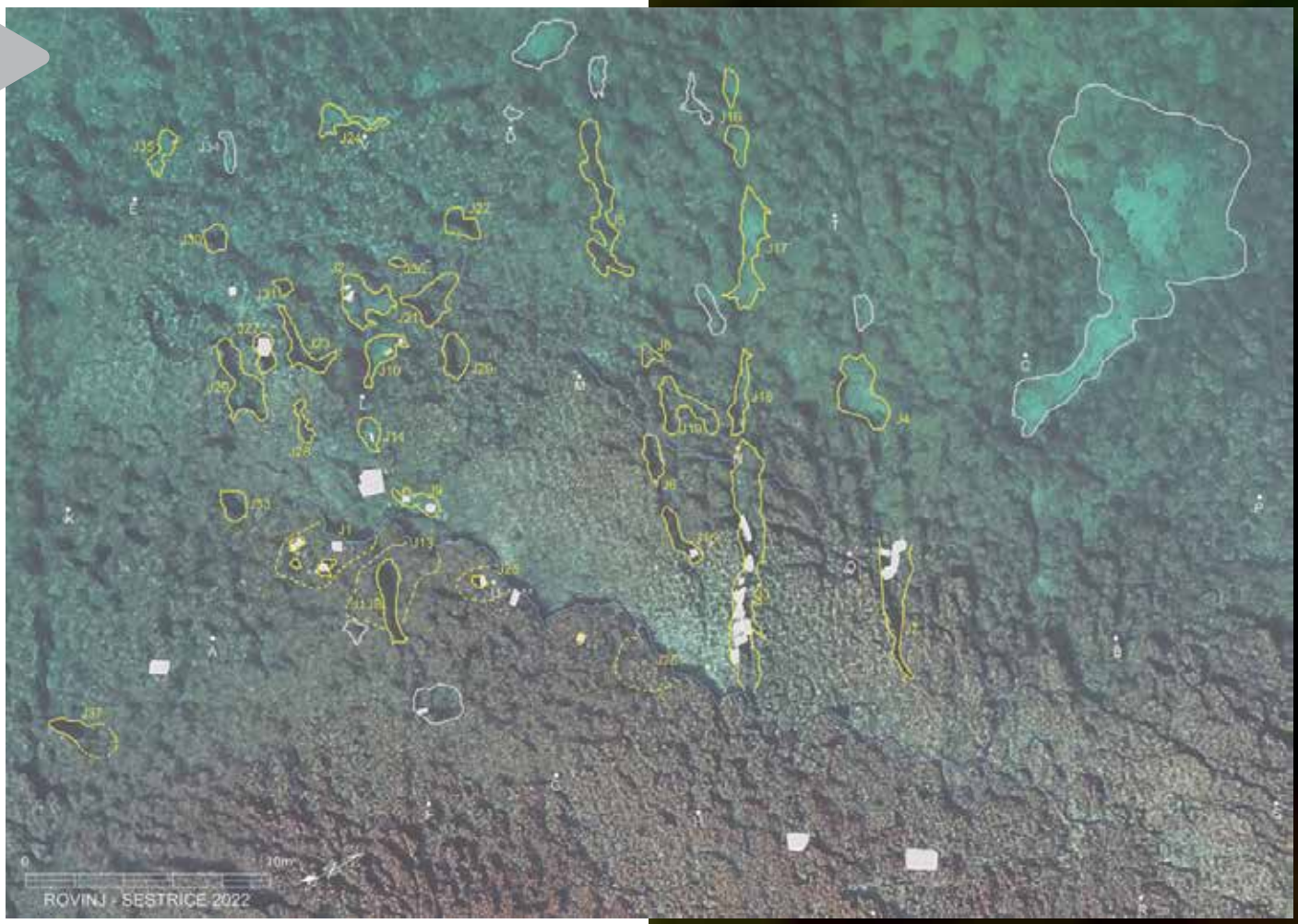
2. Excavation of SU 27,a very deep and narrow cavity / Iskop vrlo duboke i uske jame SJ 27 (Photo: M. Kaleb)

Excavation work at the Sestrica island wreck site during this campaign was limited to just two days in early October when the prevailing winds were favourable. The position faces the open sea to the south and west; because the site is in shallow water waves of any significant size make work impossible (Fig. 1). The excavation of cavities in the rocky seabed—where finer sediment and archaeological finds have been retained—was performed with the aid of a water pump-powered dredge. All special finds—metal, glass, and the handle, rim and base sherds of amphorae and other ware—were individually documented on the seabed and then transported to the laboratory for further

Iskopan je sav sediment iz jama SJ 23, 24, 25, 26, 28, 29, 30, 31, 33, 36 u kojima nije pronađeno mnogo arheoloških nalaza te jame SJ 23 i 27 u kojima je pronađeno mnoštvo pokretnih nalaza (Sl. 2). Posebno je zanimljiva bila jama - polupećina SJ 37, u kojoj je nađeno grlo amfore tipa Santarcangelo. Cijelo područje pregledano je metal detektorom, ali osim modernih otpadaka nisu pronađeni novi ulomci antičkog metala. Zadnji dan istraživanja na Sestricama napravljen je novi zračni snimak podvodnog dijela nalazišta, za potrebe fotogrametrijskog uklapanja u apsolutnu geodetsku mrežu. To je uspješno završeno i model je dobro izrađen.

U ovogodišnjoj kampanji prikupljen je 31 posebni nalaz. Među njima je pet dijelova dna, 13 dijelova ručki i četiri dijela oboda grla amfora. Osim dijelova amfora, od keramičkog stolnog posuđa pronađeno je samo dno jednog lonca. S obzirom da je zanimljivih nalaza u novim jamama sve manje, očito je da je nalazište nakon višegodišnjih istraživanja iscrpljeno i da se ne širi van prostora koji je istraživan prvih nekoliko godina (Sl. 3). Stoga se može reći da je prikupljena većina dostupnih nalaza s ovog nalazišta. Teret ovog rimskog broda bile su amfore tipa Santarcangelo i Forlimpopoli, a posadi su

3. Plan of the investigated cavities at the Velika Sestrica island Roman period wreck site / Nacrt istraženih jama na položaju rimskog brodoloma kod Velike Sestrice (By: M. Kaleb, R. Surić)



processing. The remaining finds (mostly amphorae belly sherds) were brought up to the surface only to be counted and weighed, before being restored to their respective investigated cavities.

This year we investigated 14 cavities and shallow caves. All the sediment was excavated from cavities SU 23, 24, 25, 26, 28, 29, 30, 31, 33, and 36, in which we did not find any significant number of archaeological finds, and cavities SU 23 and 27 (Fig. 2), from which an abundance of artefactswere recovered. SU 37, a cavity/shallow cave, was particularly interesting, yielding the find of the neck of a Sant'Arcangelo type amphora. The entire area was inspected with the aid of a metal detector, however no new finds were made of roman period metal fragments, only of modern scrap.A new aerial image of the underwater part of the site was produced on the final day of the investigative work at Sestrica island for photogrammetric integration with the absolute geodetic grid. This was completed and a model was successfully produced.

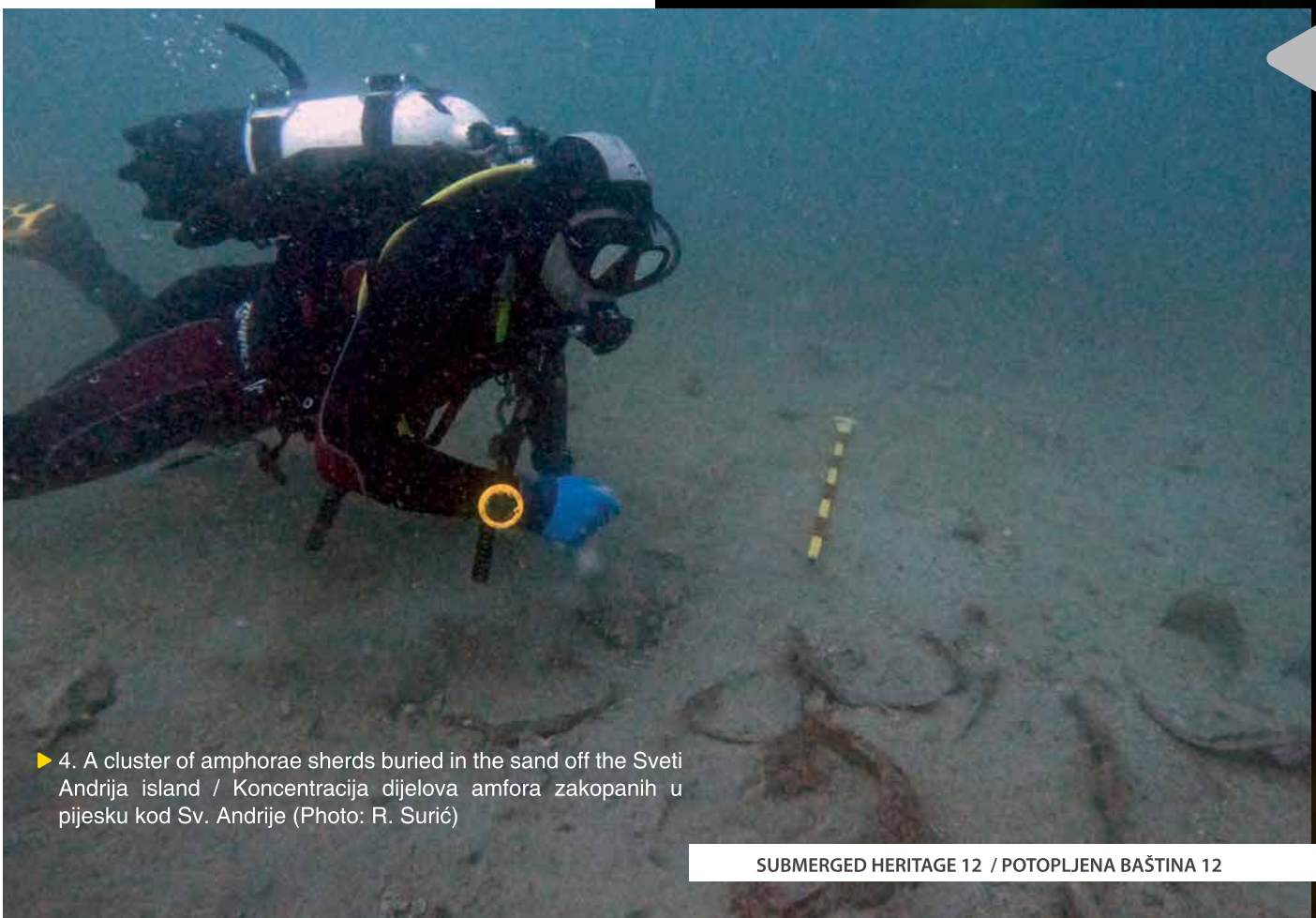
This year's campaign saw the recovery of 31 special finds. These include five base sherds, 13 handle sherds, and four rim sherds, all from amphorae. Along with the amphorae sherds, recovered ceramic tableware was limited to a base sherd from a single pot. Given the diminishing number of finds of interest in newly explored cavities it is evident that the site, after multiple years of investigation, has been exhausted and that it does not spread beyond the area investigated in the first few

pripadali brojni primjerci keramičkog i staklenog posuđa te uljanica.

S obzirom na loše vremenske uvjete tijekom ova dva tjedna, često nije bilo moguće provoditi iskopavanja na otoku Sestrice, primarno odredište istraživanja, pa je tih dana ronjeno na brojnim drugim pozicijama, koje su arheolozima iz raznih razloga bile zanimljive. S obzirom na informaciju da se između otoka Sveti Andrija i Samer nalaze ostaci nekog rimskog broda, već su prošlih godina započele pretrage ovog područja. Na žalost, osim pojedinačnih ulomaka rimske i novovjekovne keramike, dosad nije pronađena neka značajnija koncentracija nalaza koja bi ukazivala na potencijalni brodolom. Očito je da svi ti nalazi ukazuju samo na sidrište na ovom mjestu, koje je dobro zaštićeno od juga.

No ove godine je bilo više sreće. Pretraživanjem ispred pristaništa na otoku Sv. Andrija, na dubini od dvadesetak metara, pronađena je gušća koncentracija većih ulomaka amfora zakopanih u čvrsti pješčani sediment, površine oko 9 m2 (Sl. 4). Pregledom vidljivih ulomaka izdvojili smo nekoliko zanimljivih grla amfora. S obzirom da se i oko ove koncentracije nalaze daljnji ulomci amfora, postoji mogućnost da smo naišli na ostatke brodoloma koji su uočeni prije tridesetak godina, opljačkani i poslije zaboravljeni.

Od prikupljenih dijelova amfora izdvajaju se grlo amfore Dressel 6A (Sl. 5a), Dressel 6B (Sl. 5b), šiljak manje amfore, grlo amfore zaravnjenog oboda nepoznatog tipa



▶ 4. A cluster of amphorae sherds buried in the sand off the Sveti Andrija island / Koncentracija dijelova amfora zakopanih u pijesku kod Sv. Andrije (Photo: R. Surić)

years (Fig. 3). We can, thus, conclude that the bulk of available finds at this site have been recovered. The cargo borne by this ship consisted of Sant'Arcangelo and Forlimpopoli amphorae, while the crew's property consisted of numerous pieces of ceramic and glass ware and oil lamps.

Unfavourable weather during the campaign'stwo weeks often thwarted our efforts to perform excavation work at the Sestrica island site—our primary investigative target, and we used those days to dive at many other positions of archaeological interest. Information indicating a possible Roman period wreck site between the Sveti Andrija and Samer islands had seen us initiate a search of the area in previous years. Unfortunately, with the exception of discrete sherds of Roman period and post-medieval pottery, we have not to date identified any significant concentration of finds that might indicate a wreck site. All these finds point only to an anchorage site here; a position well protected against the southerly *jugo* wind.

We had better luck this year, however. A search of the area facing the quay on Sveti Andrija island at a depth of about 20 m identified a denser concentration of large amphorae sherds buried in firm sandy sediment covering an area of about nine square metres (Fig. 4). We examined the visible finds and identified a number of amphorae sherds of interest. Given that there are other amphorae sherds in the area around this cluster there is a possibility that we have come across the remains of a wreck identified some thirty years ago, later looted and forgotten.

Notable among the collected amphorae sherds are necks from Dressel 6A (Fig. 5a) and Dressel 6B amphorae (Fig. 5b), the spike of a smaller amphora, the neck of an unknown amphora type with a flat-topped rim (Fig. 5c), and a jug base sherd

5.a,b,c
Amphorae neck sherds found off Sveti Andrija island / Pronađena grla amfora kod Sv. Andrije (Photo: M. Kaleb)

(Sl. 5c) te dno vrča s početkom ručke. Za sada bi ovi nalazi datacijski mogli odgovarati jednom događaju, brodolomu iz 1. st. ali potrebno je napraviti analizu svih ulomaka koji se nalaze u ovoj koncentraciji nalaza kako bi to bilo sigurno. Osim nalaza s ovog mikro položaja, prikupljeni su još poneki nalazi na širem području između Samera i Sv. Andrije. To su ulomci novovjekovnog posuđa te razni rimski i kasnorimski ulomci amfora te jedan rimski "tubi fitili".

Dva dana kasnije, provedeno je pretraživanje ispred uvale Veštar, u cilju otkrivanja potencijalnih balastnih hrpa iz novovjekovnog razdoblja. Do sada su bile poznate brojne takve hrpe samo unutar luke Veštar. Usprkos vrlo slaboj vidljivosti, uspješno smo otkrili nekoliko hrpa koje se nalaze uglavnom na smjeru od rta Babo prema otočiću Veštar.

Naredni dan pregledavano je već otprije poznato sidrište u uvali Sv. Pelagij, u Rovinju poznatija kao "Kod bolnice". Pronađen je veći broj novovjekovnih balastnih hrpa, a jedna od njih može datirati u 15. st. što je čini jednom od najstarijih dosada uočenih (Sl. 7). Neke od balastnih hrpa sadrže i ostatke radioničkog otpada. To su rastaljeni stakleni proizvodi (Sl. 6) i razdjelnici za pečenje cakline na keramici. U uvali je pronađena i jedna izdužena kamena prečka antičkog sidra. Dužine je oko metar, a na sredini posjeduje utor koji je služio za ulaganje i privez drvene osnove sidra. Van uvale, na preko 10 metara dubine, nalazi se polje s puno ulomaka posuđa od kamenine, koje se može datirati u sredinu prošlog stoljeća. Vjerojatno se radi o otpadu iz kuhinje ortopedske bolnice.

Uz ove pozicije ponovno je pregledan položaj poznat kao "Ciglice", koji se nalazi na zapadnom dijelu otoka Sv. Ivan. Na tom mjestu ustanovljeni su ostatci kasnoantičkog brodoloma s amforama i posuđem koji potječu iz provincija sjeverne

with part of the handle. As it currently stands, the dating of these finds may indicate a single event; a 1st c. wreck. An analysis of all the sherds in this cluster of finds must, however, precede any confident conclusions. Along with the finds from this micro-location, we also collected a number of other artefacts from the broader area between the Samer and Sveti Andrija islands. These are sherds of post-medieval ware, various Roman and late Roman period amphorae sherds, and one Roman ceramic pipe of the *tubi fittili* type.

Two days later we surveyed the area facing Veštar cove with the objective of discovering possible post-medieval ballast heaps. We know of numerous such heaps located within the bounds of the harbour at Veštar. Despite the very poor visibility we successfully identified several heaps, located for the most part along the line from the Babo cape to Veštar island.

The following day we surveyed the previously known anchorage site at the Sveti Pelagije cove near Rovinj, known locally as Kod bolnice ("at the hospital"). We identified a significant number of post-medieval ballast heaps and one that may date to the 15th c., which would make it one of the oldest thus far observed (Fig. 7). Some of these ballast heaps contain construction debris. This includes melted glass products (Fig. 6) and kiln furniture used when firing glaze on pottery. Also found in the cove was an elongated stone stock from an antiquity period anchor. It has a length of about one metre, with a slot at the midpoint where the wooden shank was inserted and bound. Outside the cove, at over 10 metres depth, we identified a field with numerous stoneware sherds dated to the mid-20th c. This is likely debris from the kitchen of the orthopaedic hospital.

Along with these locations we again surveyed a position known locally as Ciglice to the west side of Sveti Ivan island. The remains of a late roman wreck with amphorae and ceramic ware from the north African provinces had been identified here. The site has, unfortunately, been thoroughly looted and we see only sporadic amphorae belly sherds.

We also revisited the position of a recently identified wreck to the west of Samer island. At this site we see numerous bricks and pan and cover roof tiles (Fig. 8). Other frequent finds are post-medieval pottery and glass. The seabed here, unfortunately, is very rocky and the finds are scattered across a broad area, such that identifying a core area is difficult. Even a survey of this kind does, however, allow us to at least more precisely date the wreck and the nature of its cargo. Judging by the sherds identified to date this is likely an 18th c. wreck.

In the course of these archaeological investigations Rovinj was the venue for an underwater archaeology

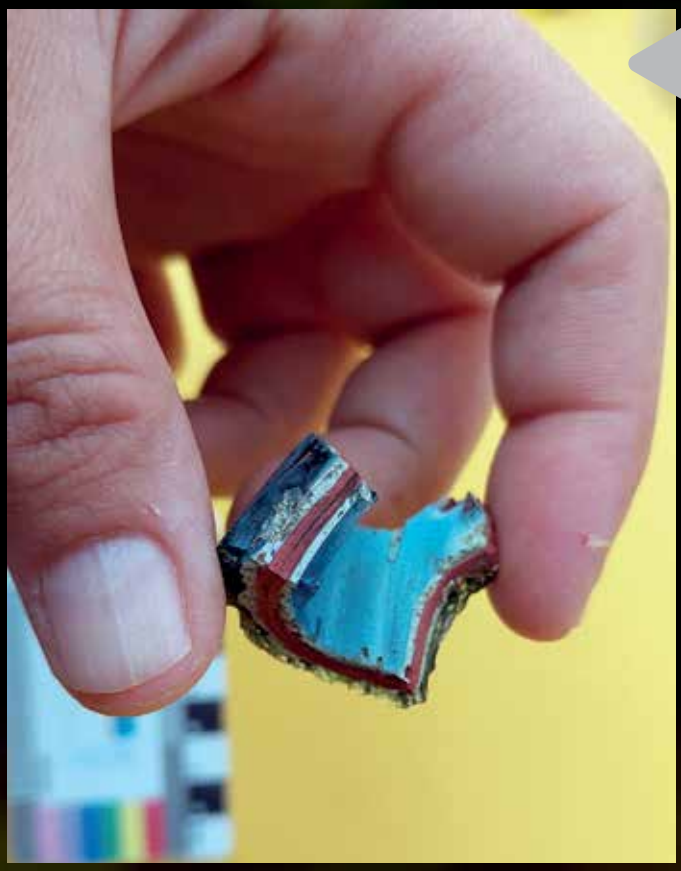
Afrike. Nalazište je na žalost potpuno opljačkano i na njemu su vidljivi samo pojedinačni ulomci trbuha amfora.

Pretraživan je ponovno i položaj nedavno otkrivenog brodoloma na zapadu otoka Samer. Tamo se pronalaze brojne opeke i dugi crjepovi (kupe). Uz njih čest nalaz je i novovjekovna keramika te staklo. Na žalost, dno je ovdje vrlo stjenovito i nalazi su raštrkani po širem području pa nije lako odrediti njegovo središte. No i ovakvim pretraživanjima moći će se barem točnije odrediti datacija i teret broda. Sudeći po zasad prepoznatim ulomcima, ovaj brodolom mogao bi se datirati u 18. st.

Tijekom ovih arheoloških istraživanja, u Rovinju se odvijao tečaj podvodne arheologije po sustavu NAS-a (Nautical Archaeology Society) kojeg je pohađalo desetak zainteresiranih osoba iz Hrvatske i inozemstva. Tečaj se održavao tri dana, od 28. do 30. rujna, na engleskom jeziku. Provedena su dva tečajna modula: "Uvod u priobalnu i podvodnu arheologiju" i "Prvi stupanj priobalne i podvodne arheologije". Na uvodnom tečaju sudjelovalo je osam polaznika, dok je na prvom stupnju sudjelovalo šest polaznika. Valja naglasiti da je tom prilikom predavanje održala i predstavnica UNESCO-a za pitanja podvodne kulturne baštine, gđa. Chihiro Nishikawa.

NAS tečajevi pružaju polaznicima tečaja (koji ne moraju biti arheolozi) uvid u temu podvodne arheologije te

▶ 6. A fragment of melted Venetian glass from Sveti Pelagije cove / Ulomak rastaljenog mletačkog stakla iz uvale Sv. Pelagija (Photo: M. Kaleb)



course based on the NAS (Nautical Archaeology Society) system, attended by participants from Croatia and abroad. The course was provided in English over three days, from 28 to 30 September. It included two modules: the Introduction to Foreshore and Underwater Archaeology, and thePart I Certificate in Foreshore and Underwater Archaeology. Eight participants took part in the Introductory module, with a further six taking part in the Part I module. Notably, the course featured a lecture from UNESCO underwater cultural heritage representative Chihiro Nishikawa.

7.
Part of a bowl from Sveti Pelagije cove with decoration typical of the 15th c. / Dio zdjele iz uvale Sv. Pelagija s ukrasima tipičnim za 15. st. (Photo: R. Surić)

NAS courses provide participants (who need not be archaeologists) insight into the topic of underwater archaeology and an opportunity to acquire skills and experience, allowing them to take part in projects and field work around the world and perhaps launch a project of their own in the future. The theoretical segments of the course modules were staged at the lecture halls of the Rovinj Underwater Activities Club (KPA Rovinj) and of the Rovinj public fire brigadelecture room (JVP Rovinj) (Fig. 9). The first module of the NAS course, Introduction to Foreshore and Underwater Archaeology, consisted of theory lectures given by ICUA Zadar underwater archaeologists Maja Kaleb, Roko Surić and Luka Bekić. The lectures discussed types of underwater sites, dating methods, underwater finds, and 2D documentation, while the practical segment covered drawing on land and underwater. The practical segment was staged in the water at the site of the antiquity period harbour at Veštar.

8. Divers with two pan roof tiles at the wreck site off Samer island / Ronioci sa dvije duge kupe na položaju brodoloma kod Samera (Photo: R. Surić)

polaznicima nude priliku da steknu vještine i iskustvo, omogućujući im da sudjeluju u projektima i terenskom radu diljem svijeta i možda pokrenu vlastite projekte u budućnosti. Teorijski dio tečajeva održan je u učionici KPA Rovinj i u učionici JVP Rovinj. Prvi modul NAS tečaja, "Uvod u priobalnu i podvodnu arheologiju" se sastoji od teoretskih predavanja koje su održali podvodni arheolozi, djelatnici MCPA Zadar: Maja Kaleb, Roko Surić i Luka Bekić. Predavanja obrađuju vrste podvodnih nalazišta i metode datiranja, podvodne nalaze i 2D dokumentiranje dok je praktični dio vezan za crtanje na kopnu i pod vodom. Praktični dio odrađen je u podmorju antičke luke Veštar. Drugi modul NAS tečaja, "Prvi stupanj priobalne i podvodne arheologije" sastoji se također od teoretskih predavanja na temu provođenja arheološkog projekta, lociranja i upoznavanja nalazišta, sigurnosti tijekom izvođenja projekta i logistika, brige o nalazima i aktivnostima nakon iskopavanja.

Ovogodišnje terensko istraživanje potvrdilo je dosadašnja saznanja o nalazištu kod otoka Sestrice. Pronađeni su daljnji ulomci amfora tipa Santarcangelo i Forlimpopoli ali nije bilo nekih iznenađenja i posebno vrijednih nalaza. Po tipološkoj analizi dosad pronađenih predmeta može se pretpostaviti kako je rimski trgovački brod ovdje stradao koncem 1. ili početkom 2. st. Predstoji konzervatorska i restauratorska obrada nalaza te priprema za objavu znanstvene monografije i prateće izložbe o ovom zanimljivom rimskom nalazištu.

9. The course was staged at the hall of the Rovinj public fire brigadelecture room / Tečaj u dvorani Javne vatrogasne postrojbe u Rovinju (Photo: M. Kaleb)

The second module of the NAS course, Part I Certificate in Foreshore and Underwater Archaeology, also consisted of theory lectures on implementing archaeological projects, locating and familiarising oneself with sites, safety when implementing a project and logistics, safeguarding finds, and post-excavation activities.

This year investigative field work confirmed what we have learned to date about the Sestrica island site. We recovered additional sherds of Sant'Arcangelo and Forlimpopoli amphorae, but there were no particularly unexpected or remarkable finds. Based on the typological analysis of the artefacts recovered to date we can posit that a Roman period commercial ship sank here late in the 1st or early in the 2nd c. The next phase will see the conservation and restoration treatment of the recovered finds and preparations for the publication of a scientific monograph and the accompanying exhibition featuring this interesting Roman period site.

With regard to the whole of the area registered as protected archaeological zone RRI 110 the finds of greatest interest—such as the sunken Roman period ship at Sveti Andrija island—remain cloaked in mystery, but we do hope to identify traces of the wreck in the near future. This is supported by the concentration of buried amphorae located this year, such that we can look forward to exploratory trenching here in the coming year. At other areas in the waters off Rovinj some positions have seen another round of surveying, which has broadened our understanding of these areas.

Što se tiče cjelokupnog područja obuhvaćenog pod brojem zaštite RRI 110, najzanimljiviji nalazi su i dalje obavijeni velom tajne, poput onog o potonulom rimskom brodu kod Sv. Andrije, ali za nadati se da ćemo mu u skoro vrijeme ući u trag. Tome ide u prilog pronađena koncentracija zakopanih amfora koja je ove godine locirana, pa se ovdje očekuje provođenje sondiranja naredne godine. Na drugim područjima Rovinjštine neke pozicije su ponovno pregledane i saznanja o njima proširena.

Bibliography / Literatura:

- Bekić, L., 2018. - Započeto sustavno istraživanje rimskog brodoloma kod otoka Velika Sestrica kod Rovinja / Systematic Excavation Starts at Rovinj's Velika Sestrica Island Roman Wreck Site, Submerged heritage / Potopljena baština 8, Zadar, 13–16.
- Bekić, L., 2020a. - Istraživanja na otoku Sestricai u okolici Rovinja 2020. godine / Investigation at Sestrica Island and the Rovinja Area in 2020,Submerged heritage / Potopljena baština 10, Zadar, 46–50.
- Bekić, L., 2020b. - Investigation of a Roman Shipwreck off Velika Sestrica Island Near Rovinj, Skyllis, 20. Jahrgang 2020, 10–16.
- Bekić, L., 2021. - Podvodna istraživanja u Rovinju tijekom 2021. godine / Underwater Investigation in Rovinj in 2021,Submerged heritage / Potopljena baština 11, Zadar, 45–50.
- Bekić, L., Kaleb, M., 2019. - Second Investigation Campaign at Sestrica Island near Rovinj / Druga kampanja istraživanja kod otoka Sestrice blizu Rovinja. Potopljena baština / Submerged Heritage 9, Zadar, 13–18.

10. Participants of the advanced segment of the NAS-based underwater archaeology course. Left to right: / Sudionici naprednog dijela tečaja podvodne arheologije po programu NAS. S lijeva na desno: Josip Vrkljan, Doris Kurtov, Roko Surić, Luka Bekić, Michael Heinzelmeier and Filip Uljanić; seated: / sjede: Chihiro Nishikawa, Maja Kaleb, and Jochen Hägele (Photo: D. Belić)

NEW INSIGHT INTO ZADAR COUNTY'S UNDERWATER CULTURAL HERITAGE

NOVE SPOZNAJE O PODVODNOM KULTURNOM BLAGU ZADARSKE ŽUPANIJE

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1. Zadar County's position / Pozicija Zadarske županije (Source: Wikipedia)

Located at the mid-point of our seaboard, Zadar County is a vital link between the northern and southern Adriatic (Fig.1). Numerous islands, navigation routes, protected coves, and marine wealth are favourable factors, while rocks lurking just below the surface, sea currents, pirates, and the unpredictable north-easterly *bura* wind are just a few of the negative factors. Taken together these factors have resulted in the great wealth of underwater culture sites in the county. From the moment of discovery each site tells a long forgotten story; a story only the underwater archaeologist can read and provide an account of for the broader public.

The Zadar County Underwater Archaeological Survey programme aims to properly approach the recording and investigation of each underwater site in the county's waters. This year's work on the programme was funded through the culture and media ministry. ICUA Zadar performed work on the programme from 15 April to 27

Smješten po sredini Jadrana prostor Zadarske županije predstavlja važnu poveznicu između njegovog sjevernog i južnog dijela (Sl. 1). Brojni otoci, plovni kanali, zaštićene uvale i bogato more povoljni su faktori, dok su skrivene hridi, morske struje, gusari i nepredvidiva bura samo od nekih negativnih faktora koji zajedno s pozitivnima rezultiraju izrazitim bogatstvom podvodnih kulturnih nalazišta u Zadarskoj županiji. Svako nalazište od trenutka otkrića priča svoju davno zaboravljenu priču koju, u tom trenutku, samo podvodni arheolog može čuti i ispričati široj javnosti.

Programom Podvodnog *arheološkog rekognosciranja* Zadarske županije nastoji se na pravilan način pristupiti evidentiranju i istraživanju svakog podvodnog nalazišta koje se nalazi njenim vodama. Ovogodišnji program financiran je od strane Ministarstva kulture i medija. MCPA Zadar program je proveo u periodu od 15. travnja do 27. listopada 2022. godine. Unatoč višegodišnjim sustavnim pregledima broj novo ubiciranih podvodnih nalazišta ne opada, već je proporcijalan broju izlazaka na teren.

Pregledom su većinom obuhvaćene arheološke pozicije za koje u znanstvenim krugovima nisu postojala saznanja i pozicije na kojima se nalaze već poznati arheološki lokaliteti. Do saznanja o nekim pozicijama došlo se

2. Departure for work in the frame of the inter-ministerial maritime coordination effort aboard the Croatian Navy ship Faust Vrančić / Odlazak na koordinaciju brodom Hrvatske ratne mornarice „Faust Vrančić (Photo: L. Bratović)

3. The team during investigative work on Ist island from left to right / Ekipa za vrijeme istraživanja na otoku Istu s lijeva na desno: Roko Surić, Luka Bekić, Goran Josifovski, Borna Krstulović, Maja Kaleb i Ivan Vidulić (Photo: I. Vidulić)

October of 2022. Notwithstanding the many years of systematic surveys, we have not seen any drop in the number of newly located underwater sites, rather it remains proportional to the number of field trips.

Both positions for which there were no indications among the specialist community that they were of archaeological interest and known archaeological sites were in our focus. Information concerning some of the positions have come to us via locals and other individuals reporting archaeological finds. Sixteen locations were surveyed across Zadar County, resulting in the discovery of eight underwater archaeological sites previously unknown to specialists.

Surveying of the Kulina/Kraljev mul site is in its second year in Privlaka.[1]This year saw continued work on the underwater imaging of a stone structure at this site. We also conducted a survey of the foreshore zone, where numerous wooden piles, having dimensions of from five to 20 cm, were observed. We performed preliminary documentation of the site with the aim of producing orthophoto imaging from which a plan of the site could later be developed. There is as yet no clear identification or date of the underwater structure and of the structures on shore.

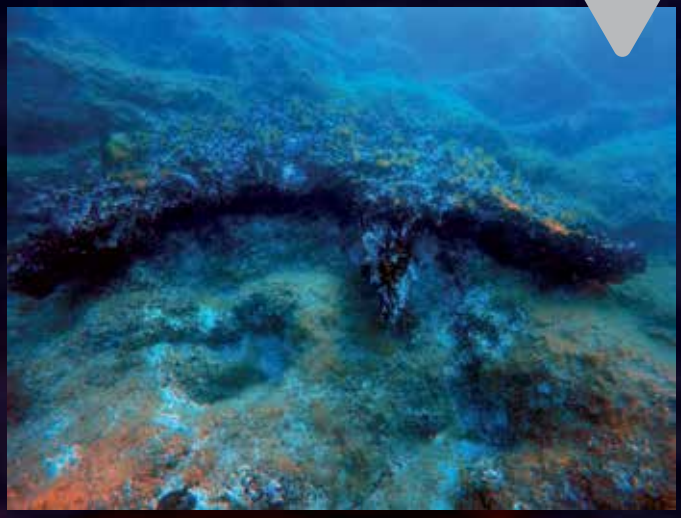
A number of locations were surveyed this year in the frame of the inter-ministerial maritime coordination body (Fig. 2). The first such location was in the waters of the Murvenjak islet at the far south end of Zadar County. The survey was performed at the southeast end of the island, off the Vrtlić cape. The survey covered the seabed around the whole of this headland, from its northern to western ends. Dives were performed to depths ranging from four to eight metres. Archaeological finds were not observed in the surveyed area during this operation.

1 Surić, Vidulić 2021, 51–52.

zahvaljujući informacijama dobivenih od strane građana, koji su na tim lokacijama prepoznali arheološke nalaze. Pregledano je 16 pojedinačnih lokacija diljem Zadarske županije, a to je rezultiralo otkrićem osam podvodnih arheoloških lokaliteta koji su stručnoj javnosti do sad bili nepoznati.

Drugu godinu zaredom vrši se pregled lokaliteta „Kraljev muja“ na položaju Kulina u Privlaci.[1] Ove godine ponovno se provelo podvodno snimanje kamene strukture. Osim podvodnog dijela, napravljen je pregled obalnog pojasa na kojem djeluju plima i oseka, na kojem su uočeni brojni drveni piloni dimenzija od 5 do 20 cm. Nalazište je preliminarno dokumentirano s ciljem da se napravi ortofotografija nalazišta, iz čega bi se naknadno mogao izvući nacrt. Determinacija i vremenska datacija podvodne strukture i struktura na obali ostaju i dalje nerazjašnjeni.

U sklopu koordinacije ministarstava Republike Hrvatske na moru ove godine pregledano je nekoliko lokacija (Sl. 2). Prva lokacija bila je uz otočić Murvenjak na samom jugu Zadarske županije. Pregled je napravljen na jugoistočnom dijelu otoka, uz rt Vrtlić. Pregledom je obuhvaćeno podmorje uz cijeli rt, od njegovog sjevernog dijela do zapadnog dijela. Ronilo se na dubinama od 4 do 8 metara. Ovom prilikom nisu uočeni arheološki nalazi na pregledanom području.



4. A large conglomerate of amphorae sherds at the wreck site off the Turtula cape / Veliki konglomerat ulomaka amfora na brodolomu u podmorju rta Turtula (Photo: L. Bekić)

Ove godine arheološki pregled otoka Ista trajao je pet radnih dana (Sl. 3). Za početak se nastavilo sa sustavnim pregledom sjeverne strane otoka, na mjestu gdje je prošle godine pregled stao, a radi se o uvali Turtula (Sl. 4). Iz nje se krenulo uz obalu u smjeru sjeverozapada. Završna točka pregleda je podmorje uz položaj Veliki Tuf. Pregledavalo se podmorje dubine od 4 do 13 metara. Ovogodišnji pregled obuhvatio je najveći dio od ukupne dužine sjeveroistočne obale otoka odnosno 2800 metara od ukupnih 5000 metara obale na toj strani Ista. Ukupna

This year the archaeological survey of the island of Ist ran for five days (Fig. 3). We began with the continuation of the systematic survey of the north side of the island where work left off last year at the Turtula cove (Fig. 4). From there we worked along the coast heading northwest. The final point was the seabed off the Veliki Tuf position. The seabed was surveyed at depths ranging from four to 13 metres. This year's work covered most of the full length of the island's northeast shore, i.e., 2,800 of the total of 5,000 metres of shoreline on this side of Ist island. The total area covered by this year's survey of the seabed is about 24 hectares. This year's effort again yielded results, further confirming the importance of the systematic underwater archaeological surveying of the northeastern side of Ist island.

The survey of the seabed yielded the find at the north entrance to the Turtula cove of numerous fragmented amphorae sherds in the fissures and clearings between the rocks on the seabed. A preliminary analysis indicates that these are amphorae of the Africana 1A Piccolo/Keay IIIA form.

The remains of a large antiquity period wreck were observed at the Prisika position. It is characterised by numerous highly fragmented amphorae sherds, with conglomerates of encrusted sherds observed at three places (Fig. 5). A preliminary examination found that the ship's cargo consisted of Sant'Arcangelo and Lamboglia II form amphorae, and sherds of other highly fragmented ceramic tableware.

▶ 5. A diver examines a conglomerate at the wreck site off Prisika cape / Ronilac u pregledu konglomerata na brodolomu u podmorju rta Prisika (Photo: L. Bekić)

površina koja je obuhvaćena ovogodišnjim pregledom podmorja iznosi oko 24 hektara. Rezultat ni ove godine nije izostao i to daje dodatnu potvrdu važnosti sustavnog podvodnog arheološkog pregleda sjeveroistočne strane otoka Ista.

Na sjevernom ulazu u uvalu Turtula pregledom dna otkriveni su brojni usitnjeni ulomci amfora u procjepima i čistinama među stijenama na morskom dnu. Preliminarnom analizom ustanovljeno je da se radi o amforama tipa *Africana 1A Piccolo - Keay IIIA*.

Na položaju Prisika uočeni su ostaci većeg brodoloma iz vremena antike (Sl. 5). Karakteriziraju ga brojni usitnjeni ulomci amfora, a na tri mjesta na lokalitetu uočeni su i konglomerati inkrustriranih ulomaka. Preliminarnim pregledom ustanovljeno je da su teret broda činile amfore *Santarchangelo i Lamboglia II* te ulomci ostalog sitnijeg stolnog keramičkog posuđa.

Treći lokalitet otkriven je na položaju Mali Tuf. Radi se o manjem brodolomu na kojem su uočeni jako usitnjeni ulomci amfora otkriveni na prostoru od 20 x 20 metara. Ulomci se mogu okarakterizirati kao dijelovi *Lamboglia II* amfora. Kao u slučaju prethodna dva nalazišta nisu otkriveni elementi broda.

6. The metal remains of a German vessel in the Kozja draga cove / Metalni ostaci njemačkog broda u uvali Kozja draga (Photo: R. Surić)

The third site was identified at the Mali Tuf position. This is a small wreck at which we observed very highly fragmented amphorae sherds, found across an area of 20 by 20 metres. The sherds are from Lamboglia II amphorae. As with the previous two sites, we did not identify the remains of a ship.

Numerous metal finds were discovered in the course of the survey of the seabed of the Kozja draga cove, which were initially thought to be metal parts of a disintegrating modern boat (Fig. 6). Upon our arrival at the settlement of Ist the local inhabitants recounted events from WWII that saw a prevailing northeastern *bura* wind trap a German boat in the cove. The boat remained at the location after the war ended and was later disassembled and removed from this position. An examination of elements brought up to the surface indicates that they are most likely parts of the German boat.

Other positions surveyed in the waters of Ist island were the Mavrela and Pud Muciji coves, and three positions in the Zapuntel channel (Fig. 7). The survey of the seabed of both coves found numerous post-medieval finds. For the most part these include sherds of post-medieval ware and fragmented bricks. Two ballast heaps were identified

7. A diver examines a ballast heap in the Mavrela cove / Ronilac za vrijeme pregleda balastne hrpe u uvali Mavrela (Photo: R. Surić)

Pregledom uvale Kozja draga na morskom dnu su uočeni brojni metalni nalazi, za koje se u prvi tren pomislilo da se radi o metalnim dijelovima raspadnutog modernog čamca. Dolaskom u mjesto Ist mještani su nam ispričali događaj iz drugog svjetskog rata u kojem se u uvali Kozja draga našao burom zahvaćen njemački brod (Sl. 6). On je na tom mjestu ostao i nakon završetka rata, no kasnije ga se razmontiralo i odnijelo s te pozicije. Pregledom izronjenih elemenata zaključeno je da su najvjerojatnije pripadali tom brodu.

Od ostalih pozicija u podmorju otoka Ista pregledane su uvale Mavrela i Pud Muciji te tri pozicije u Zapuntelskom kanalu (Sl. 7). Pregledom podmorja obiju uvala uočeni su brojni novovjekovni nalazi na morskom dnu. Radi se uglavnom o ulomcima novovjekovnih posuda i fragmentiranim opekama. Na južnom dijelu uvale Mavrela otkrivene su dvije balastne hrpe s ovećim kamenjem izmiješanim s opekama. Nalazi upućuju da se u obje uvale u nekom trenutku izbacio balast iz broda, a velika je vjerojatnost da se to dogodilo uslijed ukrcaja tereta u brod.

U Zapuntelskom kanalu pregledane su još tri pozicije. Nastavljen je pregled lučice Zapuntel na Molatu. Ove godine nastojalo se pregledati područje koje nije pregledano u prošlogodišnjem istraživanju.[2] Druga pozicija koja je pregledana nalazi se po sredini Zapuntelskog kanala na dubini od 25 do 30 metara. Pregled je izvršen na temelju dojave ribara iz Zapuntela koji je na toj poziciji slučajno u ribarskoj mreži izvukao keramičku posudu. Pregledom šireg prostora nije otkriveno arheološko nalazište, no primijećeno je da se po morskom dnu kanala nalaze nepovezani nalazi iz šireg vremenskog perioda, od antike do novovjekovnog perioda. Velika je vjerojatnost da je ribar mrežom slučajno zakačio jedan od tih pojedinačnih nalaza na dnu.

Najzanimljivija pozicija u ovogodišnjem pregledu Zapuntelskog kanala nalazi se na istočnom ulazu u

8. The remains of a wreck on the seabed off the Vranač cape in the Zapuntel channel / Ostaci brodoloma u podmorju rta Vranač u Zapuntelskom kanalu (Photo: R. Surić)

in the south end of the Mavrela cove comprised of large stones and bricks. The finds indicate that ballast was jettisoned from ships at some point in time in both coves, with a high likelihood that this occurred in the course of the loading of cargo.

Three positions were surveyed in the Zapuntel channel. We continued the survey of the small harbour at Zapuntel on Molat island. Our efforts this year were directed at surveying the area that had not been covered during last year's work.[2] The second surveyed position lies at the middle of the Zapuntel channel at a depth of from 25 to 30 metres. The survey was prompted by a report from a fisherman from Zapuntel who made a chance discovery of a ceramic vessel caught in a fishing net at this position. The survey of the broader area did not reveal the presence of an archaeological site, but did observe unrelated finds from a broad chronological range, from antiquity to the post-medieval period, scattered across the seabed of the channel. It is very likely that the fisherman's net caught one of these individual artefacts on the seabed by chance.

The position of greatest interest covered by this year's work in the Zapuntel channel is located at its eastern ingress. Amphorae sherds were identified on the sandy seabed off the Vranač cape (Fig. 8). Although not intact, the amphorae have survived to a significant degree and we can conclude that they are of the Lamboglia II type. The finds are scattered across an area of about 20 by 10 metres. As the seabed here is sandy, there is hope that remains of a wreck may still be present under the sediment.

A number of positions, four of which are located near Dugi otok island, were visited in the frame of the inter-ministerial maritime coordination. At the north end of the island we surveyed the seabed from the Barja to Tomanje capes. Off the Tomanje cape we found the remains of an

2 Surić, Vidulić 2021, 54–56.

9. The remains of an antiquity period quay in the Šipnata cove on Dugi otok island / Ostaci antičkog pristaništa u uvali Šipnata na Dugom otoku (Photo: L. Bekić)

kanal (Sl. 8). U podmorju rta Vranač na pješčanom dnu su otkriveni komadi amfora. Iako nisu cijele, amfore su sačuvane u većoj mjeri i može se zaključiti da se radi o *Lamboglia II* amforama. Nalazi se rasprostiru na prostoru od oko 20 x 10 metara. Pošto se radi o pješčanom dnu, ostaje nada da se u sedimentu nalazi još ostataka brodoloma.

U sklopu koordinacije ministarstava Republike Hrvatske na moru otišlo se na pregled nekoliko pozicija među kojima se četiri nalaze u blizini Dugog otoka. Na sjevernom dijelu otoka pregledano je podmorje od rta Barja do rta Tomanje. Na prostoru rta Tomanje otkriveni su ostaci antičkog brodoloma s ulomcima *Portorecanati* amfora. Područje rasprostiranja ulomaka je relativno malo i iznosi tek 10 x 5 metara pa se može pretpostaviti kako se radi o ostacima manjeg brodoloma.

Pregledana je pozicija u uvali Šipnata, sjeverno od mjesta Božava na Dugom otoku (Sl. 9). Konzervatorski Odjel u Zadru dobio je dojavu da se na morskom dnu u toj uvali mogu pronaći arheološki nalazi. Dolaskom na poziciju ustanovljeno je da se doista širom uvale nalaze brojni ulomci antičkih amfora. Detaljnijim pregledom ustanovljeno je da se bliže obali na jugoistočnom dijelu uvale nalaze ostaci antičkog pristaništa, odnosno konstrukcija od kamenja i amfora cementom povezanih u čvrstu strukturu. Na osnovu pregledanih nalaza može se zaključiti da je pristanište bilo u funkciji kroz čitav antički period.

Na južnoj strani Dugog otoka obavljena su dva pregleda. Prvi je obavljen na prostoru rta Vidilica koji je najjužniji rt otoka (Sl. 10). Pregledom je na sjevernoj strani rta uočeni su ostaci antičkog pristaništa. Načinjeno je od kamena lomljenca i pokojeg ulomka tegule i amfore. Uokolo strukture pronalaze se brojni ulomci antičkih amfora. Dubina je na pregledanom podmorju iznosila od 5 do 20 metara. Na jugozapadnom dijelu rta uočeno je željezno

antiquity period shipwreck with sherds of Porto Recanati amphorae. The area of the distribution of the sherds is relatively small (10 by five metres), such that we can posit that this is the site of the wreck of a small ship.

A position in the Šipnata cove, to the north of the settlement of Božava on Dugi otok island, was also surveyed (Fig. 9). The Conservation Department in Zadar received a report that there were artefacts to be found in this cove. Upon our arrival we confirmed that there were in fact numerous sherds of antiquity period amphorae scattered across the seabed. More detailed observation identified the remains of an antiquity period quay—a structure of stone and amphorae bonded into a solid structure with cement—near the shore in the southeast end of the cove. Based on the examined finds we can posit that the quay was in operation throughout the whole of the antiquity period.

Two locations were surveyed to the south side of Dugi otok island. The first was the Vidilica cape, the southernmost headland on the island (Fig. 10). To the north side of the cape the survey found the remains of an antiquity period quay. It was made of rubble masonry with sporadic sherds of tegulae and amphorae. Around the structure we see numerous sherds of antiquity period amphorae. The depth of the surveyed seabed ranges from five to 20 metres. An iron anchor was observed off the southwest end of the cape along with a section of aluminium plating that may have been part of an airplane. The anchor appears to have three arms and lies jammed between rocks on the sloping seabed.

Survey work was also performed at the Katina cove on Katina island (Fig. 11). Work at this location was motivated by its proximity to the Vela Proversa channel. Our postulation was confirmed as we observed finds in the cove from a broad chronological range from prehistory to the post-medieval period.

This year's archaeological reconnaissance has contributed to our overall insight into the archaeological potential of the waters of Zadar County. Raising the level of our understanding—and thereby protection—of underwater cultural heritage in Zadar County to the highest possible level will require the systematic surveying of locations that have shown evident archaeological potential.

10. Surveying the antiquity period quay in the Vidilica cove on Dugi otok island / Pregled antičkog pristaništa u uvali Vidilica na Dugom otoku (Photo: R. Surić)

sidro i dio aluminijske oplate za koju se pretpostavlja da bi mogla biti dio zrakoplova. Sidro je naizgled trokrako i leži zaglavljeno između stijena na padini.

Pregled je obavljen i na prostoru uvale Katina na istoimenom otoku (Sl. 11). Razlog za pregled je blizina prolaza Vela Proversa. Sumnja se potvrdila jer se na prostoru uvale uočavaju nalazi koji se vremenski mogu smjestiti u široki vremenski okvir, od prapovijesti do novovjekovnog razdoblja.

Ovogodišnji program rekognosciranja doprinio je cjelokupnom poznavanju arheološkog potencijala koji se krije u podmorju Zadarske županije. Kako bi se razina poznavanja, a time i zaštite podvodnog kulturnog blaga u Zadarskoj županiji podigla na najveću razinu, potrebno je provoditi sustavne preglede lokacija s arheološkim potencijalom.

11. Surveying the finds in the Katina cove in the Vela Proversa channel / Pregled nalaza u uvali Katina u kanalu Vela Proversa (Photo: L. Bekić)

Bibliography / Literatura:

- Surić, R., Vidulić, I., 2021 - Zadar County Underwater Archaeological Survey Programme Continues / Nastavak programa podvodnog arheološkog rekognosciranja Zadarske županije; *Potopljena Baština / Submerged Heritage 11*, Zadar, 51 – 57.

RUINS OF A MEDIEVAL MONASTERY IN THE DANUBE NEAR THE HÁROS ISLAND IN BUDAPEST

KÖZÉPKORI KOLOSTOR ROMJAI A DUNÁBAN A BUDAPESTI HÁROS-SZIGETNÉL

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Budapest has several extensive islands with significant prehistoric, Roman (e.g. Hadrian's Palace on Hajógyári Island) and medieval sites and architectural monuments. Háros Island, located on the southern course of the Danube, is not even known to the majority of local citizens, although the Premonstratensian and later Pauliner monastery and the associated village have been the subject of numerous previous studies, but modern,

1. Islands of the Danube at Budapest / A Duna szigetei Budapesten

Budapest több kiterjedt szigettel büszkélkedhet, amelyeken jelentős őskori, római (pl. Hadrianus-palota a Hajógyári-szigeten), illetve középkori lelőhelyek, építészeti emlékek találhatóak. A Duna déli szakaszán található Háros-sziget még a budapestiek többsége számára sem ismert, holott a premontrei, majd pálos kolostor, illetve a kapcsolódó falu számos korábbi tanulmány témáját képezi, azonban modern, szisztematikus, teljességre törekvő régészeti kutatása mind szárazon, mind vízen még várat magára (1. kép).

Az egykori Csút falu és a közelében található kolostor kutatása két szálon fut. Míg a falut az elmúlt 80 évben sokan és sokszor vizsgálták, addig a történeti adatokkal bőségesebben ellátott kolostornak sokáig a pontos helye is kérdéses volt.

Gerevich László az 1940-es években kezdte meg a Hárosi Furnérgyár alatt a középkori falu kutatását. A II. Világháborúig feltárta a falu templomát, és a temető jelentős részét, valamint a késő-középkori település kőházait. Később Gerő Győző, Méri István, Irásné Melis Katalin és Terei György végeztek kutatást a területen. A régészeti feltárások eredményéből kiderült, hogy a gyár alatt a több periódusban felépült templom körül helyezkedett el a késő-középkori település, tőle észak-keltre egy kicsit távolabb pedig az Árpád-kori falu. A török kor elején elnéptelenedett a helyszín.

A premontrei monostort IV. Béla (1235-1270) alapította 1264-ban. Mind ő, mind utódai V. István (1270-1272) és Kun László (1272-1290) többször megfordult itt. 1475-ben változás állt be, amikor Hunyadi Mátyás (1458-1490) elvette a premontreiektől és a pálosoknak adta. A monostor már a török hódoltság első évtizedeiben pusztulásnak indul, elhagyják.

Helye sokáig kérdéses volt. A 19. századi műemlék összeírásokban szerepel, Rómer Flóris 1864-ben fel is mérte, leírást is adott róla. Később, részben a romokra

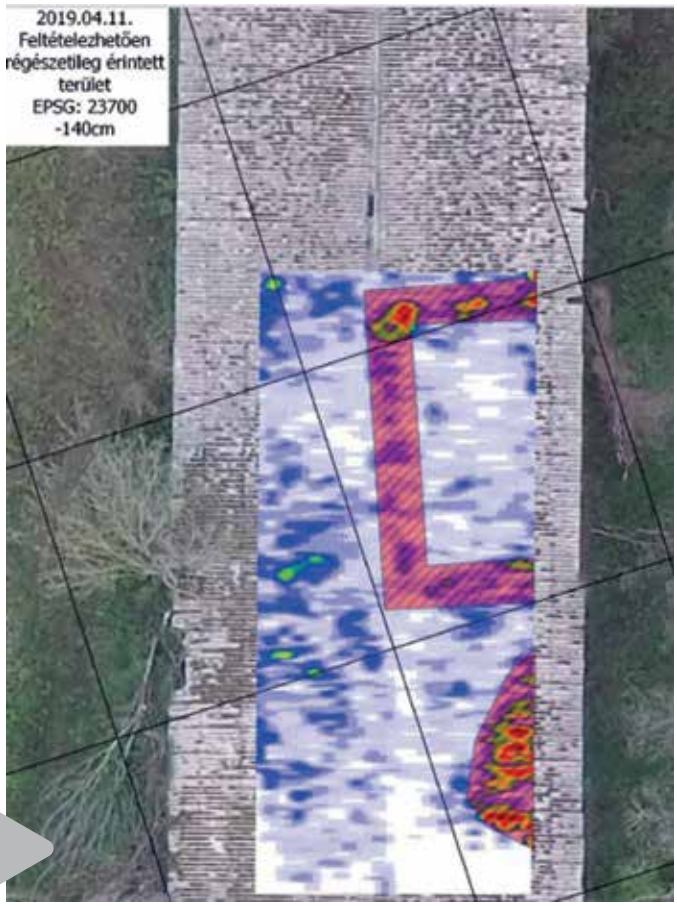
systematic and comprehensive archaeological research on both land and underwater is still awaited (Fig. 1.)

The research on the former village of Csút and the nearby monastery runs on two ways. While the village has been studied many times over the past 80 years, the exact location of the monastery, which is rich in historical data, has long been a question mark.

László Gerevich began his research of the medieval village in the 1940s, under the ”Háros Veneer Factory”. Until World War II, he excavated the church of the village and a large part of the cemetery, as well as the stone houses of the late-medieval settlement. Later on, Győző Gerő, István Méri, Katalin Irásné Melis and György Terei carried out researches in the area. The results of the archaeological excavations revealed that the late-medieval settlement was located around the church, which was built in several periods, under the factory, and the Árpádian-period village was a little further north-east. The site was deserted at the beginning of the Turkish period.

The monastery was founded by Béla IV (1235-1270) in 1264. Both he and his successors, Stephen V (1270-1272) and László IV ”the Cumanian” (1272-1290), visited the monastery several times. In 1475 a change took

2. Geophysical survey map with possible mural features, East part of the Háros Island, under a warehouse. Copyright: György Terei, BTM / A Háros-sziget keleti partjának geofizikai felmérése, falmaradvány a raktárépület alatt. Terei György, BTM



vadászlak épült. A végső pusztulása a 20. század első felében volt, amikor egy nagy méretű raktár építésével még az addig meglévő romokat teljesen a földdel tették egyenlővé. A 30-as évektől többen jártak a területen, hogy beazonosíthassák a pontos helyszínt, de mindenki csak a negatív eredményeket tudta feljegyezni. A 2000-es évektől lelkes helyi lokálpatrióták lendítették fel a kutatást. Beazonosították a Rómer Flóris által is lejegyzett kutat, 2019-ben a Pázmány Péter Katolikus Egyetem munkatársai talajradaros felmérést végeztek, mely falakra utaló nyomot jelzett a raktártól délre (2. kép).

2021 októberében a Budapesti Történeti Múzeum és az Árpád Múzeum együttműködésében, civil segítők bevonásával oldalpásztázó szonáros térképezést végeztünk a sziget keleti partja mentén. A kutatást motorcsónakból, egy Huminbird Helix SI Mega szonárral végeztük. Több, további kutatásra érdemes területet is találtunk. A legígéretesebbet azon a ponton, ahol a sziget kiszélesedik, partvonala megtörik. Itt a parton újkori raktárépületek látszanak. Ezen a részen a part előtt egy a környezetéből kiemelkedő, markánsan leszakadó szélű víz alatti plató található. A kiszélesedésnél meredeken, 2 métert emelkedik a meder, a lejtő „grízes” szerkezete arra utal, hogy ez egy masszív omladékhalom. A halom tetején néhány nagyobb tárgy látszik, ezek közül az egyik téglalap alakú, oldalhosszúsága ca. 60x80 cm. Több szonárfelvétel alapján elkészítettük a jelenség szonár-mozaikját (3. kép).

A szonárfelvételek készítését követően egy teljes adatfelvétel készült, a területet párhuzamos sávokban beszkenneltük. Az adatokat Humminbird AutoChart Pro szoftverrel feldolgozva szintvonalas térképet készítettünk (4. kép). Légifotóra helyezve a térképet látható, hogy a part mentén húzódó kiemelkedés, a kapcsolódó széles plató pontosan annak a raktárnak a szomszédságában található, ahol a régészeti geofizika alapján falmaradványokat lehet feltételezni a parton. A műszer ugyanakkor nem képes megállapítani, hogy az omladék modern planírozás emléke, vagy a középkori kolostor romja.

2022 júliusában visszatértünk a szigetre, hogy azonosító merülésekkel kiderítsük, vajon az omladékmező modern planírozás eredménye, vagy régészeti lelőhely maradványa. A Duna parton található kutatási területet az egykori honvédségi sólya irányából, vízen, csónakkal közelítettük meg, mivel a meredek part felől az ártéri dzsungel nem tette lehetővé a part elérését. A helyszínen a part meredek, egy romos, faragott köveket tartalmazó lépcső található a sziget vonalát markánsan megtörő kiszögellésnél.

Két merülést hajtottunk végre egymást követően dr. Puskás Norbert régészeti búvárral. A merülések során

place, when Mathias Hunyadi (1458-1490) took it from the Premonstratensians and gave it to the Order of Saint Paul. The monastery began to decline in the first decades of the Turkish occupation and then it was abandoned.

For a long time its location was unknown. It is listed in the 19th century monument inventories, and Flóris Rómer surveyed and described it in 1864. Later, a hunter's house was built partly on the ruins. Its final destruction was in the first half of the 20th century, when a large warehouse was built and the ruins that had existed until then were completely levelled with the ground. In the 1930s, several researcher visited the area to identify the exact site, but all could only record negative results. Since the 2000s, enthusiastic local patriots have given a boost to the search. They identified the well, which had been described by Flóris Rómer, and in 2019, a ground-penetrating radar survey by staff of Pázmány Péter Catholic University revealed possible traces of a wall south of the warehouse (Fig. 2).

In October 2021, in cooperation with the Budapest Historical Museum and the Árpád Museum, we carried out a side-scan sonar survey along the eastern coast of the island with the help of civilian assistants. The survey was carried out from a motorboat with a Huminbird Helix SI Mega sonar. We found several areas waiting for further exploration. The most promising one was at the point where the island widens and its coastline breaks. Here one can see modern warehouses on the shore. In this part of the beach there is a submerged plateau with a pronounced drop-off edge in front of the shore. The bank rises steeply by 2 m at the widening point, and the ''gritty'' structure of the slope suggests that this is a massive rubble pile. A few larger objects are visible at the top of the mound, one of which is rectangular, with sides measuring about 60x80 cm. A sonar mosaic of the features was made based on several sonar images (Fig. 3).

After the sonar images were taken, a full bathymetric data collection was taken and the area was scanned in parallel bands. The data were processed using Humminbird AutoChart Pro software to produce a bathymetric map (Fig. 4). Superimposed on the aerial photograph, the map shows that the broad plateau is located exactly adjacent to the repository where archaeological geophysics suggests wall remains on the shore. However, the instrument is unable to determine whether the rubble is the result of a modern levelling or a ruin of a medieval monastery.

In July 2022, we returned to the island to conduct identification dives to find out whether the debris field was the result of modern levelling or the remains of an archaeological site. The research area on the Danube

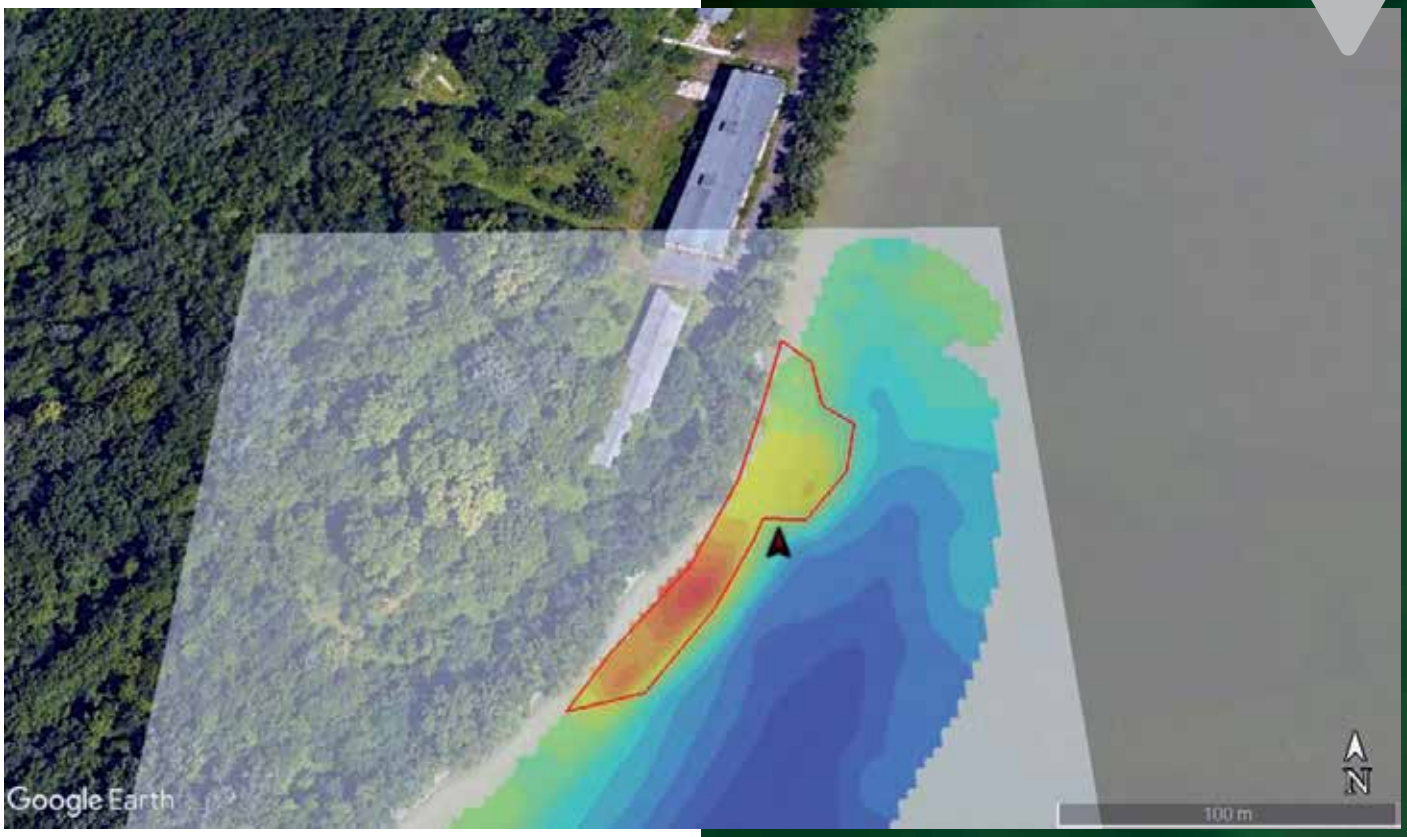
3. Mosaic of sonar images of the underwater debris-mound / A víz alatti omladékhalom szonárfelvételeiből készített mozaik kép (By :A. Tóth)

azonosítottuk a széles, lapos platót, amely számos faragott mészkövet tartalmaz, de vegyesen modern tégla és fém is található a felszínen. A plató déli lejtőjén végzett merülésen ugyanezt tapasztalatuk. A lejtő alján és a plató tetején is találtunk egy-egy lapos, téglalap alakú faragott mészkövet, egyik oldalán lépcsőzetes lefaragással, felszínén négyzetes (kb. 5x5 cm) üregekkel.

A platótól délre, a part mentén is jelzett egy markáns kiszögellést a szonár. Ezen a területen is találtunk néhány mészkövet, de a kövek többsége a térségben szokásos bazalt kövezésre utal.

A part mentén is megfigyeltünk egy lapos faragott követ négyzetes üregekkel (5. kép). Pinpointerrel megvizsgálva megállapítható, hogy az üregekben valamilyen fém, feltehetően ólom van, amelyet a kövek, illetve fa elemek rögzítésére használhattak. A lapos faragott kövek feltételezésünk szerint középkori nyílászáróhoz tartozhattak.

A Magyar Nemzeti Levéltár digitálisan közzétett állományában nemrég azonosítottunk egy 1852-re keltezett, kéziratos térképet, amelyet tévesen a szomszédos Csepel-szigethez soroltak, de a Duna



bank was approached by boat from the direction of the former military slipway, as the naturally grown ''jungle" on the steep bank did not allow access to the shore. At the site, the shore is steep, with a ruined staircase of carved stones at a prominent outcrop that breaks the island's contour.

We made two dives with the help of archaeological diver Norbert Puskás. During the dives we identified the broad, flat plateau with numerous carved limestones, but also a mixture of modern brick and metal on the surface. On a dive on the southern slope of the plateau we observed the same.

At both the bottom and the top of the plateau, a flat rectangular carved limestones were found, with a stepped cut on one side and square (about 5x5 cm) cavities on the surface. South of the platform, along the coast, the sonar also showed a prominent outcrop. A few limestones were also found in this area, but most of the stones indicate the basaltic riverbank reinforcement common in the area.

Along the coast, we also observed a flat carved stone with square cavities (Fig. 5). Examination with a pinpointer of the cavities revealed that they contained some kind of metal, presumably lead, which could have been used to fasten the stones or wooden elements. The flat carved stones are thought to have belonged to a medieval window or door frame.

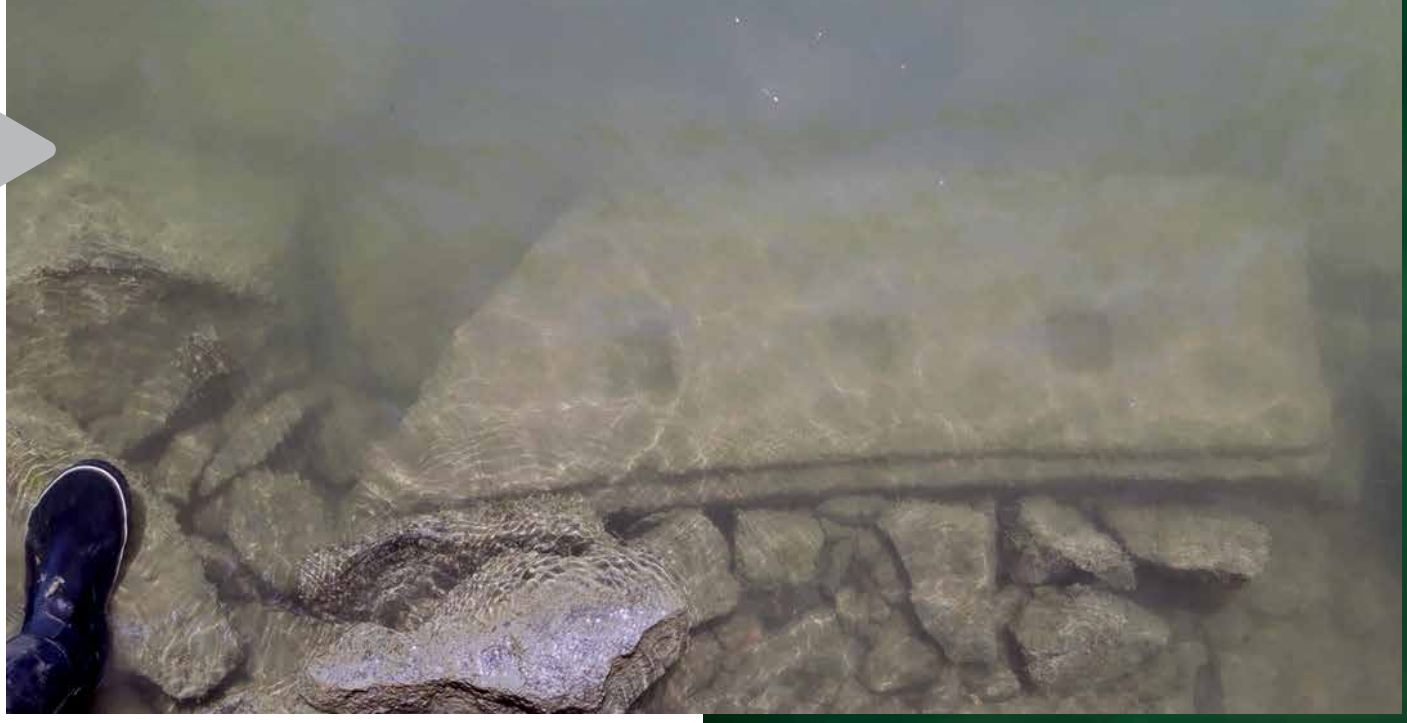
We recently identified a manuscript map dated to 1852 in the digitally published collection of the Hungarian National Archives, which was mistakenly attributed to

▶ 4. Bathymetric survey map combined with satellite image of the East coast of the Háros Island / A Háros-sziget keleti partja menti területet medret ábrázoló domborzati térkép (By: A. Tóth)

folyásiránya alapján egyértelmű, hogy nem a keleti, hanem a nyugati partot ábrázolja. A térképen a Háros-sziget ívének megfelelő partvonalat láthatunk, a szigeten más kortárs térképeken is megjelölt vadászházzal. A vadászháztól délre egy a Duna felé irányuló téglalap alaprajzú romot ábrázolnak „Altes mauerverk" felirattal, az épület folyó felőli fala hiányzik. Mindmáig ez a kolostor elhelyezkedésére utaló legjobb térképi ábrázolás (6. kép).

Megállapítottuk, hogy a víz alatti plató régészeti leleteket tartalmaz, bár mai állapotában újkori tevékenység eredménye, a felső réteg alatt intakt régészeti réteg lehet. A lelőhely a 2014. évi IX. törvény (az UNESCO víz alatti örökség egyezménye) értelmében víz alatti kulturális örökségnek számít, in-situ megőrzése, illetve tudományos kutatása indokolt.

A továbblépést az omladékból álló platóban a víz alatt nyitott régészeti kutatóárok jelentené, mivel ez segítene megállapítani a törmelékhalom belső szerkezetét és kronológiai viszonyait. Ezzel párhuzamosan a parton egy kiterjedt geofizikai felmérés tisztázhatná a kolostorrom és melléképületei elhelyezkedését.



▶ 5. Rectangular, carved limestone architetural element with small square cavities on it's surface / Négyszögletes, faragott mészkő építészeti elem, felszínén kis négyzetes üregekkel (Photo: A. Tóth)

the neighbouring Island of Csepel, but the direction of the Danube makes it clear that it does not depict the eastern bank, but the western bank. The map shows a shoreline corresponding to the curve of Háros Island, with the hunter's house on the island, also marked on other contemporary maps. South of the hunter's house, a rectangular ruin facing the Danube is depicted with the inscription "Altes mauerverk", the wall of the building facing the river is missing. This is the best map representation to date of the location of the monastery (Fig. 6).

We found that the submerged plateau contains archaeological remains. Although in its present state it is the result of recent activity, but under the upper layer it may contain an intact archaeological layer. The site is considered an underwater cultural heritage site under the terms of Act IX of 2014 (the Hungarian ratification of the UNESCO Convention on the Protecton of the Underwater Cultural Heritage), and in-situ conservation and scientific research are warranted.

▶ 6.Geographically transformed (rotated to North) manuscript map from 1852, probably depicting the ruins of the monastery. Hungarian National Archive, S168-No.110. Cartographycal transformation / 1852-ben készült kéziratos térkép északi irányba elforgatott nézete. Valószínűleg a kolostor-rom ábrázolásával. Magyar Nemzeti Levéltár S168-No.110 (By: A. Tóth)

A way forward would be to open an archaeological research trench under the water in the plateau, as this would help to investigate the internal structure and chronology of the rubble pile. In parallel, an extensive geophysical survey on the shore could clarify the location of the monastery ruins and their surroundings.

THE SCIENTIFIC DIVERS ON THE BALTIC SEA - GERMAN SCIENCE UNDER WATER

FORSCHUNGSTAUCHER IN DER OSTSTEE – DEUTSCHE WISSENSCHAFTLER UNTER WASSER

Roman Scholz roman.scholz@dainst.de / **Anne Herbst** anne.herbst@uni-rostock.de

In Mecklenburg-Western Pomerania, which is located in the north-east of Germany at the Baltic Sea, scientific diving has a long tradition. It all started with a training of light commercial swimmers in 1961 and hence scientific diving was initiated in Rostock, Mecklenburg-Western Pomerania. In general, scientific diving is a professional activity and is not part of sport diving or diving for emergency services e.g. police or fire brigade. It is applied in accordance with the existing national German rule ("Operation of research divers" BGR/GUV-R 101-023). Since 1995, the scientific diving training is realized at the University of Rostock[1] in cooperation with the Leibniz Institute for Baltic Sea Research Warnemünde.[2]

The target audience are scientists, archaeologists, engineers, physicians, technicians, and journalists who work underwater and therefore need methods to perform their research (Fig. 1). The training to become a scientific diver consists of theory lessons, training in the swimming

1 https://www.fotau.uni-rostock.de/
2 https://www.io-warnemuende.de/

1. Sediment samples were taken by scientific diver in the BaltVib project at the Institute for Baltic Sea Research Warnemünde / Sedimentproben wurden von wissenschaftlichen Tauchern im Projekt BaltVib am Institut für Ostseeforschung Warnemünde entnommen (Photo: P. Hoy)

In Mecklenburg-Vorpommern, das im Nordosten Deutschlands an der Ostsee liegt, hat das wissenschaftliche Tauchen eine lange Tradition. Begonnen hat alles mit einer Ausbildung von leichten Berufsschwimmern im Jahr 1961 und damit wurde das wissenschaftliche Tauchen in Rostock, Mecklenburg-Vorpommern, initiiert. Im Allgemeinen ist wissenschaftliches Tauchen eine berufliche Tätigkeit und nicht Teil des Sporttauchens oder Tauchens für Rettungsdienste, z. Polizei oder Feuerwehr. Es wird nach der bestehenden nationalen deutschen Vorschrift ("Einsatz von Forschungstauchern" BGR/GUV-R 101-023) angewendet. Seit 1995 wird die wissenschaftliche Tauchausbildung an der Universität Rostock[1] in Kooperation mit dem Leibniz-Institut für Ostseeforschung Warnemünde realisiert.[2]

Die Zielgruppen sind Wissenschaftler, Archäologen, Ingenieure, Ärzte, Techniker und Journalisten, die unter Wasser arbeiten und daher Methoden für ihre Forschung benötigen (Abbildung 1). Die Ausbildung zum wissenschaftlichen Taucher besteht aus Theorieunterricht, Training im Schwimmbad, praktischer Arbeit in einem Tauchteam und 30h bzw. 70 Tauchgängen im Süß- und Brackwasser. Nach wissenschaftlichen Tauchregeln besteht ein Tauchteam aus einem Tauchleiter, einem Taucher, einem Sicherheitstaucher und einem Signalmann. Im Vergleich

2. Participant of scientific diver course working underwater at the workbench in freshwater Lake Schwerin / Teilnehmer des wissenschaftlichen Tauchkurses Arbeiten unter Wasser an der Werkbank im Schweriner Süßwassersee (Photo: scientific diving course 2021)

pool, practical work in a diving team, and 30h respectively 70 dives in fresh- and brackish waters. According to scientific diving rules a dive team is built of a dive leader, diver, safety diver, and signalman. In comparison to leisure diving, the scientific diver is connected to the signalman via a signal line with which they communicate. Furthermore, the scientific diver wears a full facemask for security reasons.

The practical scientific diving training takes place in freshwater and in the Baltic Sea. During diving different scientific methods e.g. installation, sampling, and documentation are taught underwater. In each scientific diving course, a workbench is installed in the freshwater Lake Schwerin. Participants learn how to saw, chisel and hammer (Fig. 2). In addition, rescue training is also conducted from shore and ship-based from the research vessel Limanda (Fig. 3). The Limanda is a catamaran built in 2020 and suitable for scientific diving training at the Baltic Sea.

3. Rescue training with Jason's cradle / Rettungstraining mit Jason's cradle (Photo: scientific diving course 2021)

At the end of the scientific diving training an examination is performed by the professional association of construction business (BG Bau[3]). In total 296 participants succeeded the status "certified research diver" in Rostock. This qualification is equal with the European Scientific Diver (ESD) level. Certified scientific divers are ready to participate in different research projects. Here we wanted to present an example in detail.

A depot for old wrecks in the Baltic Sea - an example of the work of research divers in the Baltic Sea

Well-preserved archives from settlement and seafaring history are available for research below sea level. The flooding of the Baltic Sea, which began thousands of years ago, preserved numerous Neolithic settlements in the Baltic Sea (Fig. 4). In modern times, many ships

3 https://www.bgbau.de/

zum Freizeittauchen ist der wissenschaftliche Taucher über eine Signalleitung mit dem Signalmann verbunden, mit der er kommuniziert. Darüber hinaus trägt der wissenschaftliche Taucher aus Sicherheitsgründen eine Vollgesichtsmaske.

Die praktische wissenschaftliche Tauchausbildung findet im Süßwasser und in der Ostsee statt. Beim Tauchen werden verschiedene wissenschaftliche Methoden wie z. B. Installation, Probenahme und Dokumentation unter Wasser gelehrt. Bei jedem wissenschaftlichen Tauchkurs wird eine Werkbank im Süßwasser des Schweriner Sees installiert. Die Teilnehmer lernen, wie man sägt, meißelt und hämmert (Abbildung 2). Darüber hinaus werden Rettungsübungen von Land und vom Forschungsschiff Limanda (Abbildung 3) durchgeführt. Die Limanda ist ein 2020 gebauter Katamaran, der sich für die wissenschaftliche Tauchausbildung an der Ostsee eignet.

Am Ende der wissenschaftlichen Tauchausbildung findet eine Prüfung durch die Berufsgenossenschaft der Bauwirtschaft (BG Bau[3]) statt. Insgesamt erlangten 296 Teilnehmern in Rostock den Status „Zertifizierter Forschungstaucher". Diese Qualifikation entspricht dem European Scientific Diver (ESD) Level.

Ein Depot für alte Wracks in der Ostsee – ein Beispiel für die Arbeit von Forschungstaucher in der Ostsee

Unter dem Meeresspiegel stehen der Forschung gut erhaltene Archive aus der Siedlungs- und Seefahrtsgeschichte zur

4. Scientific diver documenting a wreck from the Middle Ages off Wismar / Ein Forschungstaucher bei der Dokumentation eines Wracks aus dem Hochmittelalter vor Wismar (Photo: M. Siegel, UWA-Logistik GmbH)

Verfügung. Die vor Tausenden von Jahren beginnende Überflutung der Ostsee konservierte zahlreiche jungsteinzeitliche Siedlungen in der Ostsee. In der Neuzeit fanden viele Schiffe durch Havarien oder kriegerische Auseinandersetzungen ihr Grab auf dem Meeresgrund. Dort sind die Objekte gut geschützt (Abbildung 4). Doch sobald sich diese Bedingungen ändern, sind die Funde auch einem besonders starken Verfall ausgesetzt. Hiervon sind nicht nur organische Materialien betroffen, sondern beinahe alle Materialien, die von archäologischer Relevanz sind. Damit

found their graves on the seabed as a result of accidents or military conflicts. The objects are well protected there. But as soon as these conditions change, the finds are also exposed to a particularly severe deterioration. This not only affects organic materials, but almost all materials that are of archaeological relevance. This means that underwater archeological investigations pose a special challenge for all those involved in the preservation of monuments. In the years 2016 to 2017, intensive excavations took place in the Bay of Wismar by the special excavation company UWA-Logistik GmbH. A total of three new wrecks from the High Middle Ages were uncovered, documented and salvaged in the area of a new harbor building. Because the wrecks were discovered deep in the sediment, all three wrecks were in a very good state of preservation. The woods of the wrecks and the many small organic finds are an important source for archaeological research (Fig. 5, 6).

5. While the supply ship secures the divers and the excavation, the construction work in the port is very close / Die Taucher auf der Ausgrabung werden von einem Arbeitsboot gesichert und unterstützt, während die Arbeiten an der Hafenanlage sehr nahe fortgesetzt werden. (Photo: R. Scholz, UWA-Logistik GmbH)

In order to stop the decay, a complex and cost-intensive conservation and restoration of the objects is necessary. The conservation of ship finds is particularly difficult because they are large objects that require special space in the workshop and depot. So what to do with all the wood? This question was asked by some research divers in Mecklenburg-Western Pomerania and prompted consideration of the creation of an underwater depot. A suitable depot must meet a number of criteria. For example, the underwater depot must be located in the territorial waters of the respective country in order to be able to apply the maximum protection rights. In addition, the water depth must not be too deep for the divers working in the depot, but also not too shallow, otherwise waves and currents can influence the environmental parameters. It also depends on whether the emplacement site is in an inland waterway or in the sea. Areas with strong currents should be avoided, as these make work

6. Aerial photo of the excavations / Ein Luftbild von den Ausgrabungen (Photo: F. Nagel, UWA-Logistik GmbH)

stellen unterwasserarchäologische Untersuchungen alle beteiligten Akteure der Denkmalpflege, eine besondere Herausforderung. In den Jahren 2016 bis 2017 fanden intensive Ausgrabungen in der Bucht von Wismar durch die Spezialgrabungsfirma UWA-Logistik GmbH statt. Im Bereich eines Hafenneubaus wurden insgesamt drei neue Wracks aus dem Hochmittelalter freigelegt, dokumentiert und geborgen. Da die Wracks tief im Sediment entdeckt wurden, waren alle drei Wracks in einem sehr guten Erhaltungszustand. Dabei sind die Hölzer der Wracks und die vielen organischen Kleinfunde eine wichtige Quelle für die archäologische Forschung (Abbildung 5, 6).

Um den Verfall aufzuhalten ist eine aufwendige und kostenintensive Konservierung und Restaurierung der Objekte notwendig. Besonders schwer ist die Konservierung von Schiffsfunde da es sich um Großobjekte handelt, die einen besonderen Platzbedarf in Werkstatt und Depot haben. Wohin also mit all den Hölzern? Diese Frage stellten einige Forschungstaucher in Mecklenburg-Vorpommern und stießen Überlegungen zur Schaffung eines Unterwasserdepots an. Ein geeignetes Depot muss einige Kriterien erfüllen. Zum Beispiel muss das Unterwasserdepot sich im Hoheitsgewässer des jeweiligen Landes befinden, um die maximalen Schutzrechte anwenden zu können. Zudem darf die Wassertiefe nicht zu tief für die im Depot arbeitenden Taucher sein, aber auch nicht zu flach, da sonst Wellen und Strömungen die Umgebungsparameter beeinflussen können. Sie ist zudem abhängig davon, ob der Einlagerungsort in einem Binnengewässer oder im Meer angelegt wird. Es sollten Gebiete mit starken Strömungen vermieden werden, da diese

in the depot more difficult and can also undesirably shift the top sediments. The sediment must have sufficient strength to protect the stored finds from free oxygen in the open sea. The thickness of the sediment is checked in advance with long needles. The location should be as far away from watercraft traffic as possible, as this will stir up the sediment, depending on the size of the watercraft. Nevertheless, there is also a demand near a port, as otherwise delivery would no longer be economical. Larger storage projects also require port infrastructure. It must be possible to safely store the timber before it is transported to the depot in the port.

7. Cleaning, documenting and packing of ship wood in the documentation center / Reinigen, Dokumentieren und Verpacken von Wrackhölzern im Dokumentationszentrum (Photo: M. Siegel, UWA-Logistik GmbH)

All of these considerations led to the creation of a special zone off Cape Arkona in Mecklenburg-Western Pomerania in 2010. As in a depot or archive on land, a system of order had to be installed first. For this purpose, the underwater area was divided into a local grid of 10x10 m. The corner points of this grid were staked out with a survey buoy and marked with stainless steel tubes in the sediment. The pieces of wood stored there later can then be located individually using measuring tapes using the corner points. The top priority when planning the depot was the longevity of the materials used to ensure that future generations can find them again.

The findings are then uncovered in defined layers, as on land, with each removal being documented three-dimensionally photogrammetrically. A vacuum pump is used to remove sediment from the finding, so that the soil material is sucked off at the excavation site and washed up a few meters next to the investigation area.

Larger objects such as ship elements are also recovered. A detailed documentation of the constructive construction in situ is particularly important, because the reconstruction and the sequence of the salvage under water are based on this. Elements weighing several tons can also be lifted out of the water using a cargo crane. The large

zum einen die Arbeiten im Depot erschweren, zum anderen auch die Decksedimente unerwünscht verlagern können. Das Sediment muss eine ausreichende Stärke aufweisen, um die eingelagerten Funde vor freiem Sauerstoff im offenen Meer schützen zu können. Die Mächtigkeit des Sedimentes wird im Vorfeld mit langen Nadeln geprüft. Der Standort sollte möglichst fern von Wasserfahrzeugverkehr liegen, da dieser je nach Größe der Wasserfahrzeuge das Sediment aufwirbelt. Dennoch ist auch in Nähe eines Hafens gefragt, da sonst eine Anlieferung nicht mehr wirtschaftlich wäre. Bei größeren Einlagerungsprojekten ist zudem eine Infrastruktur im Hafen notwendig. So müssen die Hölzer vor den Transport zum Depot im Hafen sicher zwischengelagert werden können.

All diese Überlegungen führten im Jahr 2010 in Mecklenburg-Vorpommern zur Schaffung einer speziellen Zone vor Kap Arkona. Wie in einem Depot oder Archiv an Land, musste hierzu vorerst ein Ordnungssystem installiert werden. Hierzu wurde das Areal unter Wasser in ein lokales Raster von 10x10 m unterteilt. Die Eckpunkte dieses Rasters wurden mit einer Vermessungsboje abgesteckt und mit nichtrostenden Stahlrohren im Sediment vermarkt. Die später dort eingelagerten Hölzer können dann mit Maßbändern über die Eckpunkte einzeln verortet werden. Die oberste Priorität bei der Planung des Depots war die Langlebigkeit der verwendeten Materialien, um die Wiederauffindbarkeit auch für zukünftige Generationen zu gewährleisten.

Die Freilegung der Befunde erfolgt anschließend wie auch an Land in definierten Schichten, wobei jeder Abtrag dreidimensional photogrammetrisch dokumentiert wird. Um den Befund von Sediment zu befreien wird eine Unterdruckpumpe genutzt, so dass das Bodenmaterial an der Grabungsstelle abgesaugt und einige Meter neben der Untersuchungsfläche angespült wird.

Größere Objekte wie beispielsweise Schiffselemente werden ebenso geborgen. Besonders wichtig sind hierbei eine detaillierte Dokumentation der konstruktiven Bauweise in situ, denn darauf basierend erfolgt auch die Rekonstruktion und die Reihenfolge der Bergung unter Wasser. Per Lastenkran lassen sich auch tonnenschwere Elemente aus dem Wasser heben. Die Großobjekte werden anschließend detailliert dokumentiert. Hierbei wurde ein mobiles Zelt angemietet und eine Dokumentationsstraße errichtet, um die Hölzer effektiv dokumentieren zu können. Dabei werden insbesondere photogrammetrische Verfahren und Handscanner eingesetzt, da diese einen sehr effektiven Arbeitsablauf erlauben. Anschließend erfolgt eine Zwischenlagerung der größeren Funde in speziellen Wasserbecken. Diese temporären Konstruktionen aus Holzplatten und Folie können sehr flexibel und an das Objekt angepasst errichtet werden.

Der Transport der Fundstücke von der Dokumentationsstelle zu dem Hafen in der Nähe des Unterwasserdepots, erfolgt per Anhängerüber die Straße. Von dort aus geht

8. Packed wood in the depot / Verpackte wrackteile im Unterwasserdepot (Photo: E. Schulz)

objects are then documented in detail. A mobile tent was rented and a documentation route set up in order to be able to effectively document the wood. In particular, photogrammetric methods and hand-held scanners are used, as these allow a very effective workflow. The larger finds are then temporarily stored in special water basins. These temporary constructions made of wooden panels and foil can be erected very flexibly and adapted to the object.

The transport of the finds from the documentation center to the port near the underwater depot is done by trailer by road. From there, the diving platform takes you to the actual depot. The objects to be stored are wrapped in geotextile before they are placed in the sediment to provide additional protection. In addition, there is a marking with rustproof signs that are attached to the object (Fig. 7, 8).

Subsequently, within the specified grid cell, sediment is removed with a water jet pump in order to prepare for disposal. The pumps used move about 13-15 cubic meters of seabed in one hour. When working, speed is required because the current then fills the pit and the stored object back in.

The workflow is limited by the maximum dive time. A temporary store, comparable to a storage rack made of aluminum framework under water, is therefore set up to bring in several objects. Objects can be temporarily stored here before they are deposited and fastened to protect them from currents. The storage of large complexes of finds can take several months. The depositing of the approximately 600 objects from Wismar, for example, took a team of 3 research divers about 3 months. Work that is only possible thanks to the good training and long professional experience of the research divers in the Baltic Sea. In this way, the wood is preserved for future generations even without conservation (Fig. 9).

es mittels Taucherplattform zum eigentlichen Depotplatz. Die einzulagernden Objekte werden vor ihrer Einbringung in das Sediment in Geotextil eingewickelt, um sie zusätzlich zu schützen. Zudem erfolgt dabei eine Kennzeichnung mit nichtrostenden Schildern, die am Objekt angebracht werden (Abbildung 7, 8).

Anschließend wird innerhalb der vorgegebenen Rasterzelle mit einer Wasserstrahlpumpe Sediment entfernt, um die Deponierung vorzubereiten. Die verwendeten Pumpen bewegen dabei ca. 13-15 Kubikmeter Meeresboden in einer Stunde. Bei der Arbeit ist Schnelligkeit gefragt, denn die Strömung Anschließend wird die Grube samt eingelagertem Objekt wieder verfüllt.

Der Arbeitsablauf wird durch die maximale Tauchzeit begrenzt. Zur Einbringung mehrerer Objekte wird daher ein temporäres Lager, vergleichbar mit einem Lagerregal aus einem Aluminiumgerüst unter Wasser, errichtet. Hier können Objekte vor ihrer Deponierung zwischengelagert und als Schutz vor Strömungen befestigt werden. Die Einlagerung großer Fundkomplexe kann dabei mehrere Monate Zeit in Anspruch nehmen., Die Deponierung der etwa 600 Objekte aus Wismarer dauerte mit einem Team aus 3 Forschungstauchern beispielsweise ca. 3 Monate. Arbeiten, die nur durch die gute Ausbildung und die lange Berufserfahrung der Forschungstaucher in der Ostsee möglich sind. So bleiben die Holzer auch ohne Konservierung für die nächsten Generationen erhalten (Abbildung 9).

9. Diver using a sediment extractor / Ein Taucher beim Einsatz des Sedimentsaugers (Photo: M. Siegel, UWA-Logistik GmbH)

INTERNATIONAL COLLABORATION: HERITAGE MALTA AND ICUA ZADAR

MEĐUNARODNA SURADNJA IZMEĐU HERITAGE MALTA I MPCA ZADAR

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Heritage Malta is a national agency founded in 2002 pursuant to Maltese legislation covering cultural heritage. It gained an underwater archaeology department in 2019 and is currently in the process of setting up a national laboratory for the conservation and restoration of artefacts recovered from underwater environments.

Conservators and restorers at the Heritage Malta laboratory required additional practical and theoretical training related to complex procedures, including the specialist analysis of artefacts, the documentation of their condition as found, decision-making regarding interventions aimed at preserving the historical and material integrity of artefacts, the performance of complex interventions on cultural property, and the preventive care, storage and presentation of this heritage.

With this in mind Antonia Sammut of Heritage Malta and Antonija Jozić, the head of the conservation and restoration department at ICUA Zadar, worked out

1. Restorer Martina Ćurković Madiraca gives a lecture / Predavanje restauratorice Martine Ćurković Madiraca (Photo: Z. Vrgoč)

Nacionalna agencija Heritage Malta osnovana je 2002. godine temeljem malteškog Zakona o kulturnoj baštini. U 2019. godini ustrojena je Jedinica za podvodnu kulturnu baštinu i trenutno su u fazi formiranja nacionalnog laboratorija koji bi se bavio konzervacijom i restauracijom predmeta pronađenih u podvodnim okolišima.

Zaposlenim djelatnicima u laboratoriju Heritage Malte, konzervatorima-restauratorima, bila je potrebna dodatna praktična i teorijska obuka vezano uz složenije postupke koji obuhvaćaju znanstvenu analizu predmeta, dokumentiranje zatečenog stanja, donošenja odluke o vrsti potrebne intervencije kako bi se sačuvao povijesni i materijalni integritet predmeta, te provođenje kompleksnih zahvata na samom kulturnom dobru, kao i njegovu preventivnu zaštitu, čuvanje i prezentaciju.

Iz tog razloga su gospođa Antonia Sammut iz nacionalne agencije Heritage Malta i voditeljica Odjela konzerviranja i restauriranja MCPA Zadar Antonija Jozić dogovorile buduću zajedničku suradnju. Cilj dogovorene suradnje, osim učvršćivanja odnosa između Heritage Malta i MCPA Zadar, trebao je osigurati da konzervatori-restauratori Heritage Malta budu u tijeku s aspektima metodologije konzervacije i restauracije podvodnih arheoloških nalaza.

Konzervatorice i restauratorice MCPA Zadar osmislile su i izradile program edukacije po mjeri za 8 konzervatora - restauratora Heritage Malta.

Program edukacije sastojao se od teorijskog i praktičnog dijela. Cilj programa bio je pružanje edukacije u konzerviranju i restauriranje različitih materijala kao što su : metal, keramika, staklo i organski materijal.

Suradnja je započela 01. travnja 2022. godine kada je voditeljica Odjela konzerviranja i restauriranja MCPA Zadar Antonija Jozić održala dva online predavanja: Preservation of Submerged Heritage, Mission of International Centre for Underwater Archaeology in

2. Practical work on desalination procedures / Praktičan rad na postupku desalinizacije (Photo: Z. Vrgoč)

the details of future collaboration. The objective of this collaboration, along with enhancing relations between Heritage Malta and ICUA Zadar, is to ensure that conservation and restoration specialists at Heritage Malta are up to date with aspects of conservation and restoration methodology as it pertains to underwater archaeological finds.

ICUA conservation and restoration specialists developed and produced a tailored training programme for eight of their colleagues at Heritage Malta.

The training programme is comprised of a theoretical and a practical segment. The objective of this programme is to provide training in the conservation and restoration of a variety of materials, including metals, ceramic, glass, and organic materials.

The collaboration began on 1 April 2022 with ICUA conservation and restoration department head Antonija Jozić staging two online lectures on The Preservation of Submerged Heritage and the Mission of ICUA Zadar, and on Activities Undertaken by the ICUA Restoration and Conservation Department.

The following week, from 4 to 9 April 2022, restorers Martina Ćurković Madiraca and Zdenka Vrgoč were

Zadar i Activities undertaken by the Restoration and Conservation Department of ICUA

U sljedećem tjednu od 4. travnja do 9. travnja 2022. godine konzervatorice -restauratorice Martina Ćurković Madiraca i Zdenka Vrgoč boravile su na Malti gdje su konzervatorima i restauratorima HM u njihovoj radionici pružili praktičnu i teorijsku obuku vezanu za restauraciju keramike i stakla (Sl. 4).

U sklopu praktičnog dijela u najvećoj mjeri su se posvetili problematici postavljanja i praćenja desalinizacijskog procesa keramičkih i staklenih nalaza kao i postupcima čišćenja, konsolidacije, lijepljena i rekonstrukcije

3. Knowledge exchange related to the restoration of ceramic material / Razmjena znanja vezanih uz restauraciju keramičkog materijala (Photo: M.Ć. Madiraca)

4. Practical work on glass artefacts / Praktični rad na staklenim nalazima (Photo: Z. Vrgoč)

in Malta to provide practical and theoretical training for their colleagues at the Heritage Malta workshop related to the restoration of ceramics and glass (Fig. 4).

The practical segment largely focused on issues related to setting up and monitoring the desalination process when working with ceramic and glass artefacts, and the procedures involved when cleaning, consolidating, gluing, and reconstructing ceramic and glass artefacts recovered from underwater environments. They familiarised our colleagues with all the conservation and restoration interventions performed on ceramic and glass artefacts recovered from underwater environments in the course of the conservation and restoration proces (Fig. 2, 3).

The following lectures were given in the frame of the theoretical segment: Conservation and Restoration of Archaeological Ceramic and Glass Finds and Case Study: The Conservation and Restauration of a Roman Glass Urn by M.Ć. Madiraca (Fig. 1) and In Situ Protection and Handling, Packing, Transport and Desalination of Underwater Archaeological Finds by Z. Vrgoč.

During the remainder of April, the Heritage Malta conservators and restorers were provided with online guidance concerning certain conservation and restoration processes, and the procurement of the chemicals and additional equipment they will require in their future work.

Theoretical training continued in late April with a number of online lectures: Conservation and

podvodnih nalaza izrađenih od keramike i stakla. Upoznali su ih sa svim konzervatorsko-restauratorskim zahvatima kroz koje keramički i stakleni podvodni nalazi prolaze tijekom konzervatorsko -restauratorskog procesa (Sl. 2, 3).

U sklopu teorijskog dijela održana su im sljedeća predavanja: Conservation and Restoration of Archaeological Ceramic and Glass Finds and Case Study: The Conservation and Restauration of a Roman Glass Urn od strane M.Ć. Madirace (Sl. 1) i In Situ Protection and Handling, Packing, Transport and Desalination of Underwater Archaeological Finds od strane Z. Vrgoč.

U sljedećim tjednima mjeseca travnja konzervatorima-restauratorima HM pružani su online savjeti vezano za određene konzervatorsko-restauratorske procese, kao i za nabavu kemikalija i dodatne opreme koja će im biti potrebna u budućem radu.

Krajem mjeseca travnja nastavljena je teoretska obuka te su održana slijedeća online predavanja: Conservation and Restoration of Archaeological Metal Finds and Case study: Conservation and Restoration of Two Iron Anchors (electrolytic reduction method) od strane A. Jozić i Conservation and Restoration of Archaeological Organic Finds od strane A. Jelić.

U periodu od 16. svibnja do 21. svibnja više konzervatorice-restauratorice Antonija Jozić i Anita Jelić boravile su na Malti gdje su konzervatorima i restauratorima HM u njihovoj radionici pružili praktičnu i teorijsku obuku vezanu za restauraciju podvodnih nalaza izrađenih od metala i organskog materijala (Sl. 5).

U sklopu praktičnog dijela provele su ih kroz postupke postavljanja i praćenja desalinizacijskog procesa podvodnih metalnih i organskih nalaza. Konzervatori restauratori HM su pod budnim okom mentorica proveli popisivanje, dokumentiranje i crtanje nalaza. Zajedno

5. Mechanical cleaning of a metal object / Mehaničko čišćenje metalnog predmeta (Photo: A. Jelić)

6. Practical work with bone artefacts / Praktičan rad na koštanim predmetima (Photo: A. Jozić)

Restoration of Archaeological Metal Finds and Case study: Conservation and Restoration of Two Iron Anchors (electrolytic reduction method) by A. Jozić and Conservation and Restoration of Archaeological Organic Finds by A. Jelić.

Senior restorers Antonija Jozić and Anita Jelić were in Malta from 16 to 21 May where they joined their colleagues at the Heritage Malta workshop to provide practical and theoretical training related to the restoration of metal and organic artefacts recovered from underwater environments (Fig. 5).

In the practical segment they led their colleagues through the procedures involved in setting up and monitoring the desalination process for metal and organic artefacts. Under the watchful eyes of their mentors the Heritage Malta conservators and restorers catalogued, documented, and produced drawings of artefacts. Working with their mentors the Heritage Malta conservators and restorers went through the procedures used when cleaning artefacts of metal and organic materials, while the consolidation procedure using polyethylene glycol was initiated with selected wooden artefacts. Likewise, we went through the steps of the controlled drying process for organic materials using the example of bone artefacts (Fig. 6).

The ICUA mentors also familiarised the Heritage Malta conservators with all the other conservation and restoration interventions applied for metal and organic underwater finds in the course of a conservation and restoration process (Fig. 7).

Anita Jelić gave a lecture in the frame of the theoretical segment on a Case Study: The Early Croatian Boats at Nin – Re-conservation.

7. Practical guidance related to the restoration of wet wood / Praktični savjeti vezani za restauraciju mokrog drva (Photo: A. Jozić)

sa mentoricama konzervatori restauratori HM odradili su i postupke čišćenja određenih nalaza izrađenih od metala i organskog materijala, a odabrane drvene nalaze su stavili i na postupak konsolidacije otopinom polietilen glikola. Isto tako pratili su postupak kontroliranog sušenja organskih nalaza na primjeru koštanih predmeta (Sl. 6).

Mentorice MCPA su konzervatore HM upoznale i sa svim preostalim konzervatorsko-restauratorskim zahvatima kroz koje metalni i organski podvodni nalazi prolaze tijekom pojedinog konzervatorsko-restauratorskog procesa (Sl. 7).

U sklopu teorijskog dijela Anita Jelić im je održala predavanje: Case study: The Early Croatian Boats at Nin-Re-conservation. Antonija Jozić im je pokazala kemijsko-matematičke izračune koji će im biti potrebni u budućem radu kako bi znali pripremati različite otopine određene gustoće i koncentracije (Sl. 8).

Tijekom boravka na Malti Voditeljica Antonia Sammut provela je konzervatorice restauratorice MCPA Zadar kroz preostale radionice Heritage Malte. Organizirala im je i posjet Malteškom Sveučilištu, kao i megalitskim hramovima Hadžar-Kim i Mnajdra te katakombama svetog Pavla (Sl. 9).

Osim osposobljavanja stručnjaka konzervatora na međunarodnoj razini, praktično i teoretski, ova suradnja je jednako tako pridonijela programskim ciljevima UNESCO-a kojima se MCPA Zadar obvezao težiti.

Antonija Jozić demonstrated the chemical-mathematical calculations that they will need in their future work in order to know how to prepare different solutions of a certaindensities and concentrations (Fig. 8).

During their time on Malta Antonia Sammut guided the ICUA Zadar conservator/restorers through the other Heritage Malta workshops and on visits to the University of Malta, the Hajar Qim and Mnajdra megalithic temples, and the St Paul catacombs (Fig. 9).

Along with the training of conservation specialists at the international level, both in the practical and theoretical aspects, this collaboration has also contributed to the UNESCO programme goals that ICUA Zadar has undertaken to pursue.

8. The preparation of titration solutions / Priprema titracijskih otopina (Photo: A. Jelić)

9. At the Heritage Malta workshop, from left to right: / U HM Radionici, S lijeva na desno: Anita Jelić, Antonia Sammut, Joanne Dimech, Lucia Gutierrez and Antonija Jozić (Photo: A. Jozić)

POLISH-CROATIAN EXCHANGE OF EXPERIENCE ON THE UNESCO CONVENTION ON THE PROTECTION OF UNDERWATER CULTURAL HERITAGE

POLSKO-CHORWACKA WYMIANA DOŚWIADCZEŃ W ZAKRESIE KONWENCJI UNESCO O OCHRONIE PODWODNEGO DZIEDZICTWA KULTUROWEGO

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1. Presentation of the history and achievements of the ICUA and the National Maritime Museum at the Scouts Maritime Centre in Puck / Prezentacja historii oraz dokonań ICUA oraz NMM w Harcerskim Ośrodku Morskim w Pucku (Photo: K. Kurzyk)

In spring 2022, the National Maritime Museum in Gdańsk began cooperation with a group of underwater archaeologists and conservators from the International Centre for Underwater Archaeology (ICUA) in Zadar. Thanks to funding from the Polish Ministry of Culture and National Heritage within the framework of the 'Inspiring Culture' programme, a two-year project entitled 'Polish-Croatian exchange of experience in the field of the

Wiosną 2022 roku Narodowe Muzeum Morskie w Gdańsku podjęło współpracę z grupą archeologów podwodnych i konserwatorów z International Centre of Underwater Archaeology (ICUA) w Zadarze. Dzięki dofinansowaniu ze środków polskiego Ministerstwa Kultury i Dziedzictwa Narodowego w ramach programu

2. Before diving on the Catharina wreck / Przed nurkowaniem na wraku Catharina (Photo: R. Domżał)

3. Underwater archaeologists from ICUA during diving on the sunken medieval harbour in Puck / Archeolodzy podwodni z ICUA podczas nurkowania na zatopionym średniowiecznym porcie w Pucku (Photo: P. Litwinienko)

UNESCO Convention on the Protection of Underwater Cultural Heritage' has been launched. The Embassy of the Republic of Poland in Zagreb is also a partner of the project.

The aim of the project is to promote Poland's underwater cultural heritage in Croatia and to develop cooperation between the two countries in the field of protection of underwater sites, development of underwater archaeology and conservation of artefacts.

In July 2022, the first visitors from the ICUA arrived at the National Maritime Museum in Gdańsk. Croatian underwater archaeologists (Mladen Pešić, Luka Bekić, Roko Surić and Maja Kaleb) had the opportunity to see the methods of exploration, documentation and monitoring of wrecks used in Poland. Upon arrival, the guests visited the Shipwreck Conservation Centre with Studio Warehouse in Tczew (CKWS), and then went to Puck, where the National Maritime Museum's Underwater Research Department conducted research on the 13th century wreck P5 in the area of the sunken medieval port. In the conference room of the Scouts Maritime Centre in Puck, the parties presented a brief history and achievements to date of the NMM and the ICUA in the field of underwater research and ways to popularise and protect archaeological sites within the scope of

4. Underwater archaeologists from ICUA during diving on the sunken medieval harbour in Puck / Archeolodzy podwodni z ICUA podczas nurkowania na zatopionym średniowiecznym porcie w Pucku (Photo: P. Litwinienko)

„Kultura Inspirująca" rozpoczęto realizację dwuletniego projektu pn. „Polsko-chorwacka wymiana doświadczeń w zakresie Konwencji UNESCO o ochronie podwodnego dziedzictwa kulturowego". Partnerem przedsięwzięcia jest również Ambasada Rzeczpospolitej Polskiej w Zagrzebiu.

Celem projektu jest promocja polskiego podwodnego dziedzictwa kulturowego w Chorwacji oraz rozwój współpracy pomiędzy obydwoma krajami w zakresie ochrony stanowisk podwodnych, rozwoju archeologii podwodnej i konserwacji zabytków.

5. Underwater archaeologists from ICUA during diving on the sunken medieval harbour in Puck / Archeolodzy podwodni z ICUA podczas nurkowania na zatopionym średniowiecznym porcie w Pucku (Photo: P. Litwinienko)

W lipcu 2022 r. do Narodowego Muzeum Morskiego w Gdańsku przybyli pierwsi goście z ICUA. Chorwaccy archeolodzy podwodni (Mladen Pešić, Luka Bekić, Roko Surić i Maja Kaleb) mieli okazję zobaczyć stosowane w Polsce metody eksploracji, dokumentacji oraz monitoringu wraków. Po przyjeździe goście odwiedzili Centrum Konserwacji Wraków Statków wraz z Magazynem Studyjnym w Tczewie (CKWS), po czym udali się do Pucka, gdzie Dział Badań Podwodnych NMM prowadził badania XIII-wiecznego wraka P5 na obszarze zatopionego średniowiecznego portu. W sali konferencyjnej Harcerskiego Ośrodka Morskiego w Pucku strony zaprezentowały krótką historię i dotychczasowe dokonania NMM i ICUA w zakresie badań podwodnych oraz sposobów popularyzacji i ochrony stanowisk archeologicznych w zakresie Konwencji UNESCO o ochronie podwodnego dziedzictwa kulturowego. Następnie archeolodzy z Działu Badań Podwodnych NMM zaprezentowali gościom stosowane przez siebie metody eksploracji, dokumentacji oraz zabezpieczenia in situ podwodnych zabytków archeologicznych, na przykładzie obiektów odnalezionych we wspomnianym puckim porcie. Warto nadmienić, iż dzięki ratyfikacji przez Polskę Konwencji UNESCO o ochronie podwodnego dziedzictwa kulturowego nasze muzeum zostało wyposażone w tym roku w nową jednostkę pływającą typu RIB, umożliwiającą prowadzenie podwodnych badań archeologicznych oraz monitoring obiektów morskiego dziedzictwa kulturowego

6. Underwater archaeologists from the ICUA with National Maritime Museum Director Robert Domżał on board of NMM Wodnik / Archeolodzy podwodni z ICUA z dyrektorem NMM Robertem Domżałem na pokładzie NMM Wodnik (Photo: K. Kurzyk)

the UNESCO Convention on the Protection of the Underwater Cultural Heritage. Next, archaeologists from the Underwater Research Department of the National Maritime Museum presented to the guests their methods of exploration, documentation and *in situ* protection of underwater archaeological artefacts, using objects found in the above-mentioned Puck harbour as an example. It is worth mentioning that thanks to Poland's ratification of the UNESCO Convention on the Protection of the Underwater Cultural Heritage, our museum has been equipped this year with a new RIB-type vessel, making it possible to conduct underwater archaeological research and monitoring of objects of maritime cultural heritage in the Baltic Sea. It was from this vessel that the 'Wicher' and 'Catharina' wrecks were monitored with a team from the ICUA. The first of these, lying off Hel, is the wreck of a Polish destroyer sunk in the first days of the Second World War. The second, lying near the small coastal town of Rewa, represents the remains of a merchant sailing ship destroyed in 1945 as a result of a Russian air raid. It is an interesting site in that it has not yet been subjected to an archaeological survey, which, after a positive verification, has been tentatively scheduled for 2023. The monitoring of the 'Wicher' wreck also gave visitors an opportunity to tour the Hel branch of the National Maritime Museum, the Fisheries Museum.

7. Exchange of experience between archaeologists - Maja Kaleb testing a full-face mask / Wymiana doświadczeń między archeologami – Maja Kaleb testuje maskę pełnotwarzową (Photo: J. Różycki)

na Bałtyku. To właśnie z jej pokładu, z udziałem zespołu z ICUA przeprowadzono monitoring wraków „Wicher" oraz „Catharina". Pierwszy z nich, spoczywający przy Helu, to wrak polskiego niszczyciela zatopionego w pierwszych dniach II wojny światowej. Drugi, leżący w pobliżu niewielkiej nadmorskiej miejscowości Rewa, to pozostałości żaglowca handlowego, zniszczonego w 1945 r. w wyniku rosyjskiego nalotu. Jest to obiekt o tyle ciekawy, że nie był jeszcze poddany badaniom archeologicznym, które po pozytywnej weryfikacji, zostały wstępnie zaplanowane na 2023 rok. Monitoring wraka „Wicher" stał się także okazją do oprowadzenia gości po helskim oddziale NMM, czyli Muzeum Rybołówstwa.

We wrześniu 2022 r. miała miejsce wizyta konserwatorek w składzie Antonija Jozić, Anita Jelić i Zdenka Vrgoč z ICUA w Zadarze. Pobyt przedstawicielek ICUA rozpoczął się od spotkania w Ośrodku Kultury Morskiej (OKM) w Gdańsku gdzie przedstawiciele obu zespołów zaprezentowali zakres prowadzonych prac konserwatorskich oraz wyzwania z którymi się mierzą. Następnie goście z ICUA zwiedzili pracownię oraz laboratoria, które powstały na potrzeby konserwacji i badań mokrego drewna archeologicznego i metalu. Zwieńczeniem pierwszego dnia wizyty było oprowadzenie gości po wystawie „Łodzie ludów świata" przez Przemysława Węgrzyna, kierownika Działu Edukacji. Drugiego dnia goście kontynuowali

In September 2022, a visit by a team of conservators Antonija Jozić, Anita Jelić and Zdenka Vrgoč from the ICUA in Zadar took place. The ICUA representatives' stay began with a meeting at the Maritime Culture Centre in Gdańsk, where representatives of both teams presented the scope of their conservation work and the challenges they face. The ICUA guests then toured the workshop and laboratories that have been set up for the conservation and research of wet archaeological wood and metal. The first day's visit culminated with a guided tour of the 'Boats of the World's Peoples' exhibition by Przemysław Węgrzyn, head of the Education Department. On the second day, the guests continued their meeting at the Museum headquarters in Gdańsk, where they met with Dr Robert Domżał, Director of the National Maritime Museum in Gdańsk, and the project team. On that day, the conservators also saw the permanent exhibition in the Granaries on Ołowianka Island and the two newest exhibitions 'Down to the Seabed. 50 years of archaeological underwater research at the National Maritime Museum in Gdańsk' and 'Truso. The Baltic Legend', which was guided by dr Robert Domżał. During their visit to the Shipwreck Conservation Centre, the ICUA representatives became acquainted with the specifics of the work and the equipment used by the National Maritime Museum's conservators, e.g. equipment for cleaning metal historical objects. Particular interest and numerous questions were aroused by the bathtub system with automation and mechanics, specially designed for the conservation process of wet archaeological wood within the framework of the project 'Construction

9. Presentation of the X-ray workshop with equipment at the Shipwreck Conservation Centre in Tczew. / Prezentacja pracowni rentgenowskiej wraz z wyposażeniem w Centrum Konserwacji Wraków Statków w Tczewie.

spotkanie w głównej siedzibie Muzeum w Gdańsku gdzie spotkali się z dr Robertem Domżałem, dyrektorem NMM w Gdańsku oraz zespołem projektowym. Tego dnia konserwatorki zobaczyły również ekspozycję stałą w Spichlerzach na Ołowiance oraz dwie najnowsze wystawy „Do DNA. 50 lat archeologicznych badań podwodnych Narodowego Muzeum Morskiego w Gdańsku." oraz „Truso. Legenda Bałtyku", po której oprowadził je dr Robert Domżał. Podczas wizyty w CKWS przedstawicielki ICUA zapoznały się ze specyfiką pracy oraz sprzętem wykorzystywanym przez konserwatorów NMM m.in. urządzeniami do oczyszczania metalowych obiektów zabytkowych. Szczególne zainteresowanie oraz liczne pytania wzbudził system wanien z automatyką i mechaniką specjalnie zaprojektowany na potrzeby procesu konserwacji mokrego drewna archeologicznego w ramach projektu „Budowa Centrum Konserwacji Wraków Statków wraz z Magazynem Studyjnym w Tczewie" finansowanego ze środków norweskich oraz

8. NMM and ICUA teams. From left: / Zespoły NMM oraz ICUA. Od lewej: Roko Surić, Mladen Pešić, Luka Bekić, Janusz Różycki, Maja Kaleb, Zbigniew Jarocki, Paweł Litwinienko, Krzysztof Kurzyk, Anna Rembisz-Lubiejewska. (Photo: P. Jóźwiak)

10. Presentation of the conservation workshop and Studio Warehouse at the Shipwreck Conservation Centre in Tczew by Irena Jagielska, conservator of the National Maritime Museum in Gdańsk. / Prezentacja pracowni konserwacji i Magazynu Studyjnego w CKWS w Tczewie przez Irenę Jagielską, konserwatorkę NMM w Gdańsku.

of the Shipwreck Conservation Centre with Studio Warehouse in Tczew', financed from Norwegian funds and co-financed by the Ministry of Culture and National Heritage. The ladies' attention was also drawn to the X-ray laboratory, with two types of X-ray tube of varying power with an indirect and a non-direct radiography system. Both lamps are used to examine inorganic and organic historical objects. During the meeting at the Tczew branch, guests and the representatives of the National Maritime Museum had the opportunity to listen to an online lecture presented by Dr Susan Braovac from the Museum of Cultural History in Oslo on the results of the 'Saving Oseberg' project. The aim of the project was to conserve and thus save Norwegian boats and their furnishings from the ninth century from degradation resulting from the alum method used for conservation in the past. In addition, the conservators had the opportunity to visit two branches of the National Maritime Mu-seum, i.e. the Fisheries Museum in Hel and the Dar Pomorza in Gdynia, and, courtesy of the Directorate of the Naval Museum in Gdynia, both groups visited the warship ORP 'Błyskawica' - the oldest surviving veteran destroyer which took an active part in the Second World War, a branch of the Naval Museum in Gdynia.

During both visits to Poland, both archaeologists and conservators visited the museum exhibitions at the branches of the National Maritime Museum and the workshops for the conservation and documentation of archaeological artefacts at Maritime Culture Centre in Gdańsk and Shipwreck Conservation Centre in Tczew.

During the visit of Croatian archaeologists, we had the opportunity to exchange experience in the methodology of underwater archaeological research and equipment used for underwater exploration and documentation. We also exchanged observations on the protection of submerged archaeological sites, including the possibility

współfinansowanego ze środków Ministra Kultury i Dziedzictwa Narodowego. Uwagę pań przyciągnęła również pracownia rentgenowska, z dwoma rodzajami lamp rentgenowskich o różnej mocy z systemem radiografii pośredniej oraz bezpośredniej. Obie lampy są wykorzystywane do badania nieorganicznych i organicznych obiektów zabytkowych. W trakcie spotkania w oddziale tczewskim goście oraz przedstawiciele NMM mieli sposobność wysłuchać wykładu on-line zaprezentowanego przez dr Susan Braovac z Museum of Cultural History in Oslo na temat rezultatów projektu „Saving Oseberg". Jego celem była konserwacja, a tym samym uratowanie norweskich łodzi i ich wyposażenia z IX w. przed degradacją wynikającą z zastosowanej w przeszłości metody ałunowej użytej do konserwacji. Ponadto konserwatorki miały możliwość odwiedzenia dwóch oddziałów NMM tj. Muzeum Rybołówstwa w Helu i Dar Pomorza w Gdyni, a dzięki uprzejmości Dyrekcji Muzeum Marynarki Wojennej w Gdyni obie grupy zwiedziły okręt wojenny ORP „Błyskawica" – najstarszy zachowany niszczyciel-weteran biorący aktywny udział przez cały okres II wojny światowej, oddział MMW w Gdyni.

11. Presentation of the unique collection of artefacts from the F53.30 wreck, the so-called 'Glass wreck', by Piotr Dziewanowski, conservator at the National Maritime Museum in Gdańsk. / Prezentacja unikatowej kolekcji zabytków z wraka F53.30 tzw. „Szklanego" przez Piotra Dziewanowskiego, konserwatora NMM w Gdańsku.

Podczas obydwu wizyt w Polsce zarówno archeolodzy, jak i konserwatorzy zwiedzili ekspozycje muzealne w oddziałach Narodowego Muzeum Morskiego oraz pracownie konserwacji i dokumentacji zabytków archeologicznych w OKM w Gdańsku oraz CKWS w Tczewie.

W trakcie wizyty chorwackich archeologów mieliśmy możliwość wymiany doświadczeń w zakresie metodyki prowadzenia podwodnych badań archeologicznych oraz sprzętu wykorzystywanego do eksploracji i dokumentacji podwodnej. Wymieniliśmy również spostrzeżenia w zakresie ochrony zatopionych

of protecting historic wrecks in situ and the principles of making them available for underwater tourism. The stay of conservators from the ICUA enabled the exchange of experience in methods of conservation and research of metal, wooden and ceramic artefacts from the marine environment.

The first part of the project was summarised by an open-air exhibition entitled 'Underwater archaeology in Poland. History and perspectives', opened on 23 September 2022 in Zagreb. The official opening was attended by the director of the National Maritime Museum in Gdańsk - Robert Domżał, the director of the ICUA in Zadar - Mladen Pešić and the representative of the Polish Embassy in Zagreb - Marina Hercigonja.

The aim of the exhibition was to promote Poland's underwater cultural heritage in Croatia. Several posters set up in the very centre of the Croatian capital presented wrecks important in terms of the development of boatbuilding traditions, trade and participation in military activities. Medieval boats from Puck, the wreck of a medieval ship called the Copper Ship, the 17th century Swedish ship 'Solen' and the warship 'Wicher' were considered the most significant. Subsequent charts present the effects of the conservation of monuments excavated from the depths of the sea and the history and prospects for the protection of the Baltic's underwater heritage. The exhibition could have been viewed until 6 October 2022.

The first part of the project is now over. We are looking forward to a visit to Croatia and the opportunity to learn more about how to protect Adriatic wrecks in situ and the methods of preserving artefacts retrieved from the sea used at the International Centre of Underwater Archaeology in Zadar.

13. The conservators of the ICUA and the National Maritime Museum after their visit to the Dar Pomorza in Gdynia, a branch of the National Maritime Museum in Gdańsk. / Konserwatorzy ICUA oraz NMM po zakończonej wizycie na Darze Pomorza w Gdyni, oddziale NMM w Gdańsku.

12. A guided tour of the 'Boats of the World's People' exhibition at the Maritime Culture Centre in Gdańsk by Przemysław Węgrzyn, Head of the Museum Education Department. / Oprowadzanie po wystawie „Łodzie ludów świata" w Ośrodku Kultury Morskiej w Gdańsku przez Przemysława Węgrzyna, kierownika Działu Edukacji Muzealiów.

stanowisk archeologicznych, w tym możliwości ochrony zabytkowych wraków in situ oraz zasad udostępniania ich do turystyki podwodnej. Pobyt konserwatorek z ICUA umożliwił wymianę doświadczeń w zakresie metod konserwacji i badań zabytków metalowych, drewnianych i ceramicznych ze środowiska morskiego.

Podsumowaniem pierwszej części projektu była wystawa plenerowa pt. „Archeologia podwodna w Polsce. Historia i perspektywy", otwarta 23 września 2022 r. w Zagrzebiu. W oficjalnym otwarciu wzięli udział dyrektor Narodowego Muzeum Morskiego w Gdańsku - Robert Domżał, dyrektor ICUA w Zadarze - Mladen Pešić oraz przedstawicielka Ambasady RP w Zagrzebiu - Marina Hercigonja.

Celem wystawy była promocja polskiego podwodnego dziedzictwa kulturowego w Chorwacji. Na kilku posterach ustawionych w samym centrum chorwackiej stolicy przedstawiono wraki istotne pod względem rozwoju tradycji szkutniczych, handlu i udziału w działaniach militarnych. Za najistotniejsze uznano średniowieczne łodzie z Pucka, wrak średniowiecznego statku tzw. Miedziowca, XVII-wieczny szwedzki okręt „Solen" oraz okręt wojenny „Wicher". Na kolejnych planszach przedstawiono efekty konserwacji zabytków wydobywanych z morskich głębin oraz historię i perspektywy ochrony podwodnego dziedzictwa Bałtyku. Wystawę można było oglądać do 6 października 2022 r.

Pierwsza część projektu już za nami. Z niecierpliwością czekamy na rewizytę w Chorwacji oraz możliwość poznania sposobów ochrony wraków Adriatyku in situ i metod konserwacji zabytków pozyskiwanych z morza stosowanych w International Centre of Underwater Archaeology w Zadarze.

THE ERASMUS+ U-MAR PROJECT: ICUA ZADAR ACTIVITIES AS PROJECT PARTNER AND FIRST PHASE LEAD INSTITUTION

ERASMUS+ PROJEKT „U-MAR“: AKTIVNOSTI MCPA ZADAR KAO PROJEKTNOG PARTNERA I NOSITELJA PRVE PROJEKTNE FAZE

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1. The project logo / Logo projekta (The Phoenicians' Route, ARGO)

One of the objectives of the International Centre for Underwater Archaeology in Zadar, along with the strong promotion and implementation of the 2001 UNESCO Convention, and the practical and theoretical training of conservation specialists and underwater archaeologists at both the national and international level, is to encourage international collaboration such that it enhances scientific research related to underwater cultural heritage. This includes organising and taking part in international conferences, seminars, workshops, and projects with the aim of exchanging and enhancing knowledge and promotion in the domain of underwater archaeology, both within the profession and among experts from other academic and specialist fields.

Following on a decision to award financial support in the frame of the 2021 call for project proposals under the Erasmus+ programme (Key Action 2, higher education) Croatia's Agency for Mobility and EU Programmes agreed to fund *U-Mar: Enhancing underwater archaeology to make it an innovative tool for developing sustainable*

Jedan od ciljeva Međunarodnog centra za podvodnu arheologiju u Zadru, uz snažno promicanje UNESCO-ove Konvencije iz 2001. godine i njezine provedbe, praktično i teorijsko stručno osposobljavanje stručnjaka konzervatora i podvodnih arheologa na nacionalnoj i međunarodnoj razini, je da poticanjem međunarodne suradnje unaprijedi znanstvena istraživanja vezana uz podvodnu kulturnu baštinu. Takvo poticanje uključuje organizaciju i sudjelovanje u međunarodnim konferencijama, seminarima, radionicama i projektima u cilju izmjenjivanja i unapređivanja znanja i promidžbe iz područja podvodne arheologije, kako unutar same struke, tako i sa stručnjacima iz drugih akademskih i stručnih područja.

2. The project partners at the meeting in Marinella di Selinunte in late March / Projektni partneri na sastanku u Mariniella di Selinunte krajem ožujka (The Phoenicians' Route)

& creative tourism, a strategic partnership in higher education programme (Fig. 1). The project lead partner is The Phoenicians' Route (La Rotta dei Fenici, Italy), one of the Council of Europe's cultural routes[1], responsible for the coordination, implementation, and monitoring of all project activities. Early in 2022 ICUA Zadar signed a cooperation agreement with The Phoenicians' Route as a project partner.

Six European partners are joining forces in this project. Along with ICUA Zadar, the partners are institutions in Spain (the CEI.Mar International Campus of Excellence in Marine Science in Cádiz), Italy (ARGO inthe Emilia-Romagna region; the Superintendency of the Sea of the Region of Sicily in Palermo), Cyprus (the Pafos Regional Board of Tourism), and Portugal (the Industrial and Commercial Association of Funchal - Chamber of Commerce and Industry of Madeira).

The project is aimed at three outcomes: 1) to create a new model of an innovative underwater archaeology course for culture professionals and students of archaeology (to be implemented by ICUA Zadar), 2) to establish an e-learning platform (to be implemented by CEI-MAR Cadiz), and 3) to launch underwater archaeology interpretation centres in the partner countries (to be implemented by The Phoenicians' Route). The project concept is to engage and train underwater archaeology specialists, to achieve a high quality transfer of knowledge between the partner institutions, and to develop ecologically aware tourism associated with underwater cultural heritage.

Two project teams, a core team and a broader team, made up of ICUA staffers and outside associates, were set up to coordinate and implement project activities in line with direct project activities and activities in specific areas related to the implementation of the project. In the core team are Maja Kaleb (project head and coordinator of the

1 https://fenici.net/en/

Agencija za mobilnost i programe Europske unije je, temeljem Odluke o dodjeli financijske potpore za projektne prijedloge u okviru Poziva na dostavu projektnih prijedloga za 2021. za program Erasmus+ (Ključna aktivnost 2 za područje visokog obrazovanja), prihvatila financiranje projekta strateškog partnerstva u visokom obrazovanju pod nazivom: „U-Mar - Jačanje podvodne arheologije u cilju stjecanja inovativnog alata za razvoj održivog i kreativnog turizma“ (Sl. 1). Nositelj projekta je međunarodna udruga Feničanska ruta iz Italije (*La Rotta dei Fenici*), jedna od Kulturnih ruta vijeća Europe[1], koja je nadležna za koordinaciju, provođenje i praćenje svih aktivnosti unutar projekta. Početkom 2022. godine, MCPA Zadar je potpisao Ugovor o suradnji s ustanovom Feničanska ruta kao projektni partner.

U projektnim aktivnostima sudjeluje ukupno šest europskih partnera. Osim MCPA Zadar, partneri su: institucije iz Španjolske (CEI.Mar - *Campus de Excelencia Internacional del Mar*, Cádiz), Italije (ARGO, *Emilia-Romagna; Soprintendenza del Mare della Regione Siciliana,* Palermo), Cipra (*Pafos Tourism Board*) te Portugala (*Associação Comercial e Industrial do Funchal – Câmara de Comércio e Indústria da Madeira*).

Tri su projektna rezultata: Projektni rezultat 1 - kreiranje novog modela inovativnog tečaja podvodne arheologije za djelatnike u kulturi i studente arheologije (u realizaciji MCPA Zadar), Projektni rezultat 2 - postavljanje platforme e-učenja (u realizaciji CEI-MAR Cadiz) te Projektni rezultat 3 - pokretanje interpretacijskih centara o podvodnoj arheologiji u partnerskim zemljama (u realizaciji *La Rotta dei Fenici*). Ideja projekta je uključivanje i osposobljavanje stručnih osoba u području podvodne arheologije i kvalitetan prijenos znanja između partnerskih institucija, kao i razvoj ekološki osviještenog turizma povezanog uz podvodnu kulturnu baštinu.

3. Ivan Vidulić presents summaries of the contributions of the project partners at the meeting in Marinella di Selinunte / Ivan Vidulić predstavlja sažetke doprinosa projektnih partnera na sastanku u Marinella di Selinunte (Photo: M. Kaleb)

Za potrebe koordinacije i provedbe projektnih aktivnosti projekta, uspostavio se uži i širi projektni tim kojeg čine

4. ICUA representatives visit temple E at the Selinunte archaeological park in late June / Predstavnici MCPA Zadar krajem lipnja ispred hrama E u Arheološkom parku Selinunte (ICUA Zadar)

work of the project team), Mladen Pešić (project deputy head), and Marina Mustać (financial and administrative coordinator). The broader team includes Doris Kurtov, Roko Surić and Ivan Vidulić. The project participants are ICUA Zadar staffers, with Ivan Vidulić engaged on the project as an outside associate archaeologist during the implementation of the project's envisaged 1st outcome; *a new innovative course on underwater archaeological sites for cultural operators*.

ICUA Zadar took part in a number of meetings in the course of 2022 at which the steps, deadlines, and progress paths for the implementation of the first project outcome were laid out. At the initial online meeting of 8 March 2022 MladenPešić, Doris Kurtov, and Maja Kaleb presented the scientific, presentation, and education activities performed by ICUA as an independent public institution funded and administered by Croatia and UNESCO.

ICUA Zadar representatives Mladen Pešić and Maja Kaleb were in the town of Marinella di Selinunte on Sicily, Italy on 30 March 2022 where they joined the other project partners at the first transnational meeting of the U-Mar project (Fig. 2). Our representatives presented the courses provided by ICUA that cover underwater archaeology and the conservation and restoration of archaeological artefacts recovered from underwater environments. The Phoenicians' Route and Argo presented an overall overview of the project and its outcomes, and opened a discussion on the achievement of the project's 1st outcome (the course model), and the achievement of a Transnational Training for Trainers gathering.

zaposlenici MCPA Zadar i vanjski suradnici, u skladu s izravnim projektnim aktivnostima i aktivnostima iz specifičnih područja vezanih uz realizaciju projekta. Članovi užeg tima su: Maja Kaleb (voditeljica projekta i koordinatorica rada projektnog tima), Mladen Pešić (zamjenik voditeljice) i Marina Mustać (financijski i administrativni koordinator na projektu). Članovi šireg tima su: Doris Kurtov, Roko Surić i Ivan Vidulić. Svi sudionici projekta su djelatnici MCPA Zadar, dok je Ivan Vidulić zaposlen na projektu kao arheolog-vanjski suradnik tijekom realizacije prvog projektnog rezultata, odnosno „Novog inovativnog tečaja o podvodnim arheološkim nalazištima za kulturne operatere".

MCPA Zadar je tijekom 2022. godine sudjelovao na nekoliko sastanaka gdje su određeni koraci, rokovi i tijek napretka za realizaciju prvog projektnog rezultata. Na početnom on-line sastanku 8. ožujka 2022. godine Mladen Pešić, Doris Kurtov i Maja Kaleb su predstavili Centar u vidu znanstvenih, prezentacijskih i edukacijskih aktivnosti koje Centar provodi kao samostalna javna ustanova, a čije upravljanje i financiranje provodi Republika Hrvatska i UNESCO.

5. ICUA representatives at the Baglio Anselmi archaeological museum in Marsala / Predstavnici MCPA Zadar u Arheološkom muzeju Baglio Anselmi u Marsali (Photo: F. Fazio)

The course is divided into seven learning units:

1. Underwater archaeology, documentation techniques, and the importance of the in situ protection of underwater cultural heritage

2. Communicative interpretation, valorisation and dissemination of underwater heritage

3. Shared management strategies

4. Assessment of the impact of tourism activities on the marine environment with a focus on the natural environment and cultural heritage

5. Creation of underwater cultural itineraries

6. Digital transition of cultural activities

7. Legislation for protection, museum activity regulations, tourism, and recreational diving

It was decided that each of the project partners would choose which of the lessons they would contribute to, guided by the covered topics and their level of expertise and experience in these topics, and that ICUA Zadar would collate, organise, and interpret these contributions in order to implement the course.

6. A visit to the Giuseppe Whitaker Museum on San Pantaleo island / Posjet muzeju George Whitaker na otočiću San Pantaleo (Photo: M. Kaleb)

At the Transnational Training for Trainers event staged in Marinella di Selinunte from 30 May to 4 June 2022 ICUA Zadar representatives Maja Kaleb, Roko Surić, and Ivan Vidulić presented the summaries of the contributions of the other project partners in the frame of the realisation of the 1st project outcome (Fig. 3). At this meeting the project partners discussed all the definitions and points that need to be presented and covered in the course, and determined the necessary guidelines for each lesson in order to see the course syllabus processed and prepared to the highest possible standards. The draft course syllabus was presented at a transnational project meeting in Zadar on 23 September 2022.

As part of both of the meetings in Sicily The Phoenicians' Route association organised a visit to the Selinunte archaeological park,an impressive archaeological zone

Dana 30. ožujka 2022. godine predstavnici MCPA Zadar Mladen Pešić i Maja Kaleb sudjelovali su, zajedno s ostalim projektnim partnerima, na prvom Transnacionalnom sastanku U-Mar projekta, održanom u mjestu Marinella di Seliunte na Siciliji (Sl. 2). Predstavnici MCPA Zadar su predstavili tečajeve podvodne arheologije i tečajeve konzervacije i restauracije arheoloških predmeta iz podvodnog konteksta koje Centar provodi. Feničanska ruta i Argo su predstavili pregled cjelokupnog projekta i projektnih rezultata te je pokrenuta rasprava o ostvarivanju prvog projektnog rezultata (modela Tečaja) i ostvarivanju sastanka Transnacionalni trening za trenere.

Tečaj je podijeljen u sedam nastavnih jedinica koje će se koristiti tijekom provedbe tečaja:

1. Podvodna arheologija, tehnike dokumentiranja i važnost *in situ* zaštite podvodne kulturne baštine;

2. Pristupačno tumačenje, vrednovanje i diseminacija podvodne baštine;

3. Zajedničke strategije upravljanja;

4. Procjena utjecaja turističkih aktivnosti na morski okoliš s naglaskom na prirodno okruženje i kulturnu baštinu;

5. Izrada podvodnih kulturnih itinerara;

6. Digitalna tranzicija kulturnih aktivnosti;

7. Zakonodavstvo vezano uz zaštitu, zakonodavni propisi muzejske djelatnosti, turizam i rekreacijsko ronjenje.

Odlučeno je da će svaki od projektnih partnera odabrati kojoj nastavnoj jedinici će priložiti svoje doprinose s obzirom na temu nastavne jedinice i njihovoj stručnosti i iskustvima s tim temama, te da će te doprinose MCPA Zadar prikupiti, organizirati i interpretirati kako bi se realizirao Tečaj.

Na Transnacionalnom treningu za trenere u Marinella di Selinunte, koji se održao od 30. svibnja do 4. lipnja 2022. godine, predstavnici MCPA Zadar Maja Kaleb, Roko Surić i Ivan Vidulić su predstavili sažetke doprinosa ostalih projektnih partnera u sklopu ostvarivanja Projektnog rezultata 1. Na sastanku su projektni partneri raspravljali

7. Ivan Vidulić presents a draft model of the course to the project partners at the meeting in Zadar / Ivan Vidulić predstavlja nacrt modela Tečaja projektnim partnerima na sastanku u Zadru (Photo: L. Bratović)

8. The project partners are received at the tourism board of the town of Nin / Doček projektnih partnera u turističkoj zajednici grada Nina (ICUA Zadar)

with the remains of seven temples from the period of the Greek colonisation of Magna Graecia and of the prosperous emporium at Selinunte (Fig. 4). Also organised during the meeting held in early June was a visit to the Baglio Anselmi archaeological museum in Marsala (Fig. 5) which, along with archaeological artefacts, is also home to the remains of a 3rd c. BCE Punic ship and a Roman period ship from the 3rd c. CE, and a visit to the island of San Pantaleo and the site of the Phoenician colony of Mothia. The Giuseppe Whitaker Museum on the island is home to artefacts from the period of the Phoenician founding of the colony and the following period of Punic, Greek and Roman colonisation of the island (Fig. 6).

ICUA Zadar representative Ivan Vidulić presented the draft course syllabus at the meeting organised in Zadar on 23 September 2022 with the co-leadership of The Phoenicians' Route association (Fig. 7). The draft syllabus is the fruit of many months of collecting, processing and interpreting the contributions, with each of the lessons presented as a set of facts and theoretical knowledge, and as an example of best practices in the promotion of cultural heritage in the countries of the project partners. After a round of discussions and commentary on further steps it was decided that, upon the incorporation of acknowledged modifications, a completed model of a course on underwater archaeological sites for cultural operators would be submitted by year's end. During the meeting the participants visited Zadar's Museum of Ancient Glass and Nin, a town whose roots go back to the medieval period (Fig. 8). The participants were welcomed at the office of Nin's tourism board by the office head and staffers ahead of a guided tour of the town. The participants were impressed in particular with the historical and cultural significance of this ancient town and the charm of this historical gem (Fig. 9). The guided tour was followed by a visit to the Museum of Nin Antiquities with a specialist guide where the participants learned of Nin's archaeological background from the exhibited artefacts.

koje sve definicije i točke moraju biti predstavljene i obrađene u tečaju, te su utvrđene potrebne smjernice za svaku nastavnu jedinicu kako bi se nastavni plan i program tečaja što bolje obradio i pripremio. Određeno je da će nacrt nastavnog plana i programa tečaja predstaviti na Transnacionalnom projektnom sastanku koji će se održati u Zadru 23. rujna 2022. godine.

U sklopu oba sastanka na Siciliji, Feničanska ruta je organizirala posjet arheološkom parku Selinunte, impresivnoj arheološkoj zoni s ostacima sedam hramova iz razdoblja grčke kolonizacije *Magnae Graeciae* i bogatog emporiona Selinunta (Sl. 4). Tijekom sastanka održanog početkom lipnja, organiziran je i posjet arheološkom muzeju Baglio Anselmi u gradu Marsali (Sl. 5), gdje su uz arheološke artefakte izloženi i ostaci punskog broda iz 3. st pr. Kr. i rimskog broda iz 3. st. po. Kr., kao i posjet otočiću San Pantaelo i lokalitetu feničke kolonije Mozija (*Mothya*). Na otočiću se nalazi muzej *George Whitaker*, gdje su izloženi artefakti iz vremena feničkog utemeljenja kolonije i narednih razdoblja punskog, grčkog i rimskog naseljavanja otočića (Sl. 6).

Na sastanku u MCPA Zadar, 23. rujna 2022., u partnerstvu s Feničanskom rutom, Ivan Vidulić kao predstavnik MCPA Zadar je predstavio Nacrt nastavnog plana i programa tečaja (Sl. 7). Nacrt je rezultat višemjesečnog prikupljanja, obrade i interpretacije doprinosa, gdje je svaka nastavna jedinica predstavljena kao skup teorijskih znanja i činjenica, kao i primjera dobre prakse promidžbe kulturne baštine u zemljama projektnih partnera. Nakon rasprave i komentara o daljnjim koracima, odlučeno je da se nakon uvaženih i uvedenih preinaka do kraja godine dostavi gotovi model Tečaja o podvodnim arheološkim nalazištima za kulturne operatere. U sklopu sastanka u Zadru, organiziran je i posjet Muzeju antičkog stakla u Zadru, te posjet srednjovjekovnom gradu Ninu (Sl. 8). Nakon dobrodošlice od strane voditeljice i djelatnika turističke zajednice grada Nina u uredu turističke zajednice, predstavnici projektnih partnera su uživali u organiziranom turističkom razgledavanju Nina. Posebno ih se dojmio povijesni i kulturni značaj grada te šarmantan izgled ovog povijesnog dragulja (Sl. 9). Nakon turističkog obilaska, organizirano je i stručno vodstvo kroz trajni postav Muzeja ninskih starina tijekom kojeg su posjetitelji upoznali arheološku povijest Nina kroz izložene arheološke artefakte.

U-Mar projekt stavlja u fokus razvoj znanja i vrednovanje kulturne baštine kroz podvodnu arheologiju te promicanje i osnaživanje kulturno-turističke ponude koja bi se u narednim godinama mogla povećati s obzirom na aktualnost teme i interes za ovo područje. Projektom se potiče uspostavljanje međunarodnog strateškog partnerstva u pitanju od zajedničkog interesa – razvoja podvodne arheologije – a time i povećanja zajedničkog djelovanja na transnacionalnoj razini. Sudjelovanje MCPA Zadar

The U-Mar project is focused on the development of knowledge and the appreciation of cultural heritage through underwater archaeology and the promotion and strengthening of the culture and tourism offer, which may grow in the coming years given the current relevance of the topic and the interest for this field. This project stimulates the creation of international strategic partnerships in matters for which there is a shared interest—the development of underwater archaeology—and thereby the intensification of joint activity at the transnational level. The participation of ICUA Zadar corresponds with the renovation of the Sveti Nikola monastic complex, a major project, and the development of our education and presentation centre. This will also enhance the institution's capacity for the further implementation of international projects and will broaden our network of partners abroad. The project will enable the development of centres for the interpretation of underwater archaeology in the local communities of the partner countries, which will, among other things, be included in The Phoenicians' Route network, one of the Council of Europe's first cultural routes. Upon completion of the project's first phase the baton will be passed on to our partners at the CEI-Mar institute, who have taken on the development of an online platform for the digital transmission of course knowledge to users, and in the end the leadership role will go to The Phoenicians' Route association, which will implement the interpretative educational centres on underwater archaeology.

Detailed information about the U-Mar project is available on the Internet site of The Phoenicians' Route association.[2]

2 https://fenici.net/en/about-us-2/projects/#1652519153159-318e6ae2-0dfe

▶ 9. The project partners during a guided tour through the town of Nin / Projektni partner tijekom vođenog obilaska grada Nina (Photo: M. Kaleb)

korespondira s kapitalnim projektom obnove samostanskog kompleksa sv. Nikole i razvoja edukacijskog i prezentacijskog centra. Njime će se osnažiti i kapaciteti ustanove za daljnju provedbu internacionalnih projekata, a proširit će se i mreža međunarodnih partnera. Projekt će omogućiti razvoj centara za interpretaciju podvodne arheologije u lokalnim zajednicama partnerskih zemalja koji će, između ostalog, biti uključeni u mrežu Feničanske rute, jedne od najstarijih kulturnih ruta Vijeća Europe. Nakon završetka prve projektne faze, štafeta se predaje partnerima iz instituta CEI-Mar koji su zaduženi za uspostavu on-line platforme za digitalni prijenos znanja iz Tečaja korisnicima, a na samom kraju vodstvo preuzima partnerska udruga Feničanska ruta, koji je odgovoran za implementaciju interpretativnih edukativnih centara o podvodnoj arheologiji.

Detaljnije informacije o U-Mar projektu dostupne su na mrežnim stranicama Feničanske rute.[2]

▶ 10. The project partners meet in Marinella di Selinunte / Projektni partneri tijekom sastanka u Marinella di Selinunte (The Phoenicians' Route)

CONSERVATION AND RESTORATION WORK ON WOODEN BARRELS

KONZERVATORSKO-RESTAURATORSKI RADOVI NA DRVENIM BAČVAMA

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1. Fish salting barrel, wood, H=52cm, W=38cm (bilge section), W=33.2cm (top and bottom), E-93 prior to treatment / Bačva za soljenje ribe, drvo, v=52cm, š=38cm (trbušasti dio), š=33,2cm (na vrhu i dnu), E-93 prije obrade (Photo: A. Jelić)

Salted sardines are now considered a culinary delicacy, but in the days before refrigerators and freezers it was a critical foodstuff, one that could be stored and consumed over an extended period of time. It is a well-known fact that fish—oily fish like the sardine in particular—was for many generations a cornerstone of the diet on the Croatian coast and its islands. The need to extend storage time for as long as possible led to the processing and conserving of fish by salting, which significantly increased the period in which it could be safely consumed. Although the salting process has changed little in the course of history, there have been changes in the use of packing material. Functionality and hygienic considerations have led to the current use of containers made of modern materials like plastic, rustproof metal, and glass. In the past, however, sardines were salted only in wooden barrels. Two such wooden barrels were entrusted in the 1970s to the care of the City museum of Rovinj - Rovigno.

We know that the aforementioned barrels were once used for sardine salting at the Mirna company's fish processing plant. Corroborating this is the fact that a number of fish scales were observed in the barrels, as were salt crystals that had formed on the surface of the wood.

Premda se danas slana srdela smatra delicijom ona je u vrijeme kad nisu postojali hladnjaci ni zamrzivači bila ključna namirnica koja se mogla čuvati i konzumirati kroz dulji vremenski period. Poznato je kako je riba, a posebno plava riba poput srdela, kao namirnica othranila mnoge generacije u hrvatskom priobalnom i otočnom području. Potreba za njenim što duljim čuvanjem dovodi do prerade i konzerviranja ribe soljenjem čime se znatno produljilo vrijeme njene sigurne konzumacije. Iako se sam postupak soljenja kroz povijest nije puno mijenjao promjene su prisutne u upotrebi ambalažnog materijala. Naime, zbog funkcionalnosti i higijenske održivosti danas se upotrebljavaju suvremeni ambalažni materijali poput plastike, nehrđajućeg metala, stakla. Međutim, nekad su se srdele solile isključivo u drvenim bačvama odnosno barilima. Upravo su takve dvije drvene bačve, sedamdesetih godina, dopremljene u prostorije Muzeja Grada Rovinja-Rovigno – Museo della Città di Rovinj-Rovigno.

Poznato je da su se spomenute drvene bačve nekoć koristile u tvornici za preradu ribe Mirna, gdje su se upotrebljavale za soljenje srdela. Tome u prilog ide i nekoliko ribljih ljuskica primijećenih u bačvama te kristali soli koji su se formirali na površini drva.

Svojevremeno korištenje bačvi za soljenje srdela te daljnji dugogodišnji utjecaj prisutne soli na drvo u kombinaciji s povišenom vlagom iz zraka u muzejskom depou uzrokovali su određene vidljive promjene u strukturi drva. Naime, na površini drveta vidljiva je formacija kristala soli koji su utjecali na razdvajanje drvenih vlakana odnosno listanje drvene površine te ona izgleda prašnjavo i paučinasto (Sl. 3).

Neophodno je bilo stabilizirati drvenu struktura, naročito njen površinski sloj stoga su bačve i dopremljene u radionicu za organski materijal Međunarodnog centra za podvodnu arheologiju u Zadru. Drvena bačva inventarske oznake E-94 zaprimljena je u cjelovitom stanju (Sl. 2) dok

2. Fish salting barrel, wood, H=52cm, W=38cm (bilge section), W=33.2cm (top and bottom), E-94 prior to treatment / Bačva za soljenje ribe, drvo, v=52cm, š=38cm (trbušasti dio), š=33,2cm (na vrhu i dnu), E-94 prije obrade (Photo: A. Jelić)

The previous use of these barrels for sardine salting and the further long-term effect of the salt present, in combination with elevated humidity levels at the museum depot, have led to certain visible changes to the structure of the wood. On the surface of the wood, namely, we see the formation of salt crystals, which have caused the separation of wood fibres, i.e., the exfoliation of the wood surface, causing it to appear powdery and filamentous (Fig. 3).

Stabilising the wooden structure was essential, in particular its surface layer, and the barrels were thus submitted to the organic materials workshop of the International Centre for Underwater Archaeology in Zadar. The wooden barrel with inventory code E-94 was received intact (Fig. 2), while the barrel with inventory code E-93 was received in parts, but with all the attendant and necessary elements (Fig. 1). The form of both barrels is that of a cylinder with a central bulge (the “bilge”). They share the same dimensions and appear to be identical. They are made of multiple staves that are bound together at four points with doubled wooden hoops.

In spite of the damage to the outer layer, i.e., the wooden surface, the interior layers of the wood have retained their structure and firmness. The performance of the conservation and restoration process was, however, essential in order to stabilise the wooden structure, in particular its surface layer and, of course, to reassemble

je bačva inventarske oznake E-93 zaprimljena u dijelovima ali sa svim pripadajućim i potrebnim elementima (Sl. 1). Obje bačve su trbušaste, istih dimenzija i naizgled djeluju identično. Građene su od više takozvanih duga koje su međusobno stegnute duplim drvenim obručima na četiri mjesta.

3. Salt crystals and the damaged surface layer of the wood, barrel E-94 / Kristali soli i oštećeni površinski sloj drva, bačva E-94 (Photo: A. Jelić)

Unatoč oštećenju vanjskog sloja odnosno drvene površine, unutarnji slojevi drveta zadržali su svoju strukturu i čvrstoću. Međutim, neophodna je bila provedba konzervatorsko-restauratorskog postupka kako bi se stabilizirala drvena struktura prvenstveno njen površinski sloj i naravno kako bi se spojila bačva koja je zaprimljena u dijelovima.

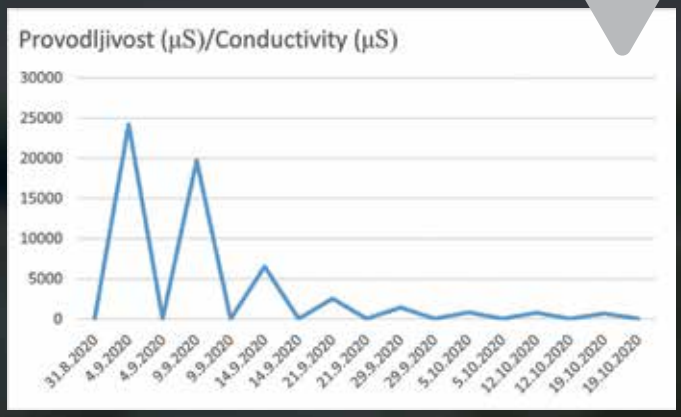
Stabilizacija drvene strukture zahtijevala je uklanjane vidljivih i nevidljivih kristala soli odnosno bilo je neophodno provesti postupak desalinizacije potapanjem drvenih bačvi u demineraliziranu vodu (Sl. 4). Budući da se radilo o suhom drvu desalinizacija se provodila pod dodatnim pritiskom kako bi se osiguralo potpuno potapanje bačvi. Kako dugotrajan utjecaj vode na drvo ima negativne posljedice na samu strukturu drva, odlučeno je proces desalinizacije provesti u što kraćem roku, a opet dovoljno dugo da se izluče eventualno prisutne vezane soli. Tijekom procesa desalinizacije voda se često mijenjala, a sam postupak desalinizacije se kontrolirao nekoliko puta dnevno mjereći električnu provodljivost vode koja je rasla s porastom izlučenih soli u vodi. Primijećena je najveća ekstrakcija soli unutar prvih nekoliko dana kad su vrijednosti otopljene soli bile veoma visoke. Pretpostavlja se da su se u tom periodu uklonili površinski odnosno vidljivi kristali soli. Potom je zabilježena velika promjena u izlučenoj količini soli odnosno količina izlučene soli znatno pada što je vjerojatno posljedica izlučivanja vezane soli kojoj je potrebno više vremena za otapanje (Sl. 5). Bilježenjem minimalnih promjena električne provodljivosti vode između dvije promjene vode zaključilo se da je proces desalinizacije proveden do kraja.

4. Desalination of barrel E-94 / Desalinizacija bačve E-94 (Photo: A. Jelić)

the barrel that was received in parts.

The stabilisation of the wooden structure required the removal of visible and invisible salt crystals, i.e., it was essential that the desalination procedure was performed by immersing the wooden barrels in demineralised water (Fig. 4). As the wood in question was dry the desalination was performed under additional pressure in order to ensure the full immersion of the barrels. Since long-term exposure of wood to water has a negative impact on the structure of wood it was decided that the desalination process be as brief as possible, just long enough to leach out any bound salts that may be present. The water was often changed during the desalination process, and the process was monitored several times per day by measuring the electrical conductivity of the water, which increased as the level of salt leached into the water increased. The highest level of salt extraction was observed within the first few days, when the dissolved salt values were very high. We posit that this period saw the removal of the visible salt crystals on the surface. We then observed a significant change in the quantity of leached salt, i.e., the quantity of leached salt dropped significantly, which likely indicated the leaching out of bound salts, which required more time to dissolve (Fig. 5). When minimal changes to electrical conductivity were recorded between two changes of water, we concluded that the desalination process had been completed.

This was followed by the air drying process. The wood was first exposed to air with an elevated humidity level, and only later to air with a lower humidity level. This slowed to the greatest possible degree the drying process and prevented additional cracking and warping of the wood, which is the most frequent result of the rapid and uncontrolled drying of wood. The drying process was controlled by monitoring the mass, i.e., by weighing the widest stave of barrel E-93, which was taken as the reference stave on account of its dimensions. Once a constant mass of the reference stave was achieved, we considered the drying process for both barrels to have



5. Graph showing the extraction of salt during the desalination of barrel E-94 / Grafički prikaz ekstrakcije soli tijekom desalinizacije bačve E-94 (Graph by: A. Jelić)

Uslijedio je proces sušenja koji se provodio na zraku. Međutim, drvo se prvo izložilo zraku s većim postotkom vlage te potom s manjim postotkom vlage. Time se maksimalno usporio proces sušenja i spriječilo dodatno pucanje i krivljenje drva što je ujedno i najčešća posljedica naglog i nekontroliranog sušenja drva. Proces sušenja kontrolirao se praćenjem mase odnosno vaganjem najšire duge bačve E-93, koja je zbog svoje veličine uzeta kao referentna duga. Uspostavom konstantne mase referentne duge pretpostavilo se da je proces sušenja za obje bačve priveden kraju. Tijekom sušenja primijećeno je da se veći dio oštećenog površinskog sloja drva uklonio samim procesom desalinizacije. Ostatak oštećenog sloja drva uklonio se nakon procesa sušenja, a u tu svrhu upotrebljavali su se brus papiri različitih granulacija. Radi bržeg uklanjanja oštećenog vanjskog sloja u početku se koristio brus papir grublje granulacije, a potom brus papir sitne granulacije i super sitne granulacije za završno poliranje drvene površine. Naročito se pazilo prilikom čišćenja cjelovite bačve E-94 da pod jakim pritiskom slučajno ne bi došlo do njenog rastavljanja. Također, dodatno se pazilo na dijelove oko obruča koji su još bili postojani na originalnoj poziciji na bačvi (Sl. 6).

Nakon čišćenja pristupilo se spajanju bačve koja je zaprimljena u dijelovima, E-93. Bilo je potrebno naći pravu poziciju svake pojedine duge. U tu svrhu koristili su se razni detalji prisutni na površini drva poput vidljivih oštećenja drva, raznih prisutnih mrlja, tragova obruča. Nakon što se pozicionirala svaka duga bilo je potrebno dodati dno bačve koje je također zaprimljeno u više dijelova. Paralelno su se međusobno spajali dijelovi dna u jednu cjelinu i fiksirali na duge tehnikom lijepljenja (Sl. 7).

Uslijedilo je zatezanje pojedinih obruča konopcem te pozicioniranje obruča na pojedinu bačvu. Pozicioniranje obruča vršilo se laganim udarcima gumenog čekića po pojedinom obruču do pozicije koju je sam obruč mogao podnijeti (Sl. 8).

been completed. In the course of drying, it was observed that the desalination process had removed most of the damaged surface layer of the wood. The remaining damaged layer was removed following the drying process with sandpaper of varying grit sizes. Sandpaper of coarse grit size was used initially to quickly remove the damaged outer layer, followed by sandpaper of finer grit size, and then very fine grit size for final polishing of the wood surface. Particular care was exercised in the course of the cleaning of intact barrel E-94 so that it would not come apart by chance as the result of excessive application of pressure. Particular care was exercised with regard to the areas around the hoops, which were still stable in their original positions on the barrel (Fig. 6).

Cleaning was followed by the reassembly of barrel E-93, which had been received in parts. It was essential that the proper position of each stave be correctly established. To this end we used various details present on the surface of the wood like visible damage marks, stains, and hoop traces. Once the staves had been positioned, the bottom of the barrel (bottom head)—also received in parts—was also put in its place. The parts of the bottom head were reconstituted as the head was attached to the individual staves with adhesive (Fig. 7).

This was followed by the tightening of the individual hoops with a rope and positioning the hoops on the individual barrels. The hoops were positioned with light blows from a rubber-headed mallet until a position appropriate to the strength of the hoop was achieved (Fig. 8).

The final phase of the work was to protect the wood. As the interior layers of the wood are well preserved, only surface layer protection was applied to the wood. A thermoplastic resin dissolved in an organic solvent was used as the protective agent. The agent was applied to the surface of the wood with flat brushes of different widths using the surface tapping technique (Fig. 9). This procedure, besides protecting the surface of the wood, also refreshed the colour of the wood and restored its shine (Fig. 10).

The restored shine of these wooden barrels was showcased at a Museum Night event staged on 28 January 2022. For the 17th Museum Night, which focused on the theme of Museums between the Phisical and Virtual World, the City museum of Rovinj - Rovigno presented The Barrel - Cradle of Salted Sardines exhibition. In the course of the production of this presentation the staffers of ICUA Zadar recorded a number of images of the conservation-restoration process accompanied by a short description of the work. Restrictions imposed on visits to the museum in light

6. Removing the damaged surface layer of the wood, barrel E-94 / Uklanjanje oštećenog površinskog sloja drva, bačva E-94 (Photo: A. Jozić)

Završna faza radova bila je zaštita drva. Budući da su unutarnji slojevi drva sačuvani zaštitio se samo površinski sloj drva. Kao zaštitno sredstvo koristila se termoplastična smola otopljena u organskom otapalu. Sredstvo se nanosilo na površinu drva pomoću ravnih kistova različite širine takozvanom tehnikom tapkanja površine (Sl. 9). Ovim postupkom osim što se zaštitila površina drva, drvu se ujedno osvježila boja i vratio sjaj (Sl. 10).

7. Reassembling barrel E-93 / Spajanje bačve E-93 (Photo: A. Jozić)

Novi sjaj drvenih bačava predstavljen na manifestaciji Noć muzeja održanoj 28. siječnja 2022. godine. Naime, na 17. Noći muzeja pod temom Muzeji – između stvarnog i digitalnog, Muzej Grada Rovinja-Rovigno – Museo della Città di Rovinj-Rovigno prezentirao je izložbu s predstavljanjem pod nazivom *Baril/Bareîl – Koljevka slanih sardona/Culla dei sardoni sotto sale*. U svrhu izrade prezentacije djelatnici Međunarodnog centra za podvodnu arheologiju u Zadru snimili su nekoliko kadrova konzervatorsko-restauratorskog postupka uz kratak opis radova. Zbog ograničenosti posjetitelja Muzeja uzrokovane pandemijom koronavirusa, SARS-CoV-2, drvene bačve i prezentacija su predstavljeni ispred samog Muzeja te na društvenoj mreži Facebook, na profilu Muzeja Grada Rovinja-Rovigno – Museo della Città di Rovinj-Rovigno. Ovim su se konzervatorsko-

8. Positioning the hoops on barrel E-93 / Pozicioniranje obruča na bačvi E-93 (Photo: A. Jozić)

of the pandemic fear related to the SARS-CoV-2 virus (COVID-19) saw the wooden barrels exhibited in front of the museum building and on the Facebook social media application profile of the City museum of Rovinj - Rovigno. In this manner the museum visitors and the general public were familiarised with the conservation and restoration of these wooden barrels.

Although the restoration of the wooden barrels has been completed, safeguarding them remains a continuing mission. As the preservation of these barrels depends on the conditions in exhibition or storage areas, it is essential that temperature and relative humidity be controlled. Also critical are intermittent visual examinations of the condition of the barrels; if any changes are observed the recommendation is to notify restorers to this effect at the first available opportunity.

restauratorski radovi provedeni na drvenim bačvama približili posjetiteljima Muzeja, ali i široj javnosti.

Iako je restauracija drvenih bačvi završena potrebo je i dalje voditi računa o njihovom stanju. Naime, kako očuvanost bačvi ovisi o uvjetima koji vladaju u izložbenoj ili skladišnoj prostoriji neophodno je da se u navedenim prostorijama kontrolira temperatura i relativna vlažnost zraka. Također, važna je i povremena vizualna provjera stanja bačvi te ukoliko se na bačvama uoče bilo kakve promjene preporuka je o tome što prije obavijestiti restauratora.

9. Surface protection of the wood of barrel E-93 / Površinska zaštita drva bačve E-93 (Photo: A. Jozić)

10. Wooden barrels E-93 and E-94, post-treatment / Drvene bačve, E-93 i E-94, nakon obrade (Photo: A. Jelić)

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