

Submerged Heritage Potopljena baština

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IN SEARCH OF UNDERWATER HERITAGE
U POTRAZI ZA PODVODNOM BAŠTINOM

MASARYK, BADOVINAC

PROJECT NAVIS
PROJEKT NAVIS

IN THIS
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U OVOM
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Excavation at Piruzi / Iskopavanje kod Piruza (Photo: R. Surić)



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Second Night of Museums at ICUA Underwater Archaeology Gallery

The International Centre for Underwater Archaeology in Zadar made its second appearance in the annual Night of Museums event. The ICUA Gallery was opened on the night of the 27th to 28th of January 2017, as was for the first time the former St Nicholas church. For the occasion the former church building was lit up with torches – after necessary adaptations it is slated to open as a new underwater archaeology museum. Finds recovered from various underwater excavations conducted by ICUA and privately donated artefacts were exhibited at the gallery. The show-stealer this year was an old diving helmet exhibited in a way that allowed visitors to put in on and experience what it was like to wear one. In all, the gallery received over 600 visits at the event.

ICUA Zadar Receives Valuable Display Cases

Representatives of the International Centre for Underwater Archaeology in Zadar were in Germany's Dresden on the 16th of March 2017 to receive a donation of ten museum display cases.



Loading the display cases at Dresden's Japanese Palace / Ukcavanje vitrina u Japanskoj palači u Dresdenu (Photo: L. Bekić)



Visitors to the ICUA Gallery on the 2017 Night of Museums / Posjetioци u Galeriji MCPA na Noć muzeja 2017 (Photo: L. Bekić)

Druga Noć muzeja u Galeriji podvodne arheologije MCPA

Međunarodni centar za podvodnu arheologiju u Zadru sudjelovao je u godišnjem događanju Noć muzeja, po drugi puta. U noći s 27. na 28. siječnja 2017, ponovno je otvorena Galerija MCPA, a ovaj puta i bivša crkva sv. Nikole. Bivša crkva je bila prigodno osvijetljena bakljama, a nakon nužne adaptacije će postati lokacija novog muzeja podvodne arheologije. U galeriji su izloženi nalazi s raznih podvodnih istraživanja koja je proveo MCPA, kao i neke donacije građana. Najviše zanimanja ove je godine prikupila starinska ronilačka kaciga, koja je bila izložena na način da su je posjetitelji mogli staviti na glavu i tako isprobati. Sveukupno je galeriju posjetilo nešto više od 600 posjetilaca.

MCPA Zadar dobio vrijedne vitrine

16. ožujka 2017. g. Međunarodni centar za podvodnu arheologiju Zadar je u Njemačkoj, u Dresdenu, preuzeo



10 muzejskih vitrina koje je dobio kao donaciju od Državnog umjetničkog muzeja (Staatliche Kunstsammlungen Dresden) za uporabu u budućem prezentacijskom centru podvodne arheologije u sv. Nikoli u Zadru.

Ujedno je stručni tim MCPA Zadar boravio u posjeti glavnom državnom muzeju Slobodne Države Saske (Freistaat Sachsen) i njegovoj restauratorsko-konzervatorskoj radionici u rezidencijskoj palači.

The German-donated display cases in use in Zadar / Njemačke vitrine u uporabi u Zadru (Photo: L. Bekić)

The donation from the Dresden State Art Collection (Staatliche Kunstsammlungen Dresden) will be used in the future underwater archaeology presentation centre at the former St Nicholas church in Zadar. The ICUA expert team also visited the Museum of the Free State of Saxony and the palace that is home to its restoration and conservation workshop.

Another Successful DEGUWA Congress

Germany's Koblenz was the venue from the 15th to 19th of March for another in a series of international symposia dedicated to underwater archaeology hosted by DEGUWA. Europe's largest regular gathering of underwater archaeologists was held at the Rhein Mosel campus of the Koblenz University of Applied Sciences. The event focused on the idea of We're All in the Same Boat – the Social Importance of Ships, Rafts and Ferries. Among a dozen Croatian participants were experts from the International Centre for Underwater Archaeology in Zadar who presented our latest projects.



An evening post-lecture reception at the Koblenz University / Večernji domjenak nakon predavanja na Sveučilištu u Koblenzu (Photo: L. Bekić)

Underwater Archaeological Heritage Management Symposium in Slovenia

A round table on underwater heritage in Vrhnika, Slovenia / Okrugli stol o podvodnoj baštini u Vrhnici, Slovenija (Photo: M. Kaleb)



Još jedan kongres DEGUWA-e

Od 15. do 19. ožujka 2017. g. u Koblenzu, Njemačka je održan još jedan u nizu međunarodnih skupova posvećenih podvodnoj arheologiji u organizaciji DEGUWA-e. Najveći redovni europski skup podvodnih arheologa ovaj puta održan je na Rhein Mosel kampusu Sveučilišta primijenjenih znanosti u Koblenzu. Osnovna tema skupa bila je "We're all in the same boat - the social importance of ships, rafts and ferries". Između desetak hrvatskih predstavnika bili su i predstavnici Međunarodnog centra za podvodnu arheologiju Zadar koji su predstavili svoje novije projekte.



ICUA projects presented at the Koblenz event / Predstavljanje projekata MCPA putem plakata u Koblenzu (Photo: L. Bekić)

Skup o upravljanju podvodnom arheološkom baštinom u Sloveniji

Međunarodni centar za podvodnu arheologiju Zadar sudjelovao je kao partner u međunarodnom stručnom skupu "Upravljanje podvodnom arheološkom baštinom" koju je organizirao Zavod za podvodnu arheologiju iz Slovenije (ZAPA). Ovaj skup odvijao se 21. i 22. travnja 2017. g. u sklopu projekta "Doživljajsko razstavišče Ljubljaničica" koji u Vrhnici provodi Muzej Grada Ljubljane i ZAPA. Projektom se nastoji približiti javnosti povijest plovidbe po rijeci Ljubljaničici i naglasiti njen baštinski značaj. Tijekom skupa održan je okrugli stol sa stručnjacima



Preparing to dive at an archaeological wood deposit near Vrhnika / Priprema za zaron na depozitoriju arheološkog drva kod Vrhnike (Photo: M. Jančar)

of countries and several lectures. The participants toured a number of sites on the Ljubljanica River and conducted several dives.

French Ambassador Visits ICUA Zadar

The French Ambassador to Croatia HE Philippe Meunier, accompanied by his wife and embassy aids, visited ICUA Zadar on the 28th of April 2017.

The visit follows on the many years of collaboration in the domain of underwater archaeology, conservation and restoration the International Centre for Underwater Archaeology in Zadar has developed with a number of French experts from Arles, Grenoble and Aix-en-Provence. Our esteemed guests met with the staff and learned about the scope of work of ICUA and about the wealth of submerged heritage in the Croatian Adriatic exhibited at the ICUA underwater archaeology gallery and the future exhibition space in the former St Nicholas church. The French ambassador expressed his warm desire to see collaboration between our countries further developed and elevated, including study trips by French students to ICUA Zadar.

Munich Hosts Late Antique Fine Ware Workshop

The Institute of Pre- and Protohistoric Archaeology and Archaeology of the Roman Provinces of the Ludwig Maximilian University of Munich staged a workshop on the 6th of May 2017 on Adriatic late antique fine ware. The Production and Distribution of Fine Wares in the Adriatic Region from the 3rd to 7th Century workshop saw participants presenting the results of the investigation of

iz više zemalja te nekoliko predavanja. Organiziran je i obilazak više nalazišta na rijeci Ljubljanici od kojih se na nekoliko njih i zaronilo.



Francuski veleposlanik posjetio MCPA Zadar

Dana 28. travnja 2017. g. u posjet zadarskom centru je stigao veleposlanik Francuske Republike u Republici Hrvatskoj, Njegova ekscelencija Philippe Meunier, sa suprugom i suradnicima iz veleposlanstva.

Poticaj za ovaj posjet bila je višegodišnja suradnja stručnjaka na polju podvodne arheologije te konzerviranja i restauriranja koju je Međunarodni centar za podvodnu arheologiju Zadar razvio s nizom francuskih stručnjaka iz Arlesa, Grenoblea i Aix-en-Provencea. Nakon upoznavanja s osobljem i radnim djelokrugom zadarskog centra, uvaženi gosti upoznali su se s bogatom potopljenom baštinom Hrvatskog Jadrana koja je izložena u Galeriji podvodne arheologije u sklopu MCPA i budućim



Ambassador Meunier with the restorers at ICUA Zadar / Posjet veleposlanika Philippea Meuniera restauratorima MCPA Zadar (Photo: M. Kaleb)

izložbenim prostorom, crkvom sv. Nikole. Veleposlanik je izrazio veliku želju da se suradnja na polju podvodne arheologije između ove dvije zemlje nastavi i podigne na još veću razinu, među ostalim i dolaskom francuskih studenata na praksu u zadarski centar.

late antique fine ware at a number of sites on the western and eastern shores of the Adriatic Sea. Taking part in the proceedings were Mladen Pešić (ICUA) and Igor Borzić (University of Zadar), presenting finds from the broader Zadar area in their presentation on Late Roman Fine Wares from Northern Dalmatia. The workshop was followed by a discussion the conclusions of which are to be published in a monograph that aims to contribute to our better understanding of this type of archaeological material.



The participants of the Munich workshop / Sudionici radionice u Minhenu (Photo: E. Cirelli)

UNESCO Paris Meeting

The sixth Meeting of States Parties to the 2001 Convention on the Protection of the Underwater Cultural Heritage was staged at UNESCO Headquarters in Paris on the 30th and 31st of May 2017. On the agenda were efforts to achieve broader implementation of the 2001 Convention among signatory countries and new ratifications of the Convention, expanding the number of employees at the Convention Secretariat, a presentation of best practices in the protection of underwater cultural heritage, reports on the work of the Scientific and Technical Advisory Body (STAB) and the elections of new members of STAB. Jasen Mesić is the current Croatian delegate to STAB through to his term end in 2019. The 8th STAB meeting was held on the 1st of June in the continuation of the meeting of Convention states parties. This meeting focused on harmonising criteria for the presentation of best practices in the protection of underwater cultural heritage and security in STAB UNESCO missions outside of Europe.



The 6th Meeting of States Parties to the 2001 UNESCO Convention / Zasjedanje na 6. sjednici država potpisnica UNESCO 2001 Konvencije (Photo: M. Pešić)



Radionica o kasnoantičkom finom posuđu u Minhenu

Na njemačkom Institutu za prapovijesnu i pretpovijesnu arheologiju i provincijalnu arheologiju Ludwig-Maximilians sveučilišta u Münchenu, 6. svibnja 2017. g. je održana radionica o kasnoantičkom finom posuđu na Jadranu. Na radionici pod naslovom „Production and Distribution of Fine Wares in the Adriatic Region from 3rd to 7th century”. Desetak sudionika predstavilo je rezultate istraživanja s kojih potječe kasnoantičko fino posuđe s različitih nalazišta zapadne i istočne obale Jadrana. Na radionici su sudjelovali Mladen Pešić (MCPA) i Igor Borzić (Sveučilište u Zadru) koji su predstavili nalaze sa šireg zadarskog područja u prezentaciji „Late Roman Fine Wares from Northern Dalmatia”. Nakon radionice je održana i rasprava čiji će zaključci uskoro biti objavljeni u monografiji koja će doprinijeti boljem poznavanju ove vrste arheološkog materijala.

Sastanak u sjedištu UNESCO-a u Parizu

U Parizu je održan šesti sastanak država potpisnica UNESCO Konvencije o zaštiti podvodne kulturne baštine iz 2001. g. Sastanak se održavao 30. i 31. svibnja 2017. g. u sjedištu UNESCO-a. Glavne teme sastanka bile su pokušaj uspostave šire implementacije Konvencije iz 2001. u zemljama potpisnicama, potreba za novim ratifikacijama Konvencije, potreba za novim zapošljavanjima unutar sekretarijata Konvencije, predstavljanje najboljih primjera zaštite podvodne kulturne baštine, izvješća s misija Znanstvenog i tehničkog savjetodavnog tijela (STAB) te izbora novih članova za STAB. Hrvatski predstavnik u STAB-u je i dalje Jasen Mesić do 2019. godine. Nastavno

Zadar's New Mayor Visits ICUA Zadar

Newly elected Zadar Mayor Branko Dukić and aids Šime Erić and Darko Kasap visited the International Centre for Underwater Archaeology on the 18th of July to learn about the work of the only UNESCO centre in Croatia. The mayor and his aids toured all of our restoration workshops, lecture hall, library, underwater archaeology gallery and the former St Nicholas church building, where a future presentation centre is planned. The mayor spoke of the significance of the work of ICUA Zadar as a UNESCO centre and promised his support in the further development of this institution.

Underwater Excavation in Tunisia

In September of 2017, at the invitation of our long time partners at the Bavarian Society for Underwater Archaeology (BGfU), we broadened our collaboration in the investigation of underwater archaeology to other continents. A one-week stint on Djerba island in Tunisia saw underwater archaeological examination at the antique Meninx site. On land excavation of the Antiquity period town was led by professor Stefan Ritter of the Institute of Classical Archaeology of Munich's Ludwig Maximilian University. The BGfU's Max Fiederling, Tobias Pflederer, Maximilian Ahl and Michael Heinzlmeier were joined by our own Mladen Pešić. The investigation was conducted

Taking samples of sediment in front of antique Meninx / Uzimanje uzoraka sedimenta ispred antičkog grada Meninx (Photo: M. Pešić)



na sastanak zemalja potpisnica Konvencije, 01. svibnja 2017. je održan 8. sastanak STAB-a. Glavne teme ovog sastanka su bile potreba za usuglašavanjem kriterija za predstavljanje najboljih primjera zaštite podvodne kulturne baštine te sigurnost djelovanja STAB-a na misijama UNESCO-a izvan Europe.

Novi zadarski gradonačelnik posjetio MCPA Zadar



18. srpnja 2017. g. novoizabrani gradonačelnik Branko Dukić je zajedno sa



Mayor Dukić visits the ICUA Zadar restoration workshops / Gradonačelnik Dukić u posjeti restauratorskim radionicama MCPA Zadar (Photo: R. Surić)

svojim suradnicima Šimom Erićem i Darkom Kasapom posjetio Međunarodni centar za podvodnu arheologiju Zadru, kako bi se upoznao sa djelovanjem jedinog UNESCO-vog centra u Hrvatskoj. Gradonačelniku i njegovoj pratnji pokazane su sve restauratorske radionice, učionice, knjižnice, galerija podvodne arheologije kao i crkva sv. Nikole gdje se predviđa urediti budući prezentacijski centar. Gradonačelnik je naglasio važnost djelovanja MCPA Zadar kao UNESCO-vog centra te obećao pomoć u daljnjem razvoju ove institucije.

Podvodna istraživanja u Tunisu

U rujnu 2017. na poziv naših dugogodišnjih suradnika iz Bavarskog društva za podvodnu arheologiju (BGfU) proširili smo suradnju u



Tunisian divers Hamza and Abdala with recovered amphorae / Ronioci Hamza i Abdala iz Tunisa s nalazima izronjenih amfora (Photo: M. Pešić)

in the shallow waters immediately facing the antique town, with the most interesting recoveries of antique and post-medieval pottery made in the canal that linked the settlement to the open sea. This initial investigation demonstrated the potential of the location, which is slated to be the site of future trench excavation.

Lecture on Wood Conservation

Specialists and the broader public filled the ICUA Zadar lecture hall on the 19th of September for a series of lectures on the conservation of archaeological wood. Restorer Marina Šimičić of ICUA Zadar spoke on the launch of the ICUA-led re-conservation of Nin's famed *Condura Croatica* ships, while Sophie Fierro-Mircovich discussed her work at the ARC NucléART regional conservation workshop in France's Grenoble and the issue of sebacate and pyrite, presenting the application and practice of a cure for pyrite in wooden artefacts conserved using the PEG method.

ICUA Zadar Open Door Days

Along with the Night of Museums, the International Centre for Underwater Archaeology in Zadar staged a further two open door events. The first coincided with City of Zadar Day on the 24th of November 2017, when many

istraživanju podvodne arheologije i na druge kontinente. Tijekom tjedan dana provedena su podvodna arheološka pretraživanja antičkog lokaliteta Meninx na otok Djerba u Tunisu. Koptena istraživanja antičkog grada vodio je prof. dr. Stefan Ritter sa Instituta klasične arheologije Ludwig-Maximilians sveučilišta u Minhenu. U podvodnim istraživanjima uz članove BGfU Maxa Fiederlinga, Tobiasa Pflederera, Maximiliana Ahla i Michaela Heinzmeiera je sudjelovao i Mladen Pešić iz MCPA Zadar. Pretraživanja su se vršila u plitkom moru u neposrednoj blizini antičkog grada, a najzanimljiviji su pronalasci antičkog i novovjekovnog keramičkog materijala nađeni u kanalu koji je povezivao naselje s otvorenim morem. Ova početna istraživanja pokazala su potencijalne lokacije na kojima će se u budućnosti raditi i sondažna istraživanja.

Predavanja o konzerviranju drva

Pred brojnim zainteresiranim stručnjacima i ostalim građanima, 19. rujna 2017. g. u učionici MCPA Zadar održana su predavanja o konzerviranju arheološkog drva. Predavanja su održale restauratorice Marina



Sophie Fierro-Mircovich of Grenoble lectures at ICUA / Predavanje Sophie Fierro-Mircovich iz Grenoblea u MCPA (Photo: L. Bekić)

Šimičić iz radionice MCPA Zadar na temu "Početak obnove čuvenih Ninskih brodova - *Condura croatica* u organizaciji MCPA Zadar" te Sophie Fierro-Mircovich iz radionice ARC NucléART, Grenoble, Francuska na teme: "ARC NucléART - Atelier regional de conservation" i "Sebaçate and pyrit - cure for pyrite in the wooden object conserved using PEG method - application and practice".

Otvoreni dani MCPA Zadar

Osim na manifestaciju Noć muzeja, dani otvorenih vrata Međunarodnog centra za podvodnu arheologiju u Zadru



Kindergarten visits during ICUA Zadar open door days / Posjet vrtića tijekom Dana otvorenih vrata MCPA Zadar (Photo: L. Bekić)

other institutions in the city celebrated our patron Saint Chrysogonus (Sveti Krševan). St Nicholas Day quickly followed on the 6th of December – we have chosen this day to celebrate ICUA Zadar in light of the saint's role as protector of mariners and the fact that ICUA Zadar has found its home in the former church dedicated to St Nicholas. On these days visitors enjoy free access to our gallery, the church building and the other parts of the centre, with many staff members on hand to explain the exhibited artefacts and the history of the complex. This year saw visits by six kindergartens, several classes from elementary schools in Zadar and many others.

Underwater Heritage Exhibition in Trieste

Trieste's Salone degli incanti was the venue on Saturday the 16th of December for the gala opening of the In the Sea of Intimacy international exhibition. The event is dedicated to the wealth of underwater cultural heritage in the whole of the Adriatic Sea, with the participation of many institutions from Italy, Slovenia, Croatia and Montenegro. The exhibition was authored and its catalogue edited by Rita Aurriemma. The International Centre for Underwater Archaeology in Zadar is one of the co-organisers of the exhibition, with display cases showcasing finds from three projects conducted by ICUA at Veruda, Babuljaš and Janice. The exhibition is open through to May of 2018.



održani su još u dvije prilike. Prvo na Dan grada Zadra, 24. studenog 2017., kada i mnoge druge gradske ustanove obilježavaju dan Sv. Krševana, zaštitnika grada. Također, ubrzo je došao i dan Sv. Nikole, 6. prosinca 2017. koji se svečano obilježava kao dan MCPA Zadar, iz razloga što je on zaštitnik pomoraca, a ujedno se i MCPA Zadar nalazi u sklopu bivše crkve Sv. Nikole. Tih dana građani imaju slobodan ulaz u Galeriju, zgradu crkve i ostale prostore, a veći broj djelatnika centra je prisutan kako bi objasnio izložke i povijest sklopa. Tijekom ove godine zabilježen je posjet čak 6 skupina vrtića i nekoliko razreda iz raznih zadarskih osnovnih škola, kao i brojni drugi posjetioци.

Izložba podvodne baštine u Trstu

U subotu 16. prosinca 2017., u Trstu, u prezentacijskom centru "Salone degli incanti" svečano je otvorena velika međunarodna izložba "In the sea of intimacy". Izložba je posvećena bogatstvu podvodne kulturne baštine s područja cijelog Jadrana, pa su na njoj sudjelovale brojne



A display case in Trieste showcasing the Babuljaš excavation / Vitrina u Trstu koja predstavlja istraživanje Babuljaša (foto: L. Bekić)

ustanove iz Italije, Slovenije, Hrvatske i Crne Gore. Autorica izložbe i urednica kataloga je Rita Aurriemma. Međunarodni centar za podvodnu arheologiju Zadar jedan je od suorganizatora izložbe te su se u vitrinama mogli vidjeti i nalazi s tri projekta koje je provodio centar, Veruda, Babuljaš i Janice. Izložba će biti otvorena do svibnja 2018. g.

Ambassador Mesić speaks at the opening of the Trieste exhibition / Govor veleposlanika Jasena Mesića na otvorenju izložbe u Trstu (Photo: L. Bekić)

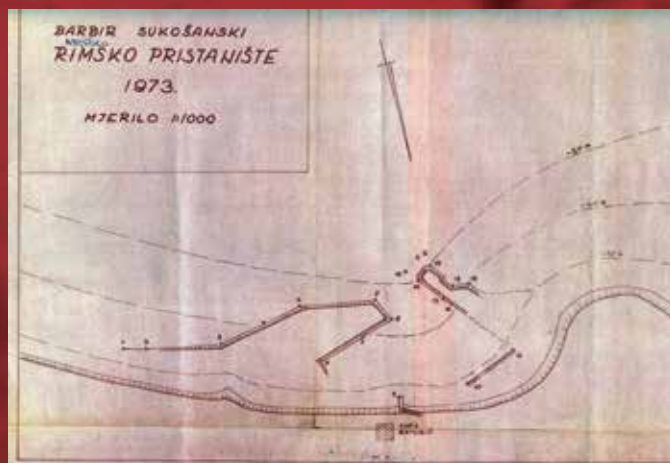
EXCAVATIONS AT THE ANTIQUITY PERIOD HARBOUR AT THE BARBIR SITE IN SUKOŠAN

ISTRAŽIVANJA ANTIČKE LUKA BARBIR U SUKOŠANU

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The remnants of antique structures at the Barbir site in the waters off Sukošan are already known of – the structures were described back in 1973 by Boris Ilakovac in a report on hydroarchaeological campaigns. It was on the basis of these data that the first protection of the site was elaborated. The area has been examined on several occasions by staffers with ICUA, in 2013 and 2014, in the frame of an underwater archaeological survey of Zadar County. Underwater and on land structures were observed in the course of the survey that required further study and analysis and in 2017 we launched a project to investigate this Antiquity period landing.

The main landing structure is located to the east of the site, with approximate dimensions of 100 by 50 metres. This structure has been designated Mole 1. This is a wide stone embankment at which we cannot currently identify the original antique landing facing stone, with the entire structure having been broadly scattered by the action of the waves. For the most part these are irregularly shaped stones of various sizes, from approximately 10 to 50 centimetres in diameter. The structure is visible from the foreshore section where it overlaps the stone in the shallow water and is not as visible, with its outer contour easily identifiable where the sea floor transitions from stone to sand. On the outer sections of the structure



1. Drawing of the harbour installations at Barbir / Crtež lučkih instalacija na Barbiru (By: B. Ilakovac 1973.)

Na lokalitetu Barbir u Sukošanu već su od prije poznati ostaci antičkih gradnji u podmorju, a navedene strukture opisane su 1973. g. od strane Borisa Ilakovca u Izvještaju o hidroarheološkim akcijama. Na osnovu tih podataka je i izrađena prvotna zaštita lokaliteta. Samo područje je pregledano u nekoliko navrata od strane djelatnika MCPA tijekom 2013. i 2014. g. u sklopu projekata podvodnih arheoloških rekognosciranja Zadarske županije. Prilikom pregleda su uočene podvodne i kopnene strukture koje su zahtijevale daljnja proučavanja i analize, te je stoga tokom 2017. g. započet projekt istraživanja ovog antičkog pristaništa.

Glavna pristanišna struktura nalazi se na istočnom dijelu nalazišta i okvirnih je dimenzija 100x50 metara. Ova struktura nazvana je Mol 1. Radi se o širokom kamenom nasipu na kojem se trenutno ne mogu prepoznati originalna lica zidova antičkog pristaništa, budući da je uslijed djelovanja valova cjelokupna struktura dosta široko razasuta. Uglavnom se radi o kamenju nepravilnih oblika različitih dimenzija, od 10-ak pa do 50-ak centimetara

2. The large stone blocks at the Barbir harbour / Veliki kameni blokovi u luci Barbir (Photo: M. Pešić)





3. Section of an Africaine II C amphora / Dio amfore tipa Africaine II C (Photo: M. Kaleb)

we see large stone blocks about 2 by 1 by 1 metre in size, strewn about the embankment. We observed some ten larger and another ten or so smaller blocks of this kind that may have been part of the antique wharf. To the west is another structure, designated Mole 2. It is quite a bit lower and less pronounced than Mole 1, but its structure can nevertheless be distinguished from the surrounding sea floor. The stone that makes up Mole 2 is relatively similar to that of Mole 1. For the most part it is formed of undressed stones of various sizes. At the southern end of Mole 2 we again observe large stone blocks the function of which was likely identical to those of Mole 1. For now, unfortunately, we can only broadly hypothesise as to whether these blocks were part of the wharf, a breakwater or served some other function. By the combined erection of these two moles the Antiquity period builders achieved a safe area with a passage between them through which ships entered a harbour protected from both the southern and northern winds and expansive enough to anchor a large number of vessels. In good weather a large number of ships could certainly have docked on the outer (southern) wharf of Mole 1. One of the basic goals of this year's archaeological campaign was to attempt to gain insight into the layering of the Barbir site.

5. Oil lamp base sherd with FORTIS mark / Ulomak dna uljanice s pečatom FORTIS (Photo: M. Pešić)



veličine. Struktura je vidljiva od obalnog dijela gdje se preklapa s kamenjem u pličaku i nije toliko izražena, dok se njeni vanjski obrisi mogu dobro zamijetiti na dijelovima gdje prelaze iz kamenitog u pjeskoviti dio. Na vanjskom dijelu konstrukcije nalazimo velike kamene blokove dimenzija oko 2x1x1 metara, koji su nepravilno razbacani po nasipu. Uočeno je oko desetak većih, te desetak nešto manjih takvih kamenih blokova koji su u antičko vrijeme možda bili dio operativne obale. Sa zapadne strane nalazi se druga struktura nazvana Mol 2. Ona je dosta niža i manje izražena od Mola 1, ali se ipak njena struktura vidljivo može odvojiti od okolnog dna. Kamenje koje čini Mol 2 relativno je slično onom na Molu 1, uglavnom se radi o neobrađenom kamenu različitih dimenzija. I na južnom dijelu Mola 2 se mogu uočiti veliki kameni blokovi koji su vjerojatno imali identičnu funkciju kao i na Molu 1. Na žalost, za sada samo nagađamo da li su ovi blokovi služili kao dio operativne obale, kao obrana od valova



4. Excavation in Trench 1 / Iskopavanje unutar Rova 1 (Photo: M. Pešić)

ili su imali neku drugu funkciju. Kombiniranom gradnjom ovih dvaju molova, antički su graditelji dobili siguran prostor s prolazom između njih kroz koji su brodovi ulazili u luku zaštićenu od južnih i sjevernih vjetrova dovoljno veliku da primi veći broj brodova. Za mirnog vremena zasigurno je za pristajanje većih brodova mogla poslužiti i vanjska (južna) operativna obala Mola 1.

Jedan od osnovnih ciljeva ovogodišnje arheološke kampanje bio je pokušaj dobivanja uvida u slojevitost nalazišta na položaju Barbir. Dosadašnjim površinskim pregledima otkriven je keramički arheološki materijal koji je pripadao periodu kasne antike, primjerice obod tanjura sjevernoafričke provenijencije, sjevernoafričke amfore i amfora tipa Late Roman II, te mnogobrojni fragmenti rimskih dolija koji se nalaze koncentrirani na nekoliko pozicija. Najveća količina dolija utvrđena je na dijelu vanjske, južne strukture i možemo pretpostaviti da su bili ugrađeni u strukturu operativne obale i koristili se prilikom ukrcaja i iskrcaja prehrambenih namirnica u samoj antičkoj luci. Prve arheološke sonde postavili smo s unutrašnje strane luke, mjesta na kojem su tijekom



6. Wooden pile submitted for conservation to the ICUA restoration department / Drveni pilon predan na konzervaciju u Odjel za restauriranje MCPA

(Photo: R. Surić)

The surface survey has so far revealed ceramic archaeological material from the late Antiquity, including the rim of a plate of North African provenance, North African and Late Roman II amphorae and numerous sherds from Roman dolia concentrated as several positions. The greatest quantity of dolia was identified at a part of the outer, southern structure, and we can hypothesise that they were built into the structure of the wharf and used in the course of the loading and unloading of foodstuffs at the antique port. We opened the first pit on the interior side of the harbour, the area where antique ships found safe anchorage and also investigated two trenches that intersected the structure of Mole 1.

Although excavation of the trenches did not yield a large quantity of archaeological material we can single out sections of rims of coarse bowls, a rim section from a glass vessel and several rim and handle sherds from amphorae. A preliminary analysis determined that the amphora from Trench A is of the Africaine II C (variant C1) form. This is a North African amphora type manufactured in the late Antiquity on the coast of modern Tunisia in the period from the mid-third to early fourth century used to transport olive oil and salted fish sauce (Bonifay 2004, 114–115). The finds recovered from Trenches 1 and 2 are much more numerous. These include a large number of sherds from bowls, pots, tegulae, spindle whorls, oil lamps, several very small fragments of glassware and sherds of amphorae. Some specimens were immediately identified as being of African Red Slip ware or African sigillata, for example a sherd from a Hayes type 50 B vessel. This type is numbered among the category of luxury ware from the fourth and fifth century period (Hayes 1972, 69–71). One of the interesting finds that provides more precise data in dating the layers and structure is part of an oil lamp found in Trench 2. This is a part of the base of an oil lamp with the FORTIS maker's mark, a frequent type of lamp manufactured in northern Italy and dated to the late first to mid-second century (Vikić Belančić 1976, 55–56). Also found in this layer is the rim of an Aegean cookware bowl from the eastern Mediterranean. This sherd is also among the finds frequently seen at underwater sites across the Adriatic, also attributable to the late first and into the second century (Parica 2009, 86–87). Overall, the finds recovered from this trench point to the antique harbour at Sukošan being used over an extended period of time, from the second to fifth century.

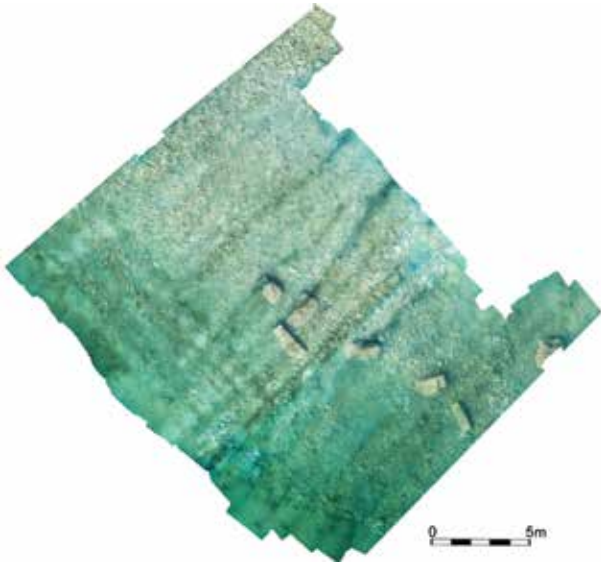
antike brodovi nalazili sigurno mjesto za sidrenje, a osim njih istražena su i dva rova koja su presijecala samu strukturu Mola 1.



7. Orthophoto of the trench profile with wooden piles / Ortofotografija profila sonde s drvenim pilonima

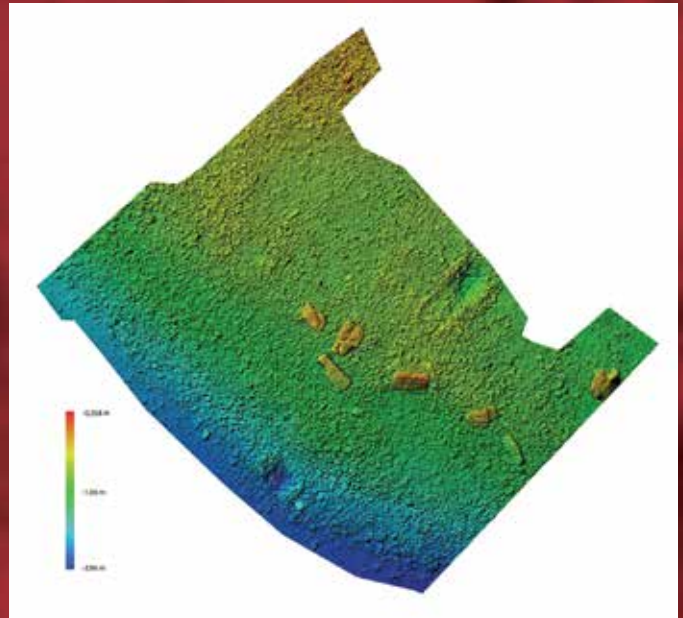
(By: R. Surić)

Iako iskopavanjem sonde nisu otkrivene velike količine arheološkog materijala, možemo izdvojiti dijelove oboda grubljih zdjela, ulomak oboda staklene posude, te nekoliko ulomaka oboda i ručki amfora. Preliminarnom analizom ustanovljeno je da amfora iz sonde A pripada tip Africaine II C (varijanta C1). Radi se u tipu sjevernoafričke amfore koja se proizvodila u kasnoj antici na obalama današnjeg Tunisa u periodu od polovice 3. do početka 4. st., a osim maslinovog ulja u njima se prevozio i umak od usoljenih riba (Bonifay 2004, 114-115). Puno brojniji arheološki nalazi pronađeni su unutar Rovova 1 i 2. Radi se o većem broju ulomaka zdjela, lonaca, tegula, pršljen, uljanica, nekoliko sitnijih fragmenata staklenih posuda, te dijelovima amfora. Pojedini primjerci su odmah prepoznati i definirani kao African red slip ware ili afrička sigilata, primjerice ulomak tipa Hayes 50 B. Ovakav tip posuđa spada u kategoriju luksuznog posuđa iz perioda 4. i 5. st. (Hayes 1972, 69–71). Jedan od zanimljivijih nalaza koji nam pruža pobliže podatke o datiranju slojeva



8. Orthophoto model of part of Mole 1 with Trenches 1 and 2 / Ortofoto model dijela Mola 1 sa Rovovima 1 i 2 (By: D. Badovinac)

Along with the archaeological material the excavation are provided very interesting data on the construction of the antique mole in the find of vertical wooden piles in situ. The excavation attained the depth of the end of the vertical piles and it is evident that they were worked by human hands, i.e. tapered at the bottom end. The piles are preserved to a length of about 60 centimetres, with the upper sections in quite poor condition and replete with the holes and canals formed by the naval shipworm (*Teredo navalis*), while the lower ends protected by the sand and silt have been well preserved. It was concluded that the piles were part of the structure of the mole that served to hold the stone fill in place as it was dumped here. It is evident that the building of the mole saw the wooden piles first rammed into the silt at intervals of 20 to 30 centimetres, with stones of various sizes dumped into the resulting structure. One of the piles was submitted for conservation and a sample taken from another for radiocarbon dating and an analysis of the type of wood used. The analysis of the wood was done at the Gozdarski Inštitut Slovenije (Slovenian Forestry Institute), our long time associates, and showed that this was a species of pine, most likely the stone pine (*Pinus pinea*).



9. A digital elevation model (DEM) created from the orthophoto model / Digitalni elevacijski model (DEM) izrađen na osnovu ortofoto modela (By: D. Badovinac)

i struktura je i dio uljanice koja ja nađena u Rovu 2. Radi se o dnu uljanice koja nosi pečat FORTIS, čestom tipu uljanica koje su se proizvodile na prostoru sjeverne Italije, a njihova datacija se može smjestiti u period kraja 1. do oko sredine 2. st. (Vikić Belančić 1976, 55-56). Unutar ovog sloja nađen je i obod zdjele koji pripada egejskom kuhinjskom posuđu, porijeklom iz istočnog Mediterana. I ovaj ulomak pripada nalazima koji se često susreću na podvodnim nalazištima Jadrana, a mogu se također smjestiti u kraj 1. i u 2. st. (Parica 2009, 86-87). Ukupni nalazi iz ovih sondi upućuju nas da se prostor antičke luke u Sukošanu koristio duži vremenski period, a aktivnost luke okvirno možemo smjestiti u period od 2. do 5. st.

Osim arheološkog materijala, prilikom iskopavanja smo dobili i vrlo zanimljive podatke o gradnji same strukture antičkog mola gdje su pronađeni vertikalni drveni piloni in situ. Vertikalnim pilonima se prilikom iskopa dosegnuo kraj, te je vidljivo da su oni obrađeni ljudskom rukom, točnije, zašiljeni su na dnu. Piloni su očuvani do dužine od oko 60 cm, gornji dijelovi su u dosta lošem stanju i puni su rupica i kanalića koje su napravili morski crvi (lat.



10. Orthophoto model of walls I through VII / Ortofoto model zidova od I do VII (By: R. Surić)

This species of pine was certainly very frequent in the coastal region around Sukošan in the Antiquity period

Teredo navalis), dok su donji dijelovi koji su bili zaštićeni u mulju i pijesku dobro očuvani. Zaključeno je da su piloni bili dio strukture mola koji su služili za zadržavanje kamenja prilikom njegovog nasipanja. Očigledno je da su prilikom gradnje strukture mola prvo zabijani drveni

– along with the piles we also see many pine nuts and cones from this species in the trenches. The date analysis was performed at the Poznan Radiocarbon Laboratory in Poland and confirmed the conclusion already derived from the finds of pottery. The wood from Trench B was dated to the first to second century, while the analysis of the piles in the structure of Mole 1 places its construction in the second half of the fourth century. Further excavation will show whether the structure of Mole 1 existed in earlier periods.

Along with the geodetic surveying that continued the documentation performed in previous field surveys, this year we aimed to also obtain better insight into the overall distribution of the site. To this end side scan sonar imaging was done of the entire Barbir cove area and work began on creating a 3D model of the site. A series of photographs were made and processed in the Agisoft Photoscan software programme, resulting in a high-resolution picture of part of the Mole 1 area. The photography and final data processing was performed by David Badovinac at Aegir Visuals. The lengthy imaging process means that we have this year succeeded in documenting only a part of the mole structure and we hope in the coming years to continue our investigative efforts and complete the imaging of the entirety of the structures.

Along with the underwater excavation this year's campaign also saw the start of documentation of the on land structures alongside the antique dock. We identified twelve separate walls, most of which are partially visible as they protrude above the earthen profile along the shore. Walls I through VII stand near the steps that lead to the water in the immediate vicinity of Mole 1, while the structures numbered from VIII to XII lie a little to the west. For the most part these are short sections of walls up to one metre in length, some of which have only one preserved face, while only a few have both faces preserved. On those on which both faces are preserved we measured thicknesses of from 90 to 100 centimetres. The exact function of these walls remains unknown, although we presume that they may have formed part of a larger complex associated with the antique harbour. Their thickness leads us to consider the possibility that they served as some form of support for the elevated shoreline typical of this part of the cove. Based on the preserved remains it appears that walls VI and VII were part of one room, given that they intersect at a right angle. Due to the destruction of the section between the extant sections they now appear as two separate walls. It was here that a very interesting ceramic finds was recovered – a sherd from the base of a vessel of North African provenance with a stamped decoration. Toothed concentric circles are a frequent decoration on these vessels and are of the form Hayes 32, in use from the late fourth to mid-fifth century (Atlante I, 125. cat. 17; Hayes

piloni u mulj na razmaku od oko 20-30 cm, a unutar te strukture je zatim nabacivan kamen različitih dimenzija.

Jedan od pilona predan je na konzerviranje, a od drugog pilona uzet je uzorak za

C 14 analizu starosti te analizu vrste drva. Analiza drva rađena je na Gozdarskom Inštitutu Slovenije, našim dugogodišnjim suradnicima, te je pokazala da se radi o vrsti bora, najvjerojatnije piniji (lat. *Pinus pinea*). Zsigurno je ova vrsta bora u antičkom periodu bila česta na primorskom teritoriju oko Sukošana, budući da smo osim drvenih pilona unutar sondi nalazili i veći broj pinjola i češera koji pripadaju istoj vrsti. Analize starosti drva rađene su u Poznan Radiocarbon Laboratory u Poljskoj i potvrdile su već prije donesene zaključke koji su izvedeni na osnovu analize keramičkog materijala. Drvo iz sonde B je datirano u

1./2. st., a analize drvenih pilona iz strukture Mola 1 smještaju njegovu gradnju u period druge polovice 4. st. Daljnja istraživanja će nam pokazati da li je struktura Mola 1 postojala i u ranijim periodima.

Uz geodetska snimanja koja su se nastavila na dokumentiranje izvršena prilikom prethodnih pregleda terena, ove godine pokušalo se dobiti i bolji uvid u cjelokupno rasprostiranje nalazišta. U tu svrhu je cjelokupno područje uvale Barbir skenirano Side scan sonarom, ali je započeta i izrada 3D modela nalazišta. Snimljen je niz fotografija koje su naknadno obrađene u programu Agisoft Photoscan, a rezultat je slika dijela područja Mola 1 velike razlučivosti. Fotografiranje i finalnu obradu podataka radio je David Badovinac iz Aegir Visuals. Radi dugotrajnog postupka snimanja uspješno je dokumentiran samo dio struktura mola, te se nadamo da će se sljedećih godina u nastavku istraživanja moći dovršiti snimak cjelokupnih struktura.

Osim podvodnih istraživanja, ove smo godine započeli i s dokumentiranjem kopnenih struktura uz antičko pristanište. Prepoznato je 12 odvojenih zidova, od kojih je većina djelomično vidljiva budući da izlaze iz zemljanog profila uz obalu. Zidovi od I do VII se nalaze uz stepenice koje vode do mora u neposrednoj blizini Mola 1, dok su strukture pod brojevima od VIII do XII nalaze nešto zapadnije. Uglavnom su to manji dijelovi zidova dužine do 1 m od kojih neki imaju sačuvano samo jedno lice, a rijetki zidovi imaju sačuvana oba lica. Na onima koji imaju sačuvana oba lica možemo izmjeriti debljinu od 90 do 100 cm. Za sada nije poznata točna funkcija navedenih zidova, a pretpostavlja se da bi mogli biti dio većeg kompleksa koji je povezan s antičkom lukom.



11. Potsherd with stamped decoration / Ulomak posude s pečatiranim ukrasom (Photo: M. Kaleb)

1972, 236). A palmette with double central rib is of the Hayes form 5 and is not frequent, dated to the mid-fifth century, to which we can attribute this potsherd (Atlante I, 127, cat. 115, 116; Hayes 1972, 231).

The archaeological excavations in the Barbir area this year were yet another opportunity to pass on our knowledge to young researchers. Three days were dedicated to NAS Intro and Part I courses with the participation of Marily Papadopoulou (Greece), Jona Petešić, Zdenka Vrgoč and Velimir Vrzić (Croatia) and Giuseppe Avola (Italy). We also staged a course on underwater photogrammetry led by instructor David Badovinac of ZaPA (Institute for Underwater Archaeology, Slovenia) and Roko Surić. Taking part in the course were Jelena Čelebić (Montenegro), Marija Ivić, Duje Kalajžić, Igor Ružić (Croatia), Giuseppe Avola (Italy) and Angélique Falatakis (Switzerland). Along with a number of lectures and practical exercises at sea and on land, the course participants mastered basic photogrammetry and 3D modelling skills for underwater archaeological sites, which will certainly be of great practical benefit in their future work.

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Radi njihove debljine možemo spekulirati da su služili i kao neka vrsta potpornja za visoko uzdignutu obalu koja je karakteristična za ovaj dio uvale. Prema sačuvanim ostacima, čini se da su zid VI i VII bili dio jedne prostorije budući da se njihovi pravci pružanja sijeku pod pravim kutom, no radi uništenja dijela zida između njih, danas izgledaju kao dva odvojena zida. Upravo u tom prostoru nađen je i jedan vrlo zanimljiv keramički nalaz. Radi se u ulomku dna posude sjevernoafričke provenijencije koji je ukrašen pečatiranim ukrasom. Koncentrični krugovi sa zupcima čest su ukras na ovakvim posudama i pripadaju tipu ukrasa Hayes 32, a njihovu upotrebu možemo smjestiti u period kraja 4. do sredine 5. st. (Atlante I, 125. kat. 17; Hayes 1972, 236). List palmete s dvostrukim središnjim rebrom pripada tipa Hayes 5, i nije baš čest, a datira se u period oko sredine 5. st., kada bi mogli datirati i ovaj ulomak posude (Atlante I, 127, kat.115, 116; Hayes 1972, 231).

Osim samih arheoloških istraživanja na području Barbira, i ove se godine dio vremena posvetio educiranju mladih znanstvenika. Tijekom tri dana održani su tečajevi NAS Intro i Part I na kojima su sudjelovali Marily Papadopoulou (Grčka), Jona Petešić, Zdenka Vrgoč i Velimir Vrzić (Hrvatska) te Giuseppe Avola (Italija). Također je održan i Tečaj podvodne fotogrametrije koji je uz instruktora Davida Badovinca iz slovenske ZaPA-e vodio i Roko Surić. Na tečaju su sudjelovali polaznici Jelena Čelebić (Crna Gora), Marija Ivić, Duje Kalajžić, Igor Ružić (Hrvatska), Giuseppe Avola (Italija) i Angélique Falatakis (Švicarska). Uz niz predavanja i praktičnih vježbi u moru i na kopnu, polaznici su ovladali osnovnim vještinama fotogrametrije i izrade 3D modela na podvodnim arheološkim nalazištima koje će im zasigurno koristiti u njihovom budućem radu.

12. Divers during the photogrammetry course, shot from a drone / Ronioci za vrijeme tečaja fotogrametrije snimljeni dronom (Photo: D. Kalajžić)



PIRUZI ROCKS SHIPWRECK EXCAVATIONS COMPLETED

ZAVRŠETAK ISTRAŽIVANJA BRODOLOMA KOD HRIDI PIRUZI

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After four years of systematic underwater excavation at the Piruzi site we have “hung up our dredge” so to speak. Although the dig is over the research still continues and we expect to see a monograph publication on this important Antiquity period site in the waters off Rovinj.

The International Centre for Underwater Archaeology in Zadar led underwater excavations at Veliki Piruzi in the first half of June 2017, collaborating again this year with the Bavarian Society for Underwater Archaeology (BGfU) from Germany. Continued financial support was provided by the City of Rovinj Tourism Board.

Luka Bekić PhD served as field director leading the 2017 expert team of underwater archaeologists Mladen Pešić, Maja Kaleb and Roko Surić of ICUA, Max Fiederling,

2. A digital elevation model showing the Mučje Sike position / Digitalni elevacijski model pozicije Mučje Sike (By: D. Badovinac)



1. David Badovinac lectures for the underwater photogrammetry course / Predavanje Davida Badovinca u sklopu tečaja podvodne fotogrametrije (Photo: L. Bekić)

Nakon četiri godine sustavnih podvodnih

iskopavanja na nalazištu Piruzi, objesili smo “mamute o klin”. No, iako su iskopavanja završena, istraživanja još traju, a očekujese iskorašnjamonografskaobjava ovog važnog antičkog nalazišta u rovinjskom akvatoriju.

Tijekom prve polovice lipnja 2017. g., Međunarodni centar za podvodnu arheologiju u Zadru (MCPA) vodio je podvodna iskopavanja u podmorju hridi Veliki Piruzi, surađujući i ove godine s Bavarskim društvom za podvodnu arheologiju (Bayerischen Gesellschaft

**3. Excavation in pairs in Trench I /
Iskopavanje para ronioca u sondi I (Photo: R. Surić)**

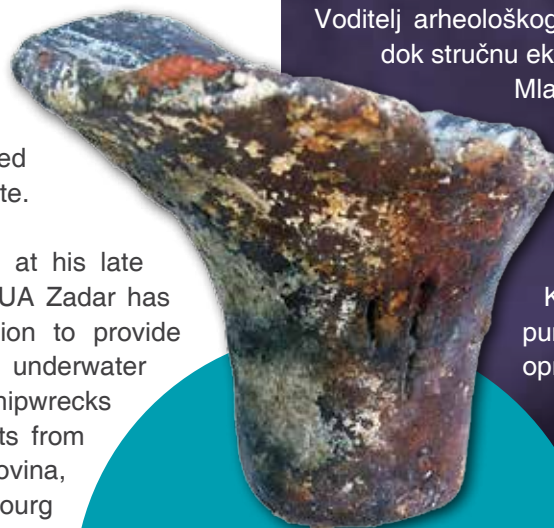


Tobias Pflederer, Anna Sophia Fuchs and Michael Heinzlmeier of BGfU, and outside and technical staffers Marko Srećec and Borna Krstulović. Logistical support for diving tank filling and equipment storage was provided by the RC Rubin diving centre at the Villas Rubin tourist resort to the southeast of Rovinj, while the Old Diver centre at the Mon Perin campgrounds provided the use of their diving boat at the site.

Since the start of the excavation at his late antique shipwreck site in 2014 ICUA Zadar has successfully carried out its mission to provide education in the domain of underwater archaeology in the frame of the Shipwrecks of Rovinj project – twenty students from Croatia, Slovenia, Bosnia-Herzegovina, Czechia, Germany and Luxembourg completed Foreshore and Underwater Archaeology courses following the Nautical Archaeology Society (NAS) programme and an underwater photogrammetry course. Students and archaeologists from Slovenia, Germany and Croatia took part in this year's one-day photogrammetry course organised by ICUA and ZaPA (the Institute for Underwater Archaeology, Slovenia). The course consisted of theoretical and practical segments. The theoretical segment was staged

für Unterwasserarchäologie - BGfU) iz Njemačke. Kao i do sada, financijska sredstva osigurana su potporom Turističke zajednice Grada Rovinja.

Voditelj arheološkog istraživanja je dr. sc. Luka Bekić, dok stručnu ekipu 2017. g. čine podvodni arheolozi Mladen Pešić, Maja Kaleb i Roko Surić iz MCPA, Max Fiederling, Tobias Pflederer, Anna Sophia Fuchs i Michael Heinzlmeier iz BGfU, te vanjski i tehnički suradnici Marko Srećec i Borna Krstulović. Logističku podršku punjenja ronilačkih boca i skladištenja opreme pružio je Ronilački centar Rubin u turističkom naselju "Villas Rubin" jugoistočno od Rovinja, a za rad na lokaciji koristio se ronilački brod centra Old diver iz kampa "Mon Perin".



**4. A spike with maker's mark
(SF 203) consisting of two parallel
vertical lines of unequal length /
Šiljak s pečatom (PN 203) kojeg
čine dvije paralelne okomite
linije nejednakih duljina
(Photo: R. Surić)**

Od početka istraživanja kasnoantičkog brodoloma 2014. g. MCPA Zadar uspješno provodi svoju misiju obrazovanja na polju podvodne arheologije i u sklopu projekta Rovinjski brodolomi, pa je tako ukupno 20 studenata iz Hrvatske, Slovenije, Bosne i Hercegovine, Češke, Njemačke i Luksemburga završilo tečajeve priobalne i podvodne



5. Daily documentation (photography, logging, weighing), discussion and packaging of finds in the courtyard of the RC Rubin diving centre / Svakodnevno dokumentiranje (fotografiranje, popisivanje, vaganje), diskusija i pakiranje nalaza u dvorištu Ronilačkog centra Rubin (Photo: M. Pešić)

at the premises of RC Rubin with David Badovinac of ZaPA giving several lectures on the topic of photogrammetry, the equipment required and the differences in photogrammetry imaging on land and in the water. The lectures were followed by a discussion and exchange of theoretical experience. The practical segment was staged in the waters of Mučje Sike cove. This location was selected on account of its interesting harbour installations – besides the existing drawings this campaign saw the creation of digital documentation. A metal grid serving as a reference field on the photomosaic and underwater cameras were used to create imagery of the structure, which is reminiscent of a fishhook or letter J. All of the participants successfully completed the course and some joined the underwater archaeological excavation work.

The remains of the late antique wreck, as our readers already know, are located among the large rocks on the sea floor to the southwest side of Veliki Piruzi rock. As this is a ship that struck against a rock that was likely just under the surface of the water at the time of the wreck, parts of the archaeological remains are scattered on both sides of the rock. The focus of the excavation thus far has been on the section of the site where the greater concentration of finds was identified and where trench excavation was technically feasible. When planning the strategy for the final excavation campaign at the wreck it was decided that, along with the quadrant-by-quadrant method applied

arheologije prema Nautical Archaeology Society (NAS) programu, te tečaj podvodne fotogrametrije. Na ovogodišnjem jednodnevnom tečaju fotogrametrije sudjelovali su studenti i arheolozi iz Slovenije, Njemačke i Hrvatske u organizaciji MCPA i Zavoda za podvodno arheologiju (ZaPA) iz Slovenije. Tečaj se sastojao od teorijskog i praktičnog dijela. Teorijski dio odvijao se u prostorijama RC Rubin gdje je David Badovinac (ZaPA) održao nekoliko predavanja na temu fotogrametrije. Polaznici su upoznati s pojmom fotogrametrije i nužnom opremom potrebnom za rad, kao i s razlikama u odnosu izrade fotogrametrije na kopnu i pod morem. Nakon predavanja, uslijedila je rasprava i razmjena teorijskog iskustva. Praktični dio tečaja održao se u podmorju uvale Mučje Sike. Ova lokacija izabrana je zbog zanimljive lučke instalacije koja je osim ranije napravljene nacrtne dokumentacije, ovaj put i digitalno dokumentirana. Uz pomoć metalnog mrežišta koje služi kao referentno polje na fotomozajku, te podvodnih kamera, snimljena je konstrukcija koja svojim izgledom podsjeća na udicu, odnosno slovo J. Svi polaznici uspješno su završili tečaj, a neki su se priključili i podvodnim arheološkim iskopavanjima.

Ostaci kasnoantičkog brodoloma, kao što je to našim čitateljima već poznato, nalaze se među velikim stijenama na morskom dnu jugozapadne strane hridi Veliki Piruzi.

Kako je riječ o brodu koji je udario o stijenu koja je u vrijeme udesa vjerojatno bila neznatno ispod površine mora, dio arheoloških ostataka nalazi se s jedne, a dio s druge strane spomenute stijene. Fokus dosadašnjih iskopavanja bio je na dijelu nalazišta gdje je uočena veća koncentracija nalaza i gdje je tehnički bilo izvedivo sondažno iskopavanje. Međutim, prilikom planiranja strategije za finalnu kampanju istraživanja brodoloma, odlučeno je da će se, osim dosadašnje metode "kvadrat po kvadrat", s druge strane stijene primijeniti i metoda sustavnog iskopavanja jama.

Prvih nekoliko dana hrvatsko - njemački tim je sudjelovao u iskopavanju jama.

Pripremljene oznake od J1 (Jama 1) do J 11 postavljene su u odgovarajuću jamu. Također, svakoj jami pripremljena je po jedna košara, namijenjena čuvanju alata i pribora za iskopavanje i dokumentiranje, ali i pohranjivanju arheoloških nalaza. Iskopavanje se vršilo pomoću tzv. mamut sisaljke, a u svakoj jami je radio par ronioaca. Jedan ronilac bio je zadužen za iskopavanje, odnosno uklanjanje sedimenta iz jame, a drugi za pomicanje većih kamenja, te dokumentiranje i



6. A lead sounding weight (SF 129) / Olovni dubinomjer (PN 129) (Photo: R. Surić)



7. A diver emerges with a Spatheion amphora found in Cavity 5 / Ronilac izranja s spatheion amforom pronađenoj u jami 5 (Photo: M. Fiederling)

thus far, that the method of systematic excavation of the cavities would also be applied on the other side.

During the first several days the Croatian-German team took part in the excavation of the cavities. Prepared markers from J1 (Cavity 1) to J11 were placed at the appropriate excavation. Each trench was also furnished with a basket for excavation and documentation tools and equipment and to store archaeological finds. Excavation was conducted using a dredge, with a pair of divers working each cavity. One diver was responsible for excavation, i.e. removing the sediment from the cavity, and the other for moving larger stones and documenting and packing finds in the basket. This excavation method has already been demonstrated in ICUA practice as excellently adapted to demanding rocky terrain and at shallow sites where the majority of surface material has long ago been removed. Irrespective of the action of the sea the remaining archaeological material in the cavities is over time covered with a deposit of sediment and thus concealed. That this was a good move was attested to by some of the most



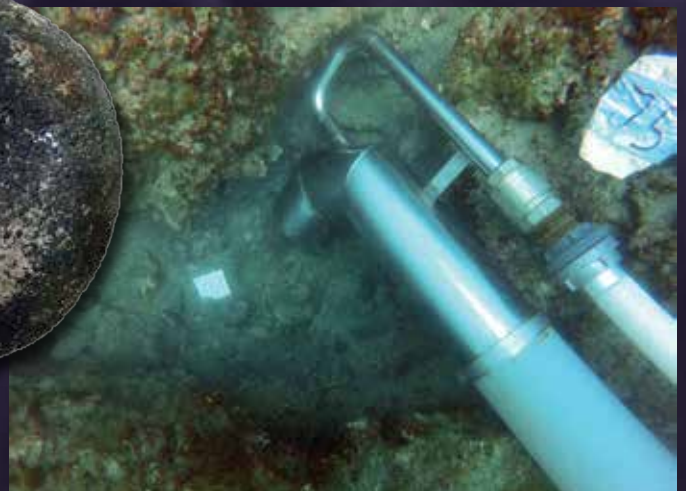
pakiranje nalaza u košaru. Ova metoda iskopavanja već se u praksi MCPA Zadar pokazala odličnom upravo na zahtjevnim kamenitim terenima, te na plitkim lokalitetima gdje je većina površinskog materijala davno odnesena. Tada, arheološki materijal bez obzira na djelovanje mora ipak ostaje unutar jame, a određena količina sedimenta se nataloži i na taj način arheološki nalazi ostaju skriveni. Da je donesena dobra odluka pokazuje i činjenica da su upravo iskopavanjem jama pronađeni neki od najznačajnijih nalaza na ovom nalazištu.

Nakon što su sve jame istražene, istraživački tim je prešao na područje nalazišta gdje je ranije postavljeno mrežište. (Više o metodologiji iskopavanja i dokumentiranja unutar mrežišta u: Bekić, 2016, 42-43). Uz pomoć tzv. mamut sisaljki u potpunosti su istraženi kvadrati: I, N i O, dok su L i P djelomično istraženi. Nakon iskopavanja i dokumentiranja, tipološki i kronološki određivi ulomci su zapakirani i trenutno su u procesu desalinizacije u MCPA Zadar, dok je ostatak vraćen u more, na isto mjesto odakle je izvađen.

Tijekom četiri istraživačke kampanje u potpunosti je istraženo 14 kvadrata dimenzija 4 x 4 m, dok su 2 kvadrata tek djelomično istražena. Uzimajući u obzir da je dubina sonde nekad prelazila i 2 metra, procjenjuje se da je ukupno istraženo oko 350 m² samo na području gdje je postavljeno mrežište, dok je otprilike 50 m² iskopano istražujući jame. Ukupno je na nalazištu Veli Piruzi istražena površina od oko 400 m².

U nastojanjima da se što bolje i preciznije dokumentira nalazište i ove godine je dio radnog vremena izdvojen za izradu detaljne nacrtne, foto i video dokumentacije. Prije svega, odlukom da se ove godine iskopavaju jame, bilo je potrebno suvremenom digitalnom tehnologijom dokumentirati područje jama prije iskopavanja. One su nacrtne skicirane (Bekić), a nakon toga i snimljene podvodnim kamerama (Surić, Fiederling) kako bi se izradio fotomozaik. Također je podvodnim kamerama snimljeno i područje između jama i postavljenog

8. A discoid whetstone (SF 131) in situ at discovery in cavity 5 / Kameni diskoidni brus (PN 131) in situ prilikom otkrića u jami 5 (Photo: L. Bekić)



significant finds at this site being recovered in the excavation of these cavities.

Once all of the cavities had been excavated the team moved on the part of the site where a grid had been previously installed (see more on the grid excavation and documentation methodology in: Bekić, 2016, 42–43). Using a dredge the following quadrants were fully explored: I, N and O, while L and P were partially excavated. After the dig and documentation the typologically and chronologically identifiable sherds were packed and are currently undergoing desalinisation at ICUA Zadar, while the remainder was restored to the sea floor at the location they were found at.

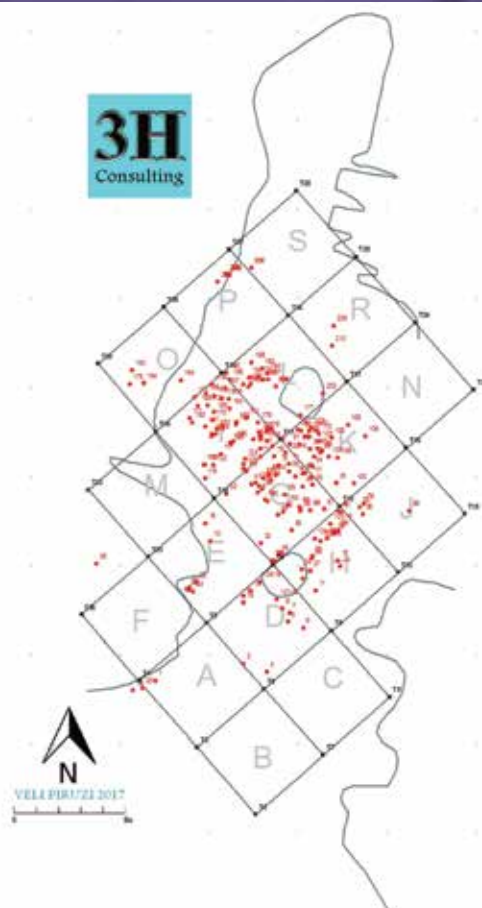
In the course of the four excavation campaigns we fully excavated fourteen 4 by 4 metre quadrants, with two quadrants partially explored.

Taking into consideration that the depth of the trenches at times surpassed two metres we estimate that a total of about 350 square metres were explored just in the area where the grid was installed, while about 50 square metres was excavated in the cavities. In all the Veliki Piruzi site saw the exploration of an area of about 400 square metres.

With the objective of the best and most precise possible documenting of the site this year again we set aside some of the work time to the creation of detailed drawing, photographic and video documentation. Firstly, given the decision to excavate the cavities this year, we used modern digital technology to document the cavity area prior to excavation. Drawings were first made (Bekić) before imaging was done with an underwater camera (Surić, Fiederling) to create a photomosaic.



9. A Spatheion amphora (SF 133) / Spatheion amfora (PN 133) (Photo: R. Surić)



10. A map of the site with indicated trenches and find positions / Plan nalazišta s označenim sondama i unesenim pozicijama nalaza (By: M. Kaleb)

mrežišta kako bi nalazište bilo dokumentirano u cjelini. U računalnom programu Site Recorder napravljen je precizan plan nalazišta (Kaleb), a unutar plana vidljiva je i disperzija nalaza zahvaljujući mjerama uzetim prilikom iskopavanja i pronalaska posebnog nalaza.

Metodološka dosljednost postupanja s arheološkim nalazima možda se najbolje očituje na ovom nalazištu. Tijekom četiri kampanje iskopavanja sonde i od 2017. g. - jama, prikupljeni su i dokumentirani svi arheološki nalazi. Tipološki i kronološki neodredivi ulomci (najčešće trbusi amfora) su nakon dokumentiranja vraćeni na morsko dno. Nalazi za koje je već prilikom iskopavanja utvrđeno da imaju databilne elemente, fotografirani su na morskom dnu zajedno s brojem koji im je dodijeljen, te pozicionirani metodom trilateracije. Posebni nalazi tada su zapakirani u mrežice i izvađeni iz mora zajedno s ostalim nalazima. Nakon dokumentiranja nalaza in situ pod morem, uslijedilo je ponovno fotografiranje, ali i vaganje te unošenje podataka u ranije pripremljenu tablicu.

Iskopavanjem ukupno 11 jama na nalazištu, pronađena su 496 arheološka nalaza, od kojih su 22 okarakterizirana kao "poseban nalaz" (PN). Najviše materijala, odnosno neodredivih ulomaka, a ujedno i posebnih nalaza (12) pronađeno je u J5. Iskopavanjem kvadrata I, L, N, O i P na nalazištu Veliki Piruzi, pronađeno je ukupno 767 arheoloških nalaza od kojih 54 nosi oznaku PN.

Underwater cameras were also used to shoot the area between the cavities and the installed grid to document the whole of the site. A precise map of the site was created using the Site Recorder software (Kaleb), with the dispersion of finds visible in the map thanks to the measures put in place during excavation and the recovery of special finds.

Methodological consistency in processing archaeological sites was perhaps best expressed at this site. In the course of the four trench excavation campaigns, of which the 2017 effort also saw the rock cavities excavated, all archaeological finds were collected and documented. Typologically and chronologically unidentifiable sherds (usually the belly sections of amphorae) were restored to the seabed after documentation. Finds that had already been identified as having datable elements during excavation were photographed on the sea floor together with the number assigned to them and positioned using the triangulation method. Special finds were then packed in nets and extracted from the sea together with the other finds. Documentation of the finds in situ underwater was followed by a second photographing, weighing and logging in a prepared table.

The excavation of a total of eleven cavities at the site yielded the recovery of 496 archaeological finds, of which 22 have been characterised as special finds (SF). The most material, sherds that were not determinable, and special finds (12) were found in J5. The excavation of quadrants I, L, N, O and P at the Veliki Piruzi site yielded the recovery of a total of 767 finds, 54 of which are special finds.

All of the collected archaeological material in the final year of the excavation, weighing a total of 185 kilograms, can be divided into several groups – pottery, metal, glass and stone. Among the pottery we see amphorae, vessels, building materials, and fishing equipment. Among the metal artefacts are parts of ship's elements, the glass comprises one base of a bottle, and among the stone we see part of the equipment and functional elements essential to any ship.

The most represented among the pottery are amphorae. A total of 1,160 amphorae sherds were found, of which 60 were characterised as SFs. These include amphorae plugs, bases, handles, rims and necks. Among the special finds we can single out a neck with handles (SF 136) of a small amphora, a spike with a maker's mark consisting of two parallel vertical lines of unequal length (SF 203), and the well preserved upper section of a Spatheion amphora (SF 133). Ceramic ware is represented with 64 specimens, of which 18 are SFs, including sherds of a casserole, a bowl from Pantelleria island (Pantellerian ware) and other small bowls and small pots. Building materials collected include several tegulae sherds, while the group of fishing equipment includes a ceramic net weight. The glass

Sav prikupljeni arheološki materijal težine 185 kilograma iz završne godine istraživanja možemo podijeliti u nekoliko skupina i to na nalaze od: keramike, metala, stakla i kamena. U skupinu keramičkih predmeta ubrajamo amfore, posude, građevinski materijal i pribor za ribolov. Skupini metalnih predmeta pribrajamo dijelove brodske opreme, skupini predmeta od stakla jedno dno boce, dok



11.
**A neck with handles (SF 136)
from a small amphora / Grlo s
ručama (PN 136) koje pripada
amfori malih dimenzija
(Photo: R. Surić)**

među nalazima od kamena imamo dio opreme i funkcionalne elemente prijeko potrebne na svakom brodu. Od svih keramičkih predmeta najzastupljenije su amfore. Pronađeno je ukupno 1160 ulomaka amfora od kojih je njih 60 je okarakterizirano kao PN. Riječ je o nalazima oklopaca, dna, ručki, te oboda i grla amfora. Među posebnim nalazima amfora treba izdvojiti grlo s ručkama (PN 136) amfore malih dimenzija, šiljak s pečatom kojeg čine dvije paralelne okomite linije nejednakih duljina (PN 203), te dobro sačuvani gornji dio spatheion amfore (PN 133). Keramičke posude zastupljene su s 64 primjeraka, od kojih je 18 u kategoriji posebnih nalaza, a riječ je o ulomcima kaserola (casserole), zdjela porijeklom s otoka Pantelleria (Pantellerian ware), te ostalim zdjelicama i lončićima. Od građevinskog materijala prikupljeno je nekoliko ulomaka tegula, dok u grupu ribarskog pribora ubrajamo keramički uteg za mrežu. Predmetima od stakla pripada samo jedan ulomak koji, po svoj prilici, predstavlja dno zelene staklene boce. Nalazi od metala nisu mnogobrojni, ali su jako važni i zanimljivi jer pripadaju brodskoj opremi. Tako su pronađeni po jedan brončani i jedan željezni čavao, te svakako najznačajniji predmet na ovogodišnjem iskopavanju, olovni dubinomjer (PN 129) koji je pronađen u J10. Funkcionalni elementi od kamena zastupljeni su s nekoliko primjeraka balastnog kamenja, te jednim kamenim brusom diskoidnog oblika (PN 131). Kao rezultat precizne dokumentacije, po završetku iskopavanja ovog značajnog i zanimljivog brodoloma, moguće je iznijeti statistički pregled koji može poslužiti kao osnova za daljnja razmišljanja i donošenje zaključaka. Tako je u ukupno 4 istraživačke kampanje pronađeno 387.366 kilograma arheološkog materijala od kojih 307.928 kilograma čini 2677 ulomaka amfora. Ukupno 210 predmeta je dobilo oznaku posebnog nalaza. Teret broda uglavnom su, kao što je već navedeno, činile amfore iz razdoblja od 4. do 6. stoljeća sjevernoafričke provincijencije, ali prepoznati su i bliskoistočni tipovi.

group is represented by a sole fragment that is likely the base of a green bottle. There are few metal finds, but they are interesting and important as elements of the ship's structure. These are one bronze and one iron nail and certainly the most important artefact from this year's excavation, a lead sounding weight (SF 129) found in J10. The functional stone elements are represented with several ballast stones and one whetstone of discoid form (SF 131).

As a result of the precise documentation we are able at the close of the excavation of this important and interesting wreck to offer a statistical overview that can be a guide in further elaboration and in drawing conclusions. Thus the four campaigns have seen finds of 387.366 kilograms of archaeological material, of which 307.928 kilograms consists of 2,677 amphorae sherds. A total of 210 artefacts have been designated as special finds. The cargo of the ship consisted primarily of amphorae from the fourth to sixth century period of North African provenance, although Middle Eastern types were also identified. We can confidently say that the discovered material forms only part of the remains of the wreck, with the remainder having been collected from the site in the course of earlier surveys of the waters of Rovinj by archaeologist Štefan Mlakar (Vrsalović, 2011, 65) and by curious visitors to the Veliki Piruzi rock.

At the close of the excavation and documentation all typologically unidentifiable finds were restored to the sea floor around the rocks to bear witness to this maritime tragedy and its scale, while all typologically identifiable finds are treated in a monograph that will be presented to the general public and specialist readers as the result of our excavations at the site.

Sa sigurnošću možemo reći da pronađeni materijal čini samo dio ostataka brodoloma, dok je ostatak odnesen sa nalazišta prilikom ranijih pregleda rovinjskog akvatorija od strane arheologa Štefana Mlakara (Vrsalović, 2011, 65), te od strane znatiželjnih posjetitelja hridi Veli Piruzi. Po završetku iskopavanja i dokumentiranja, svi tipološki neodredivi nalazi su vraćeni u podmorje hridi kako bi na taj način svjedočili o pomorskoj tragediji i njezinim razmjerima, dok se svi tipološki određivi nalazi obrađuju za monografiju u kojoj će javnosti i znanstvenim krugovima biti predstavljeni rezultati našeg istraživanja.

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12. The members of the Piruzi 2017 team, from the left: / Članovi istraživačke ekipe Piruzi 2017: S lijeva: Tobias Pflederer, Mladen Pešić, Borna Krstulović, Zoran Blažević, Maja Kaleb, Marko Srećec, Max Fiederling, Michael Heinzlmeier, Roko Surić, Luka Bekić (Photo: G. Sabelić)





1. Every find was documented / Svaki pojedini nalaz bio je dokumentiran (Photo: L. Bekić)

VERUDA SHIPWRECK INVESTIGATION WRAPS UP

ZAVRŠETAK ISTRAŽIVANJA BRODOLOMA KOD VERUDE

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The final campaign in the investigation of a post-medieval shipwreck at Veruda island to the south of Pula was staged in May of 2017. Following the initial discovery in 2013 and the major excavations of 2016, this year saw a shorter archaeological campaign, from the 17th to 22nd of May. Taking part in the work were Luka Bekić (field director), Mladen Pešić, Maja Kaleb and Roko Surić of ICUA Zadar and Antje Fischer, Andreas “Eckbert” Grundman and Roman Scholz of DAI-RGK Frankfurt, joined by outside associate Borna Krstulović. Diving Pula proprietor Branislav Danevski provided logistic support to the archaeological team. The archaeological excavations began in the frame of international collaboration between the German Archaeological Institute (DAI Berlin) and the International Centre for Underwater Archaeology in Zadar. Last year the majority of co-funding was provided



2. The excavations were performed along the previous, now covered dig / Istraživanje je provedeno uz zatrpanu staru sondu (Photo: M. Pešić)

by the Honor Frost foundation, while DAI Berlin and ICUA Zadar financed this year's excavation.

In 2016 the archaeological team moved a heap of ballast stones and excavated and documented the entire central section of the shipwreck with the remains of the wooden structure of the ship and then carried out in situ protection of the remains.

The protection was provided such that the wooden remains were covered with a large quantity of sand collected from a deeper part of the sea floor. The central area was then covered with geotextile. This was in turn covered by a thinner layer of sand to prevent it from rising from the bottom. Finally the entire ballast heap was restored to the central area of the ship to prevent irresponsible persons from digging up the remains.

The arrival of our archaeological crew this year was important primarily with regard to the supervision of the condition of the site. Our monitoring of the site one year down the road showed that it was well preserved and in the same condition in which we left it last year. The quantity of sand now atop the wooden remains is greater than was present when the site was discovered, meaning that the further destructive action of naval shipworms will not be possible. The wooden structure is thus better protected than it was prior to the archaeological excavation.

3. Searching with a metal detector / Pretraživanje metal detektorom (Photo: R. Scholz)



**4 a,b. X-ray image of corroded tool and a large nail /
Rengenski snimak korodiranog alata i velikog čavla
(Photo: Zadar General Hospital)**

Tijekom svibnja 2017. g. provedena je posljednja kampanja istraživanja novovjekovnog brodoloma uz otok Veruda, južno od Pule. Nakon prvog otkrića 2013. g. te velikih iskopavanja 2016. g., ove godine provedena je jedna kraća arheološka kampanja, od 17. do 22. svibnja. U istraživanju su sudjelovali Luka Bekić (voditelj), Mladen Pešić, Maja Kaleb i Roko Surić iz MCPA Zadar zatim Antje Fischer, Andreas "Eckbert" Grundman i Roman Scholz iz DAI - RGK Frankfurt, te vanjski suradnik Borna Krstulović. Logističku potporu arheološkoj ekipi pružio je ronilački centar "Diving Pula" vlasnika Branislava Danevskog. Arheološka istraživanja započeta su u okviru međunarodne suradnje između Njemačkog arheološkog instituta (DAI Berlin) i Međunarodnog centra za podvodnu arheologiju u Zadru.

Prošle godine istraživanja su većim dijelom sufinancirana projektom Honor Frost zaklade, dok su ovogodišnja istraživanja obavljena sredstvima DAI Berlin i MCPA Zadar.

Nakon što je 2016. g. arheološka ekipa premjestila gomilu balastnog kamena te iskopala i dokumentirala cijeli središnji dio brodoloma na kojem su se nalazili ostaci drvene strukture broda, provedena je *in situ* zaštita njihovih ostataka.

Zaštita je provedena na način da su se drveni ostaci prvo zasipali velikom količinom pijeska koja je prikupljena iz dubljih dijelova morskog dna. Potom je središnji dio prekriven geotekstilom. Na njega je potom nanovo zasipan tanji sloj pijeska, kako se on ne bi odizao od dna. Na kraju je cijela balastna gomila ponovno vraćena na središnji dio broda, kako bi se spriječilo prekopavanje ostataka od strane neodgovornih pojedinaca.

Dolazak arheološke ekipe ove godine u prvom redu je bilo važan zbog nadzora stanja nalazišta. Naš monitoring nakon godinu dana je tako pokazao kako je nalazište dobro očuvano i u stanju kakvim smo ga prošle godine napustili. Zbog veće količine pijeska na drvenim ostacima nego u prvotno zatečenom stanju, daljnje djelovanje morskih crva na uništenju drva neće biti moguće.

Na taj način je drvena struktura bolje zaštićena nego je bila prije početka arheoloških iskopavanja.

Potom su započeta dodatna arheološka istraživanja, koja su za cilj imala proširiti područje iskopavanja za pojas od dva metra sa svih strana prethodno istražene plohe.

We then moved on to further archaeological excavation that had as its objective the expansion of the excavation area to a zone of two metres to all sides of the previously investigated area. Although the site area is on a stone plateau without much sandy sediment, the excavation aimed to collect individual finds that are outside the area of highest concentration. Careful search and documentation of every new find in the pre-installed coordinate grid largely contributed to the intensity of investigation at this site. We recovered 316 new individual finds, mostly to the northwest and southeast sides. For the most part these are bits of melted metal, copper, tin, lead or alloys, like the finds from previous years. Very few artefacts are identifiable with most being melted beyond recognition. Also found were numerous iron nails from the ship's structure of all sizes, but unfortunately highly corroded.

After the archaeological excavation of these sectors a metal detector was used to search the broader surroundings in order to collect objects that have slipped into deeper parts of the sea floor. Here too we met with success, recovering some ten additional finds, mostly bronze nuts and one conglomerate of at least four iron cannonballs and part of a large anchor ring. These finds were also measured into the existing coordinate grid.

Based on the results of the excavation and analysis so far the Veruda island wreck can be attributed to the very end of the sixteenth century. This is clearly a merchant ship transporting a large cargo of metal. The metal can be classed into several groups – waste metal objects prepared for melting (scrap metal), semi-melted material, bits of metal slag, copper ingots, copper intermediate products such as sheets and wire and various for now unidentified metal objects. The provenance of the metal cargo is diverse: some objects can be attributed to southern German brass production and others to the oriental Ottoman sphere. It can thereby be concluded that the owners of the ship earned their income by the purchase, processing and trade of metal in the broader Adriatic area.

Among artefacts that may have belonged to the crew or been part of the ship's equipment we see only numerous iron nails and spikes used in the structure of the ship or held in reserve. Then there are the iron cannonballs, several of which were found grouped in a corroded conglomerate and that, by

Mada je prostor nalazišta na kamenoj zaravni bez mnogo pješčanog sedimenta, istraživanjem se htjelo prikupiti pojedine nalaze koji su izvan područja najgušće koncentracije. Pažljivim pretraživanjem te dokumentiranjem svakog novog nalaza u prethodno postavljeno koordinatno mrežište uvelike se doprinijelo stupnju istraženosti ovog nalazišta. Pronađeno je čak 316 novih pojedinačnih nalaza, uglavnom na sjeverozapadnoj i jugoistočnoj strani. Većinom su to dijelovi rastaljenog metala, bakra, kositra, olova ili nekih slitina, poput nalaza iz prethodnih godina. Rijetki su predmeti koji se mogu prepoznati, većina ih je rastaljena do neprepoznatljivosti. Uz njih, kao dijelovi brodske opreme pronalaze se brojni željezni čavli svih veličina, nažalost jako korodirani.

Nakon arheološkog iskopavanja ovih sektora, metal detektorom pretraženi su dijelovi šireg okoliša, kako bi se prikupili pojedini predmeti koji su otklizali u dublji dio dna. I tu je zabilježen uspjeh pa je pronađeno desetak dodatnih nalaza, uglavnom brončanih matica, ali i jedan konglomerat od barem četiri željezne topovske kugle kao i dio velikog sidrenog prstena. I ovi nalazi su umjereni u već od prije postavljeno koordinatno mrežište.

Brodolom kod otoka Verude se prema dosadašnjim rezultatima istraživanja i analiza nalaza može datirati u sam kraj 16. st. Očito je riječ o trgovačkom brodu koji je kao teret prevezio veću količinu metala, Taj metal može se klasificirati u nekoliko skupina - to su otpadni metalni predmeti pripremljeni za taljenje (lom metal) zatim polurastaljeni predmeti, komadi metalne zgure, ingoti bakra, poluproizvodi bakra poput ploča i žica te razni zasada nedefinirani metalni predmeti. Porijeklo metala iz tereta je raznovrsno, neki predmeti se mogu pripisati južnonjemačkoj proizvodnji od mjedi, a drugi pak orijentalnom osmanskome krugu. Na osnovu toga može se zaključiti kao su vlasnici broda zarađivali novac otkupom, preradom i preprodajom metala na širem području Jadrana.

Od predmeta koji su mogli pripadati posadi i opremi broda mogu se navesti brojni željezni čavli i klinovi, koji su mogli biti iskorišteni u strukturi broda ili čuvani kao rezerva. Zatim su to željezne topovske kugle, od kojih se nekoliko pronašlo grupirano u korozivskom konglomeratu, a prema kalibru mogle bi se pripisati manjim palubnim obrtnim topovima. Brodskoj opremi možda se mogu pripisati



**5. Half of a copper ingot /
Polovina bakrenog ingota
(Photo: M. Kaleb)**



**6. An iron cannonball /
Željezna topovska kugla
(Photo: M. Kaleb)**

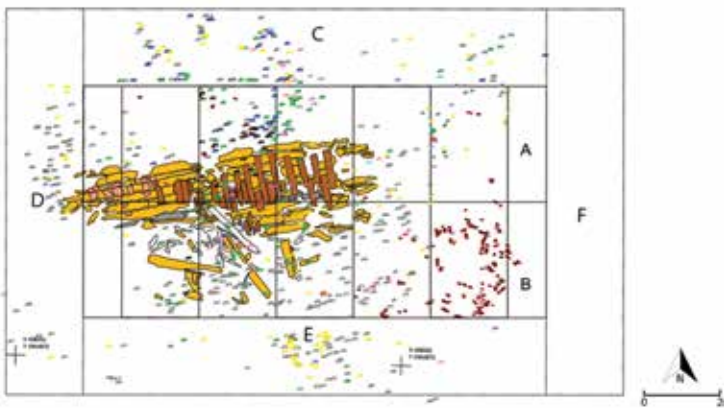


**7. Receiving ring of
a copper cauldron /
Prijvatna alka bakrenog
kotla (Photo: M. Kaleb)**



**8. Various square nuts / Razne kvadrataste matice
(Photo: M. Kaleb)**

their calibre, can be attributed to small deck-mounted swivel guns. Perhaps attributable to ship's equipment are pyramidal lead fishing weights, small tin bowls and plates, the odd potsherd and the lower end of a glass beaker with lion's heads. The other ceramic and glass fragments are so highly fragmented that it is more likely that they were refuse in the ship's below deck areas than some integral artefact used by the crew when the vessel sank. Artefacts belonging to the crew largely point to a northern Adriatic origin, such that it is possible that the ship was near its homeport when it went down.



9. Map of Veruda shipwreck remains / Nacrtna ostataka brodoloma Veruda (By: R. Scholz, M. Kaleb)

All in all, for now the indicators speak to the premise that this is in fact the merchant vessel looted and burned by Uskok pirates at anchor in 1597. In further analysis of the finds and the archival sources we hope to resolve this small enigma and tell a long forgotten tale of southern Istria.

i ribolovni piramidalni olovni utezi, kositrene zdjelice i tanjuri, poneki ulomak keramičkih posuda te donji dio staklene čaše s lavljim glavama. Ostali keramički i stakleni ulomci su toliko usitnjeni da su vjerojatnije bili otpad u štivama broda nego cjeloviti predmeti koje je u trenutku potonuća koristila posada. Predmeti koji su pripadali posadi broda uglavnom ukazuju na sjevernojadransko porijeklo, pa je moguće da se brod u trenutku potonuća nalazio bliže svojoj matičnoj luci.

Sve u svemu, za sada svi pokazatelji govore kako je upravo ovo trgovački brod koji su gusari Uskoci opljačkali i zapalili na sidrištu 1597. godine. Daljnjom analizom nalaza ali i arhivskih izvora, nadamo se razriješiti ovu malu misteriju i ispričati jednu davno zaboravljenu priču iz južne Istre.

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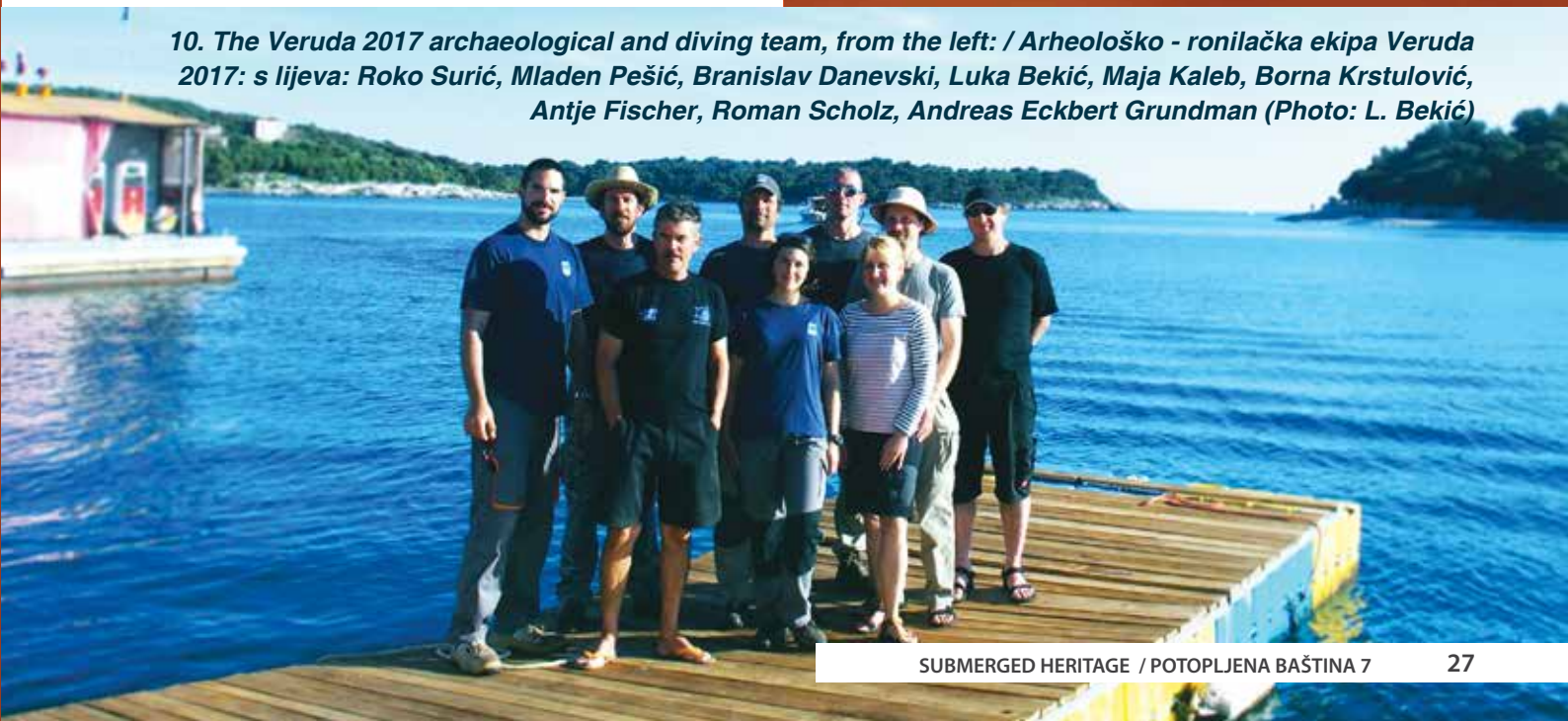
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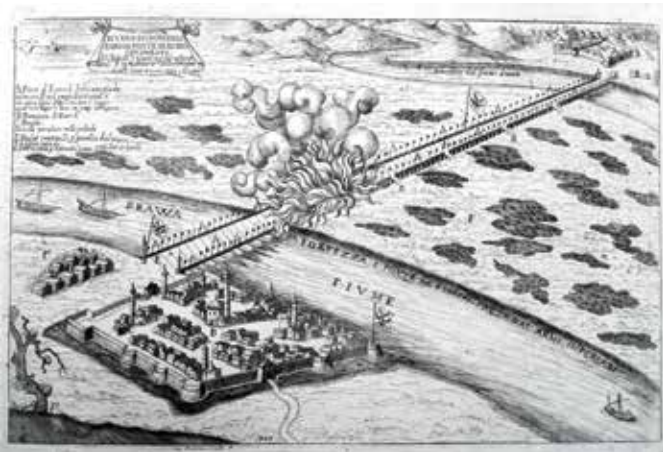
10. The Veruda 2017 archaeological and diving team, from the left: / Arheološko - ronilačka ekipa Veruda 2017: s lijeva: Roko Surić, Mladen Pešić, Branislav Danevski, Luka Bekić, Maja Kaleb, Borna Krstulović, Antje Fischer, Roman Scholz, Andreas Eckbert Grundman (Photo: L. Bekić)



ON THE ROUTE OF OSIJEK'S GREAT BRIDGE - ARCHAEOLOGICAL INVESTIGATION OF THE DRAVA RIVER

NA TRASI VELIKOG OSJEČKOG MOSTA - ARHEOLOŠKA ISTRAŽIVANJA RIJEKE DRAVE

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1. A depiction of a boat-mounted bridge over the Drava River / Prikaz mosta na čamcima preko Drave (From: Pelc 2014, 44)

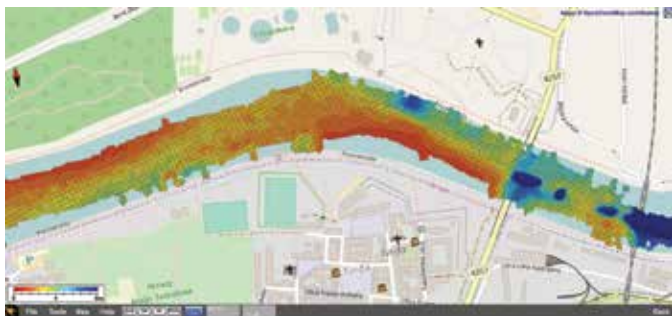
After several seasons of archaeological excavation of the wooden structure of Süleyman's Great Bridge at Osijek at the Darda site, this year the archaeologists with the International Centre for Underwater Archaeology in Zadar aimed to locate the southern terminus of the bridge (Pešić 2015). At the initiative of its conservation department in Osijek the culture ministry allocated funding for a search of the Drava River at the presumed location of this end of the Great Bridge, not far from Osijek's Tvrđa citadel. The primary objective of the investigation was to scan the bottom of the Drava River and then to undertake an underwater survey of locations deemed to be interesting and to document structures on land possibly associated with the bridge.

The historical sources tell us that the bridge erected for a

Nakon nekoliko sezona arheoloških istraživanja drvenih struktura Velikog osječkog mosta koja su se odvijala u Dardi, ove godine su arheolozi Međunarodnog centra za podvodnu arheologiju iz Zadra pokušali pronaći južni kraj istoimene građevine (Pešić 2015). Na inicijativu Konzervatorskog odjela u Osijeku, Ministarstvo kulture je osiguralo sredstva za provođenje programa pretraživanja rijeke Drave na mjestu gdje se pretpostavlja da je bio početak Velikog osječkog mosta, nedaleko osječke Tvrđe. Primarni cilj istraživanja bio je skeniranje dna Drave, a zatim i podvodni pregled zanimljivih lokacija te dokumentiranje struktura na kopnu potencijalno vezanih uz postojanje mosta.

Povijesni izvori govore da je most koji je napravljen za potrebe vojnih pohoda Sulejmana I. Veličanstvenog preko Drave 1566. g. bio podignut na nizu povezanih drvenih čamaca. Ti podaci su dosta proturječni, pa se negdje spominje 40, a negdje čak 118 čamaca na kojima je bio podignut most (Matasović 1929: 4; Čelebi 1973: 373). Most su, prema Evliji Čelebiji, putopiscu koji je u jednom od svojih djela opisao i ovu građevinu, držali debeli željezni lanci, a s obje strane je imao čvrsta i utvrđena vrata (Čelebi 1973: 373). Iz navedenih podataka se može zaključiti da prijelaz preko Drave nije bio građen u vidu tipičnog mosta. Iako se struktura na pilonima nije očekivala na ovom mjestu, svejedno je prostor Drave na kojem se pretpostavlja da je prijelaz preko rijeke započinjao zahtijevao opsežni pregled.

Skeniranje dna rijeke Drave se tijekom nekoliko dana obavljalo iz čamca na kojem je bio montiran Side scan sonar, model Humminbird Helix 9. Niski vodostaj Drave u ovo doba godine uvjetovao je opseg područja kojeg



**2. Bathymetry of a part of the scanned area /
Batimetrija dijela skeniranog područja
(By: Allesta d.o.o.)**

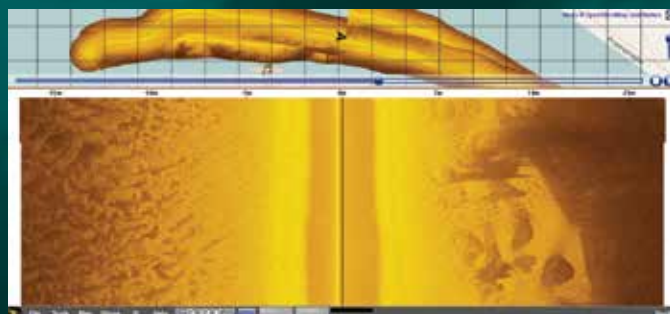
military campaign led by Süleyman the Magnificent (Süleyman I) over the Drava in 1566 was mounted on a series of linked wooden boats (pontoons). These data are quite contradictory, with sources mentioning at times forty and elsewhere 118 boats on which the bridge was raised (Matasović 1929: 4; Çelebi 1973: 373). According to Evliya Çelebi, a travel writer who described this structure in one of his works, the bridge was linked by thick iron chains and had firm and fortified gates at both ends (Çelebi 1973: 373). From these data we can conclude that the passage over the Drava was not built as a typical bridge. Although a pile-mounted structure was not expected at this location, the area of the Drava at which the passage over the river was presumed to have begun nevertheless required a comprehensive survey.

The scanning of the bottom of the Drava was performed over the course of a few days with a boat-mounted Humminbird Helix 9 model side-scan sonar. The low water level in the Drava River at this time of the year influenced the scope of the area we were able to survey. Due to the low depth at the fringes of the river we could not access them. The water level also saw a reduction of passenger boat traffic on the river and a relatively slow flow rate, which provided grater safety during scanning and diving. Some areas, however, where not suitable for diving – the significant and abrupt changes in depth at places created vortices in the river and no diving was undertaken in these areas.

**4. Wooden piles visible at low water / Uslijed niskog
vodostaja vidljivi su drveni piloni (Photo: M. Kaleb)**



je bilo moguće pregledati. Radi male dubine uz rubne dijelove rijeke, njima se nije moglo pristupiti. Razina vodostaja pogodovala je smanjenju prometa putničkih brodova na rijeci, kao i njenoj relativno manjoj brzini, što je omogućilo veću sigurnost pri obavljanju skeniranja i ronjenja. No ipak, pojedina područja nisu bila sigurna za ronjenje jer je na nekim dijelovima velika i nagla razlika u povećanju dubine stvarala vrtložnja rijeke, te se na tim pozicijama nije ronilo. Nakon što je navedeno područje skenirano, a rezultati skeniranja pregledani, zaključeno je da se mogu izdvojiti tri područja na kojim su zamijećene anomalije na dnu, ali da je samo na jednoj poziciji moguće obaviti podvodni pregled. Dvije pozicije eliminirane su prvenstveno radi blizine dubljeg dijela rijeke s opasnim virovima, ali i strukturama koje ne odgovaraju konstrukciji mosta.



**3. The irregular structure at the bottom of the Drava
at the dive position / Nepravilne strukture na dnu
Drave na poziciji zarona (By: Allesta d.o.o.)**

Jedina struktura koja je svojom lokacijom i izgledom potencijalno odgovarala mostu nalazi se na zapadnom dijelu Tvrđe, gdje je primijećeno da iz dna Drave vire pojedini piloni. Pozicija je potencijalno zanimljiva radi uzdignutog dna i vidljivih struktura pilona, koji se pri niskom vodostaju nalaze čak i izvan vode. Taj uzdignuti dio nastao je tijekom godina taloženjem riječnog pijeska uokolo navedene drvene strukture. Ronjenje i podvodni pregled terena upravo je stoga bio koncentriran na navedeno područje. Radi sigurnosti ronilaca, uzvodno od navedene lokacije usidren je čamac, s kojeg je pušteno uže preko kojeg se ronilac spuštao do lokacija pilona. Nakon što se dosegla udaljenost od broda do konstrukcije, bilo je neophodno da se ronilac veže karabinerima za užu koji je pušteno nizvodno s broda. Vrlo jaka struja i vidljivost od svega dvadesetak centimetara u ovim prilikama dosta su otežavali mogućnost pregleda šireg prostora, te se pregled zadržao samo uokolo ove strukture. Tijekom zarona prepoznato je da se ovdje nalazi 7 vertikalno zabijenih drvenih pilona koji vire oko jedan metar iznad riječnog dna. Raspoređeni su u 3 paralelna reda na podjednako udaljenosti jedan od drugog. Razmak između redova je oko jedan metar, a piloni su međusobno odaljeni oko pola metra. Prilikom zarona uzeto je 5 uzoraka drva radi dendrokronološke i C14 analize starosti.

Budući da je tijekom ronjenja pronađen tek manji dio



5. For safety divers were tied to a boat with a rope / Ronioci su radi sigurnosti bili vezani s brodom pomoću užeta (Photo: M. Kaleb)

After the area was scanned and the results of the scan examined it was concluded that three areas could be singled out as having anomalies on the riverbed, but that an underwater survey could only be performed at one of these positions. The other two positions were eliminated primarily due to the proximity of deeper areas with dangerous vortices and on account of structures that are not consistent with the structure of a bridge.

The only structure the location and appearance of which was possibly consistent with a bridge was located to the western end of the Tvrđa citadel, where we observed individual piles jutting out of the Drava's bottom. The position is potentially interesting on account of the raised bottom and visible pile structure, which at low water levels breaks the water surface. This raised section was created as the result of years of sedimentation of river sand around this wooden structure. Dives and underwater examinations of the terrain were, consequently, concentrated on this area. A boat was anchored upstream of this location from which rope was paid out to secure the diver heading down to the pile location. Upon reaching the distance from the boat to the structure the diver had to tie off with a D-ring (carabiner)

drvenih elemenata, bilo je teško zaključiti da li se radi o strukturi koja bi se mogla povezati s Velikom osječkim mostom. Radi toga su nam analize starosti bile ključne za određivanje točne datacije ovih struktura. Jedan uzorak poslan je na dendrokronološku analizu na Gozdarski inštitut Slovenije, ali uzorak od 36 godina na pilonu nije bio dovoljan da bi se točno datirala struktura. Uzorak istog pilona je stoga poslan i na C14 analizu starosti u Poznan Radiocarbon Laboratory u Poljskoj.



6. Some of the wooden piles visible on the Drava riverbed / Dio drvenog pilona vidljiv na dnu Drave (Photo: M. Pešić)

to the rope. The very strong current and visibility of only about twenty centimetres in these conditions significantly hampered any broader inspection, which was reduced to the area immediately around the structure. In the course of the dive seven vertically rammed wooden piles were identified jutting about a metre above the riverbed. They lie in three parallel rows at equal spacing. The spacing between rows is about one metre, with the piles themselves set at a spacing of about half a metre. Five samples were taken of the wood during the dive for dendrochronological and radiocarbon age analysis.

Given that only a small part of the wooden elements were found during the dive it was difficult to conclude whether or not this structure can be associated with the Great Bridge at Osijek. As a result an age analysis was critical in determining a date for this structure. One sample was sent for dendrochronological analysis to the Gozdarski inštitut Slovenije (Slovenian Forestry Institute), but the sample with 36 rings on the pile was not sufficient to provide a precise date. Another sample from the same pile was then sent for radiocarbon analysis at the Poznan Radiocarbon Laboratory in Poland. The results of this analysis place the sample in the period from 1810 to 1924. This outcome points confidently to a recent wooden structure, created long after the erection of Süleyman's Great Bridge and having no direct association to it.

With the low water level of the Drava a wooden structure was revealed on the right bank that was not visible at a high water level. It too was sketched and measured and samples were taken for age analysis. The structure lies in the immediate vicinity of Osijek's Tvrđa citadel, where the Drava passes under its western end and is made of squared piles and planks. Forty-six piles were observed during documentation, which we can divide

Rezultati ove analize pokazali su da se uzorak može datirati u period između 1810. i 1924. g. Rezultati ovih analiza s velikom sigurnošću nam pokazuju da se radi o novijoj drvenoj strukturi, koja je nastala daleko nakon izgradnje Velikog osječkog mosta i da s njim nema direktne veze.

Budući da je uslijed niskog vodostaja Drave na desnoj obali na vidjelo izašla drvena konstrukcija koja uslijed višeg vodostaja nije vidljiva, ovom prilikom je i ona skicirana i izmjerena, te su uzeti uzorci za određivanje njene starosti. Konstrukcija se nalazi u neposrednoj blizini osječke Tvrđe, na području Drave koja prolazi ispod njenog zapadnog dijela, a rađena je od kvadratnih pilona i dasaka. Prilikom dokumentiranja uočena su 46 pilona koje možemo podijeliti na dvije različite vrste, one kvadratnog presjeka bez vidljive dodatne obrade te pilone kvadratnog presjeka s utorima u koje su umetnute vodoravne daske. Ispunu konstrukcije čine cigle, od kojih se na nekima vidi pečat „EF“. Dužina cijele konstrukcije je 20 metara, a širina bliže obali je 2,2 metra te se prema kraju blago sužava. Unutar konstrukcije nisu uočeni sitni arheološki nalazi. Analiza starosti jednog od drvenih elemenata je pokazala vrlo sličnu dataciju kao i uzorka uzetog iz prethodno opisane konstrukcije, i datira se period između 1811. i 1921. g. Nažalost, nakon izvršenog skeniranja, te pregledavanja pojedinih lokacija rijeke Drave, na prostoru ispred osječke Tvrđe možemo zaključiti da se ne mogu vidjeti ostatci drvene konstrukcije koja bi se mogla povezati sa ostacima Velikog osječkog mosta. Slijedom ovih terenskih rekognosciranja, može se zaključiti da je struktura mosta preko Drave zasigurno bila sačinjena od povezanih čamaca, kao što nam to

7. Documenting the wooden structure on the Drava riverbank / Dokumentiranje drvene konstrukcije uz obalu Drave (Photo: L. Bekić)





8. A detail of a squared pile with slot and vertical plank insert / Detalj kvadratnog pilona s utorom i okomite daske u utoru (Photo: M. Kaleb)

into two types, those of squared cross-section without evident additional working, and those of squared cross-section with slots into which horizontal planks are inserted. The fill of the structure is made of brick, with the “EF” maker’s mark visible on some. The length of the entire structure is twenty metres and the width nearer to shore is 2.2 metres, gently tapering towards the end. Small archaeological finds were not observed within the structure. The analysis of one of the wooden elements yielded a date very similar to that from the sample taken from the previously described structure, between 1811 and 1921. Unfortunately, after the scan and survey of locations in the Drava River in the area facing Osijek’s Tvrđa citadel we can conclude that there are no evident remains of a wooden structure that could be associated with the remains of Osijek’s Great Bridge. Following on these field surveys we can conclude that the bridge structure over the Drava was certainly comprised of linked boats, as historical sources tell us. Remains of the bridge structure may be found in future land excavation in this area, where such a structure would be identifiable as some sort of anchoring point or base for the reinforcement of a boat-mounted structure.

govore povijesni izvori. Eventualni ostaci konstrukcije mosta mogli bi se pronaći tokom budućih kopnenih istraživanja na ovom području, gdje bi se takve strukture mogle prepoznati kao nekakva sidrišta ili baze za učvršćivanje brodske konstrukcije.

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9. The wooden structure on the Drava riverbank / Drvena konstrukcija uz obalu Drave (Photo: M. Kaleb)





1. An agglomeration of fragmented amphorae /
Aglomeracija fragmentovanih amfora (Photo: M. Jabučanin)

UNDERWATER ARCHAEOLOGICAL INVESTIGATION OF RISANSKI ZALIV

PODVODNA ARHEOLOŠKA ISTRAŽIVANJA U RISANSKOM ZALIVU

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In the frame of its competences the Centre for Conservation and Archaeology of Montenegro (CKACG) has undertaken the archaeological investigation of Risan Bay (Risanski Zaliv), one of only three legally protected underwater sites in Montenegro. The project is being implemented through a cultural property protection and preservation programme financed for the third consecutive year by the Montenegrin culture ministry. The excavation manager is archaeologist Marija Jabučanin, leading the research team of Nikola Borovinić, Dejan Drašković, Petra Zdravković, Dejan Gazivoda, Dragutin Radimir and Božidar Jovičević.

Joining the team for this year's campaign were Mladen Pešić and Maja Kaleb of the International Centre for Underwater Archaeology in Zadar. The collaboration is part of an inter-institutional agreement between CKACG and ICUA Zadar that was preceded by the signing of a cooperation memorandum in the domain of the protection

Centar za konzervaciju i arheologiju Crne Gore (CKACG) u okviru svojih nadležnosti, sprovodi arheološka istraživanja u Risanskom zalivu, jednom, od samo tri Zakonom zaštićena podvodna lokaliteta u Crnoj Gori. Projekat se realizuje kroz Program zaštite i očuvanja kulturnih dobara, a finansira ga treću godinu za redom, Ministarstvo kulture Crne Gore. Rukovodilac istraživanja je arheolog Marija Jabučanin, a u istraživačkom timu su Nikola Borovinić, Dejan Drašković, Petra Zdravković, Dejan Gazivoda, Dragutin Radimir i Božidar Jovičević.

Osim pomenutih, učesnici u istraživanju tokom ovogodišnje kampanje bili su i Mladen Pešić i Maja Kaleb iz Međunarodnog centra za podvodnu arheologiju (MCPA) iz Zadra. Do pomenute saradnje se došlo nakon međuinstitucionalnih dogovora između CKACG i MCPA Zadar, kojima je prethodilo potpisivanje Memoranduma o saradnji na području zaštite i očuvanja podvodne kulturne baštine između Ministarstva kulture



2. Mapping / Mapiranje (Photo: M. Pešić)

and preservation of underwater cultural heritage between the Croatian and Montenegrin culture ministries.



The objective of this investigation is the protection of the rich cultural heritage of the waters of Risanski Zaliv

formed in the course of several millennia of contact and commerce in prehistory and during the Illyrian, Greek, Roman, Byzantine, Venetian and Uskok periods, right up to the contemporary period. It is based primarily on the surveying of various small archaeological materials, which implies the application of specific methodological approaches that aim to create underwater archaeological maps and includes a determination of the condition-as-found of archaeological elements.

A network of polygons and squares formed by GPS reference points in space is used to this end. For the creation of final site maps and to procure data on the spatial boundaries of a site each of the fragments or agglomerates found that can be typologically identified was documented and photographed in situ.

Dives were undertaken at Carina/the mouth of the Sopot and at cape Rtac/Manastir Banja covering a total of ten thousand square metres. The selection of locations is

Republike Hrvatske i Ministarstva kulture Crne Gore. Zadatak ovog istraživanja je zaštita bogate kulturne baštine akvatorija Risanskog zaliva, nastale kao posljedica višemilenijumskih kontakata i trgovačkih interesa iz vremena praistorije, Ilira, Grka, Rimljana, Vizantije, Venecije i Uskoka, sve do modernog doba.

Njeno proučavanje bazirano je prvenstveno na prospekiji raznorodnog pokretnog arheološkog materijala, koje podrazumjeva primjenu specifičnog metodološkog pristupa, sa ciljem izrade podvodne arheološke mape, koji uključuje i utvrđivanje zatečenog stanja arheoloških elementa.

U svrhu toga, korišćena je mreža poligona i kvadrata koji su formirani referentnim tačkama - GPS pozicioniranim u prostoru. Radi izrade konačnog plana nalazišta, idobijanjanpodatakaoprostornimgranicamalokaliteta,svaki od pronađenih fragmenata ili aglomerata koji je mogao biti tipološki definisan, dokumentovan je i fotografisan in situ.

Ronilo se na potezu Carine - ušće Sopota, kao i Rtova Rtac - Manastir Banja, u ukupnoj površini od 10.000 m². Odabir lokacija je vršen na osnovu pretpostavki da se na ovim položajima nalazi nekoliko pozicija sa potopljenim brodskim teretima

koji su u more dospjeli prilikom utovara i istovara, kao i na osnovu informacija dobijenih od ronilaca i ribara, i literature o ostacima antičkog Risna i njegove luke.

3.
Fragmented Corinthian amphorae, conical base and opening in the form of an open figure eight, 6th to 3rd century BCE / Fragmentovane korinthske amfore, kupasto dno i otvor u obliku otvorene osmice, VI - III v. p. n. e. (Photo: M. Jabučanin)

Risanska luka u pomorskim mapama nikad nije postojala kao



4. Raising amphorae from the sea floor with air lift bags/ Izronjavanje amfore uz pomoć vazdušnog lifta (Photo: M. Jabučanin)

based on the presumption that there are a number of positions at these locations with ship cargoes that sank during loading and unloading and on the basis of reports



5. Underwater excavation with a dredge / Mamutiranje, podvodno iskopavanje (Photo: M. Jabučanin)

from divers, fishers and the literature on the ruins of Antiquity period Risan and its harbour.

The Risan harbour does not appear on maritime maps as a point of navigation as it does not lie on a direct navigation route along the busy eastern Adriatic coast that linked the Aegean with the far north of the Adriatic Sea and required ships to make a significant detour from the route, especially in the Antiquity period.

7. Drawing up documentation of the shipwreck / Izrada nacrtne dokumentacije, brodolom (Photo: M. Jabučanin)



navigaciona tačka jer se ne nalazi u direktnoj plovnoj liniji duž frekventne istočnojadranske obale, koja je spajala Egej i krajnje sjeverne tačke Jadrana, što je za brodove u prolazu



6. The various types of amphorae from Risan / Različiti tipovi risanskih amfora (Photo: M. Jabučanin).

zahtijevalo veliko skretanje s rute, naročito u antičko doba. Međutim, geomaritimni uslovi Zaliva, manje uvale zaštićene od vjetrova i talasa u kojima se može sidriti, izvori pitke vode i dobra veza sa zaleđem, vrlo rano su učinili da ipak postane važno pomorsko sjedište u posljednjim vjekovima stare ere.

Nažalost, usljed erozije terena i infrastrukturnih intervencija, a naročito kontinuiranih krađa i devastacija, utvrđeno je da je stratigrafija ovog nalazišta gotovo uništena, pa su zbog toga hronološke odrednice bazirane uglavnom na uporednim tipološkim interpretacijama



The geo-maritime conditions of the bay, however, with its small coves protected from wind and waves and suitable for anchorage, with sources of potable water and good links to the hinterland, very early on made it an important maritime hub in the last centuries BCE.

Unfortunately, as a result of the erosion of the terrain and infrastructure interventions, and in particular the continual looting and devastation, the stratigraphy of this site has been almost entirely destroyed. As a result the chronological indicators are based largely on comparative typological interpretations of underwater archaeological material.

A preliminary analysis of the small finds collected in the course of the mapping puts them in a context analogous with the broader eastern Adriatic zone in the Greek, Roman and late Antiquity periods. There are, however, also forms and fabrics for which we cannot find confident analogies and for which local production is presumed.

In the course of the excavations and in line with UNESCO recommendations only indicative archaeological finds were extracted from the sea. All are in the process of desalination and stabilisation and have, as

8. Creating an underwater archaeological map / Mapiranje, podvodna arheološka karta (By: N. Borovinić)

podvodnog arheološkog materijala. Preliminarna analiza pokretnih nalaza koji su prikupljeni tokom mapiranja u kontekstu i analogijama su šireg istočnojadranskog pojasa iz perioda grčkog, rimskog i kasnoantičkog perioda. Doduše, javljaju se oblici i fature za koje nije moguće naći sigurne analogije pa se pretpostavlja njihova lokalna proizvodnja.

U toku istraživanja, u skladu sa UNESCO-ovim preporukama, vršeno je izronjavanje samo indikovanih arheoloških nalaza. Svi su samo okvirno datovani jer se nalaze u procesu desalinizacije i stabilizacije.

Istraživanje u Risanskom akvatoriju je dalo rezultate i u segmentu sondiranja manjeg obima u cilju identifikacije i potvrde brodoloma koji je sadržao teret grčko-italskih amfora, koje su uz Lamboglia 2, najzastupljeniji tip nalaza na ovom lokalitetu. Brodolom je otkriven prilikom šire pretrage na 18 m dubine, na terenu prilično ravne konfiguracije, gdje su u debelom sloju mulja konstatovana vidljiva ispupčenja korpusa i fragmentovanih amfora tipično starije grčko-italske faze IV – III v. p.n.e. kao i jedna nekompletna amfora prelazne forme koja izgledom i fakturom



**9a. Greco-Italic amphora, shipwreck, 3rd century BCE /
Grčko - italska amfora, brodolom III v. p.n.e.
(Photo: M. Jabučanin)**

such, only been approximately dated. The excavation in the Risan waters has also produced results in the segment of small-scale trenching aimed at identifying and confirming a shipwreck with a cargo of Greco-Italic amphorae – along with the Lamboglia 2 form the most represented type of find at this site. The shipwreck was discovered during a broader search at a depth of 18 metres on a terrain of relatively flat configuration. A protrusion was identified in a thick layer of silt along with fragmented amphorae of the typical older Greco-Italic phase of the fourth to third century BCE, and one incomplete amphora of a transitional form the appearance and fabric of which is most reminiscent of the Massalian amphorae of the fifth to third century BCE.

The underwater archaeological investigation also aimed to locate and observe sunken architectural elements and possible harbour installations.

The remains of a quay were identified in the cove between cape Rtac and Manastir Banja, most likely a small landing where ships could find shelter and stock up on water and food. Commerce could be conducted here and a trip continued into the interior by land.

The initial survey shows that this was a very small port with a very simple breakwater following the configuration of the shoreline. For now we can make out at the surface the perimeter stones with the rubble fill. Some of the stone was likely built into the current mole, which intersects the installation into two parts: the southern, which runs from the shoreline to a depth of 0.30 metres, and the northern part, which runs to a depth of 1.50 metres and terminates in the form of the Cyrillic P. Besides the cape as a natural obstacle and the existing structure, this and all other landings are also confirmed



9b. A late Antiquity Keay type LIII amphora, 5th to 7th century CE / Kasnoantička amfora tip Keay LIII, V-VII v. n.e.
(Photo: M. Jabučanin)

najviše podsjeća na masalijske amfore V - III v. p.n.e. Pored toga, podvodno arheološko istraživanje bilo je usmjereno na lociranje i opservaciju potopljenih arhitektonskih elemenata i eventualnih lučkih instalacija.

U uvali između rtova Rtac i Manastir Banja, ustanovljeni su ostaci operativne obale, najvjerovatnije manjeg pristana gdje su brodovi, mogli naći zaklon, obezbijediti vodu i namirnice. Oдавде se moglo trgovati i nastaviti put kopnom u unutrašnjost.

Prva prospekcija je pokazala da se radi o mandraču – jednostavnoj brani, koja prati konfiguraciju obale. Sa površine se za sad, nazire samo rubno kamenje sa rasutom zapunom. Jedan dio kamena je najvjerovatnije ugrađen u današnji mol koji kida instalaciju na dva dijela, južni, koji se pruža od same obale i dubine od 0,30 m i sjeverni do dubine 1,50 m koji ima završetak u obliku ćiliričnog slova P. Osim rta kao prirodnog ustava i postojeće konstrukcije, ovaj, kao i sve druge pristane, potvrđuje i raznovrstan material akumuliran na morskom dnu.

Sve dok se ne izvrše sistematska istraživanja, ne može se govoriti o vremenu trajanja ovog pristana, pri čemu treba uzeti u obzir i pad nivoa morskog dna za 1 mm godišnje (1m/1.000 god.) i tektonske deformacije koje su naročito izražene u ovom dijelu Bokotorskog zaliva.

Uprkos činjenici da je ovaj podvodni lokalitet, na pregledanim pozicijama koje su nekad sadržale široku paletu arheološkog materijala, ljudska ruka uništila ili otuđila, količina prikupljenih podataka, kao i rezultat istraživanja su više nego zadovoljavajući. Pronalaskom nekoliko različitih tipova amfora i njihovih djelova hronološki opredijeljenih od IV vijeka prije nove ere do VII vijeka nove ere, koji su u more dospjeli prilikom pretovara, uz ulomke keramike finije izrade, kuhinjskog posuđa, građevinskog materijala imbreksa i tegula, u mogućnosti smo da dobijemo sliku o šarolikom teretu koji je morskim putem putovao istočno-jadranskom obalom od Grčke, Italije i istočnog Mediterana, sjeverne Afrike i Crnog Mora.



9c. An extracted Lamboglia 2 amphora / Izronjena Lamboglia 2
(Photo: M. Jabučanin)

by the diverse material accumulated on the sea floor.

Until systematic excavation is undertaken we cannot draw confident conclusions on the period of use of this landing, which also must take into consideration an annual drop in the sea floor level of 1 millimetre (1 metre per 1,000 years) and the tectonic deformations that are particularly pronounced in this part of the Bay of Kotor.

In spite of the fact that this underwater site, at the examined locations that once held a broad range of archaeological material, has been destroyed or looted by humans, the quantity of collected data and the results of the investigation are more than satisfactory. The find of sherds of several types of amphorae covering the period from the fourth century BCE to the seventh century CE that were lost in the waters in the course of loading and unloading, along with sherds of pottery of finer fabrication, cooking ware and construction materials (imbrices and tegulae), provide us with a picture of the diverse cargoes that were transported along the eastern Adriatic shores from Greece, Italy, the eastern Mediterranean, North Africa and the Black Sea.

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10. From left to right: Nikola Borovinić, Dejan Drašković, Maja Kaleb, Mladen Pešić, Dragutin Radimir, Marija Jabučanin / S lijeva na desno Nikola Borovinić, Dejan Drašković, Maja Kaleb, Mladen Pešić, Dragutin Radimir, Marija Jabučanin





1. A photogrammetric image of the site /
Fotogrametrijski prikaz lokaliteta (By: J. A. Moya)

THE BOU FERRER SHIPWRECK

BRODOLOM BOU FERRER

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2. Vila museu, reconstruction of a navis oneraria /
Vila museu, rekonstrukcija navis oneraria

1. Stern / Krma, 2. Covered part of the ship (cabin for important passengers) Natkriveni dio broda, „kabina za važne putnike“, 3. Auxiliary boat / Pomoćni čamac, 4. Mast / Jarbol, 5. Hatch leading below deck to the cargo area / Otvor potpalube, dijela koji je sadržao teret, 6. Small sail at the bow (artemon) / Malo jedro na pramcu (artimon), 7. Bow, although the bow of the Bou Ferrer wreck is considered to have been of a different, sickle shape / Pramac, iako se smatra da je onaj na Bou Ferreru bio nešto drugačiji, srpastog oblika, 8. The “ribs” of the ship / „Rebra” broda,, 9. Keel / Kobilica, 10. Two lateral rudders (there is no evidence of a central rudder until the 13th century) / 2 bočna kormila (centralno kormilo bilježi se tek u XIII vijeku).

Ovogodišnja arheološka kampanja, podvodno istraživanje brodoloma Bou-Ferrer, trajala je od 15. jula do 20. septembra. Zahvaljujući potpisivanju sporazuma o saradnji između Opšte uprave za kulturnu baštinu Generalitata Valensije (Dirección General de Patrimonio Cultural Valenciano y Museos, a Conselleria de Cultura, Educación y Deporte) i Centra za podvodnu arheologiju Katalonije, u ovoj arheološkoj kampanji učestvovali su vodeći podvodni arheolozi iz zemlje i njihovi brojni saradnici iz inostranstva. Rukovodioci istraživanja bili su Carlos de Juan Fuertes i Franca Cibecchini. Brod Thetis, vlasništvo Centra za podvodnu arheologiju Katalonije, služio je tokom čitava dva mjeseca kao logistički centar, smještaj za arheologe i najbitnije, pružao tehničku podršku tokom iskopavanja.

Bou Ferrer, rimski brodolom koji se datuje u I vijek n.e. , pronađen na dubini od oko 25 metara, nalazi se gotovo 1000 metara od obale, u neposrednoj blizini gradića Villajoyosa (opština Alicante). Brod je najvjerovatnije plovio od južne Španije ka Italiji, kad tone, kako se pretpostavlja, uslijed neočekivanog nevremena koje ga je pogodilo na pučini. Smatra se da je njegovo skretanje sa rute ka obali bio neuspjeli pokušaj pronalaženja utočišta. Sistematska podvodna istraživanja odgovorila su na mnoga pitanja vezana za porijeklo tereta i njegov



3. Vila museu: storage of the amphorae post-conservation / Vila museu: deponovanje amfora po završenoj konzervaciji (Photo: J. Čelebić)

This year's archaeological campaign in the underwater excavation of the Bou Ferrer shipwreck ran from the 15th of July to the 20th of September. Thanks to a signed cooperation agreement between the general directorate for cultural heritage and museums of the Valencian department for culture, education and sports (Dirección General de Patrimonio Cultural Valenciano y Museos, a Conselleria de Cultura, Educación y Deporte) and the Center for Underwater Archaeology of Catalonia, this archaeological campaign saw the participation of leading underwater archaeologists from the country and their many associates from abroad. Serving as excavation managers were Carlos de Juan Fuertes and Franca Cibecchini. For the duration of the two-month campaign the Center for Underwater Archaeology of Catalonia's ship Thetis served as the logistics hub, providing accommodation for the archaeologists and, most importantly, providing technical support during the dig.

The Bou Ferrer wreck was a Roman vessel, dated to the first century CE, found at a depth of about 25 metres and about 1,000 metres off shore, near the small town of Villajoyosa (Alicante municipality). The ship was likely sailing from southern Spain to Italy when it sunk, probably having been hit by an unexpected squall in open waters. It is hypothesised that it veered off its route and headed towards shore in an unsuccessful attempt to find a safe haven. Systematic underwater excavation has provided answers to many of the questions pertaining to the origin and content of its cargo. This wreck is, however, in the focus of research efforts primarily on account of the high level of preservation of its wooden structure, opening

sadržaj. Međutim ovaj brodolom je u fokusu nauke prije svega zbog očuvanosti drvene građe na osnovu koje se može proučavati tipologija broda s početka carskog perioda. Brodolom su otkrili španski ronionci Bou i Ferrer 1999. godine, dok je javnost o tome obaviještena 2001. g. Nažalost, u tom periodu počinjene su mnogobrojne krađe. Prva sistematska arheološka kampanja organizovana je 2006. g., istraživanja su nastavljena 2007, pa zatim nakon četvorogodišnje pauze od 2012. do 2017. g.

Bou Ferrer je jedini rimski trgovački brod (*navis oneraria*) ovih dimenzija na Mediteranu, koji se nalazi na dubini od 26-27 m, što ga čini pristupačnim podvodnim arheolozima. Budući da je na mjestu potonuća morsko dno muljevito, jedan dio drvene brodske građe je ostao sačuvan.

Brod Bou Ferrer vjerojatno spada u grupu velikih trgovačkih jedrenjaka koje pominje Strabon (Str. III, 2, 6) kada govori da su najveći brodovi koji su stizali u rimske luke bili oni iz Betike (današnja Andaluzija).

Nakon sistematskih arheoloških istraživanja, sakupljeno je dovoljno podataka da bi se mogle pretpostaviti dimenzije broda. Radi se o većem jedrenjaku dužine 30-ak (prvobitno procijenjeno 27, sad 33 m) i širine najviše 9 metara. U zavisnosti u koliko su nivoa bile naslagane amfore, 3 ili 4, pretpostavlja se da je nosivost broda bila



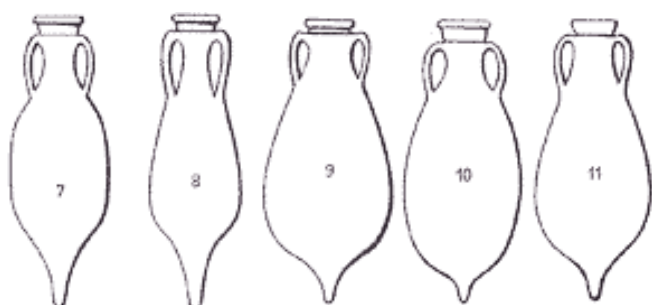
4. Vila museu: a reconstruction of the alignment of the amphorae / Vila museu, rekonstrukcija položaja amfora

a window to a study of early Imperial ship typology. Although the wreck was found in 1999 by Spanish divers Bou and Ferrer the public only learned of the discovery in 2001. The intervening period, unfortunately, saw numerous instances of looting. The first systematic archaeological campaign was organised in 2006, with excavation continued in 2007, followed by a four-year hiatus and then a new round from 2012 to 2017.

The Bou Ferrer wreck is the only Roman merchant freight vessel (*navis oneraria*) of this size in the Mediterranean lying at a depth (26 to 27 metres) that makes it accessible to underwater archaeologists. The silty nature of the sea floor at the site of the wreck has preserved a part of the vessel's wooden structure.

The Bou Ferrer wreck is likely from the group of large merchant sailing vessels mentioned by Strabo (III, 2, 6) when he writes that the largest ships that docked in Roman ports were those from Baetica (present day Andalusia).

Following the systematic archaeological excavations sufficient data was collected to form a hypothesis on the dimensions of the ship. It was a large sailing vessel with a length of about 30 metres (the initial estimate of 27 now stands at 33 metres) and a width of at most nine metres. Depending on whether the amphorae were stacked in three or four levels the research points to the ship's cargo tonnage as being from 170 to 230 tonnes. Given the number of amphorae discovered and the estimated amount still covered by silt it is believed that the amphorae were in fact stowed in four rows and that the ship carried about 230 tonnes. The amphorae number from 2,500 to 3,000 units and are of the Dressel 7-11 type, likely manufactured in Cadiz. The samples that were analysed indicate that the amphorae contained garum, a fish sauce, or any one of the numerous other variants of fish-based condiments esteemed in Roman cuisine, and that it contained anchovies, mackerel and carp.



5. Dressel 7-11 amphora typology / Tipologija amfora Dressel 7-11 (By: H. Dressel)

The four-year hiatus from 2008 to 2011 was used to conduct an analysis and processing of the collected data, to inform the specialist community and to establish new cooperation ventures. Also involved in the study of the



6. A visual analysis of the lead ingots / Vizuelna analiza olovne poluge (Photo: J. A. Moya)

između 170 i 230 tona. Imajući u vidu brojnost amfora, otkrivenih i onih koje se još uvijek nalaze pod muljem, procjenjuje se da se ipak radi o 4 reda, te da je nosivost ovog broda bila oko 230 tona. Radi se o oko 2500- 3000 amfora tipologije Dressel 7-11, za koje se smatra da su proizvedene u Kadizu. Uzorci na kojima je izvršena analiza pokazuju da se u amforama nalazio riblji sos, garum, ili neka od brojnih varijanti ribljih soseva cijenjenih u rimskoj gastronomiji, te da je sadržao incune, skuše i šarane.

Četvorogodišnja pauza od 2008. do 2011. g. služila je kako za analizu i obradu sakupljenih podataka, tako za informisanje naučne javnosti i sklapanje novih saradnji. Proučavanjem amfora bavila se Franca Cibecchini. Homogenost tereta, tj. amfore Dressel 7-11, ukazuje na pretpostavku da je teret utovaren u jednoj luci, te da se ne radi o kabotažnoj plovidbi, koja je imala za cilj raspodjelu dobara po manjim lukama. Iako rasprostranjene, amfore tipa Dressel 7-11 predstavljaju veoma veliku grupu te su ovom prilikom podjeljene u četiri podtipa nazvana BF1, BF2, BF3 i BF4 (tip BF1 ima zapreminu od oko 43 litra, visinu oko 100 cm, dok težina same ambalaže iznosi oko 24,5 kg; tip BF2 je neznatno manjih dimenzija, samim tim i zapremine, dok je njegova forma oblija od forme prethodnog tipa; tip BF3 je sličnih karakteristika kao BF2 tip, mada nešto lijevkastije forme, dok BF4 predstavlja ovalniji tip, koji skoro u potpunosti odgovara tipu Dressel 9). Prva dva tipa mogu naći paralelu sa

amphorae was Franca Cibecchini. The homogeneity of the cargo, i.e. of Dressel 7-11 amphorae, leads us to hypothesise that the cargo was loaded at a single port, and that this was not cabotage navigation that aimed to distribute the goods at smaller ports. Although widespread, the Dressel 7-11 type is a very large group, and in this case has been subdivided into four subtypes, referred to as BF1, BF2, BF3 and BF4 (the BF1 subtype has a volume of about 43 litres and a height of about 100 centimetres with the empty amphora having a weight of about 24.5 kg; subtype BF2 has slightly smaller dimensions and smaller volume, with a form more rounded than that of the previous subtype; subtype BF3 has characteristics similar to those of BF2, although somewhat more funnel-shaped, while BF4 is a more oval subtype, almost entirely consistent with the Dressel 9 type). We find parallels for the first two subtypes among the amphorae at the Sud-Lavezzi 2 and Tour Sainte Marie 1 shipwrecks, both dated to the first half of the first century CE. We find the best parallels for subtype BF3, a morphological anticipation of the Beltrán IIB type, among the amphorae from Villanueva at Puerto Real, one of the major manufacturing centres in Cadiz, active between the mid-first and early second century CE.

7. Decompression stop / Deko stop (Photo: J. A. Moya)



Along with the dominant cargo of amphorae, subsequent archaeological campaigns saw the recovery of lead ingots. An analysis of the marks, i.e. stamps on the

amforama brodoloma Sud-Lavezzi 2 i Tour Sainte Marie 1 i oba se datiraju u prvu polovinu I vijeka n. e. Tip BF3, koji morfološki anticipira tip Beltrán IIB, pronalazi najbolje paralele sa amforama iz Villanueve iz Porta Real, jednog od većih proizvođačkih centara iz Kadiza, aktivnog između polovine I i početka II vijeka n. e.

U narednim arheološkim kampanjama, pored dominantnog tereta – amfora, pronađene su i olovne poluge. Analize natpisa, tj. žigova na polugama, u koje su bili uključeni međunarodni stručnjaci, dale su nemjerljive rezultate. Serija žigova (Imp GER, AVG) donosi pretpostavku da je njihov vlasnik bio rimski car, tj. da je brod bio u vlasništvu carstva. Iz navedenih natpisa zaključuje se i da su carevi koji su imali navedene titule bili Kaligula, Klaudio i Neron. U ovogodišnjoj kampanji nađena su dva novčića iz perioda Neronove vladavine što ukazuje na post quem u datovanju ovog brodoloma, tj. 64-68. godina n. e. Osim novca, još jedan nalaz koji potvrđuje dataciju broda jeste žig na olovnoj poluzi NER. CA (Neronis Curator Aquarum). Ovaj žig bi se mogao odnositi na senatora delegiranog od strane samog cara za sistem vodosnabdjevanja u Rimu, koji je bio odgovoran za održavanje akvadukta i sistema kanalizacije grada. Moguće je i da je taj senator bio zadužen i za provjeru i kupovinu olova, porijeklom sa planinskog vijenca Siera Morena, koje je skladišteno u luci u Kadizu, i moglo je da služi za izradu cijevi za dovod vode.

Istraživanje je prvih godina rađeno na središnjem dijelu lokaliteta. Prvobitno je otvorena sonda 3x3 m, da bi se u toku kasnijih kampanja prostor istraživanja širio, te danas iznosi nekoliko desetina kvadratnih metara. Iako se radi o većem prostoru, do kraja ovogodišnje kampanje, još uvijek se nije došlo do sterilnog sloja. Na prednjem dijelu broda, pod teretom amfora je ostao očuvan veliki dio drvene brodske građe. Imajući u vidu dubinu na kojoj se brodolom nalazi, metod dokumentovanja, izrada fotogrametrije, olakšava proces samog istraživanja, budući da bi u suprotnom tradicionalni način dokumentovanja u mnogom usporio proces rada. Jose A. Moya, profesor informacionih nauka sa Univerziteta iz Alikantea, od otkrića brodoloma uključen u ovaj projekat, zadužen je za grafičku obradu podataka, izradu fotogrametrije, tj. realizaciju 3D prikaza ovog arheološkog lokaliteta.

Bou Ferrer svojim dimenzijama odgovara velikim trgovačkim bordovima, globularnog poprečnog presjeka, specifične krme, uzdignute od dna broda, što je davalo ravnotežu centralnom dijelu, budući da je pravougaono jedro težilo da ga disbalansira.

O velikim trgovačkim brodovima s početka carstva i dalje se malo zna, stoga je očuvanost drvene građe Bou Ferrera od izuzetnog značaja za nauku. Za period republike materijalne podatke o brodogradnji daju brodolomi La Madrague de Giens, Dramont A i Titan. Za II vijek n. e. to čine Saint Gervais 3 i La Bourse, dok je brodogradnja u I vijeku n. e. ostajala nepoznanica. Bou Ferrer se



**8. Conducting protective measures upon completion of excavations /
Sprovođenje mjera zaštite po završetku iskopavanja (Photo: J. A. Moya)**

ingots that saw the participation of international experts produced invaluable results. The series of stamps (Imp GER, AVG) leads to the hypothesis that they were the property of the Roman emperor, i.e. that the vessel was an imperial ship. The emperors that held the titles in the inscriptions were Caligula, Claudius and Nero. Two coins from the period of Nero's reign were recovered in the course of this year's campaign, indicating a terminus post quem in the dating of these wrecks of 64 to 68 CE. Along with the coins another find supporting this dating is that of a NER.CA (Neronis Curator Aquarum) stamp on a lead ingot. This mark may refer to a senator delegated by the emperor to see to the water supply system in Rome and responsible for the upkeep of the aqueducts and the canalisation system in the city. The same senator may have been responsible for assaying and purchasing lead that came from the Sierra Morena and was warehoused in the port at Cadiz. This lead may have been used to make water supply piping.

During the first years the excavations were conducted at the central part of the site. The first trench to be opened was three by three metres, expanded in later campaigns and now covering tens of square metres. Although this is a large area, the close of this year's campaign has still not reached a sterile layer. Much of the ship's wooden structure at the front of the vessel is preserved under the cargo of amphorae.

Bearing in mind the depth at which the wreck lies, the method of documentation based on photogrammetry greatly facilitates the excavation process – the traditional method of documentation would significantly slow the

po sličnosti tereta može porediti sa brodolomima Sud-Perduto 2, Sud-Lavezzi 2 i Lavezzi 1, takođe datovanim u rani period carstva. Poznato je da su glavna obilježja konstrukcije broda Bou Ferrer zajednička za brodove iz helenističkog perioda. Kod ovih brodova prvobino je izrađivan trup (shell first), sa gredama sastavljenim na vrhu pomoću tehnike utora i jezička (mortise and tenon) blokiranih drvenim klinovima, gdje se okvir koji služi kao pojačanje strukture, obično postavlja nakon sastavljanja. Proučavanjem brodogradnje, tj. tehnika izrade pojedinih djelova, može se katkad naslutiti geografska tradicija kojoj pripada. Pronalaženje kokpita Bou Ferrera (konstrukcije iz koje se upravlja brodom) i dijela trupa broda, koji su po tehnici gradnje slični brodovima pronađenim u napuljskoj luci, otvara prostor za pretpostavku da je i ovaj brod izgrađen na tom području.

Jedna zona broda je i dalje prekrivena amforama složenim u prilično uredne redove, dok su na drugom dijelu haotično raspoređene, što dovodi do zaključka da je jedan dio broda prilikom tonjenja, ostao uzdignut, najvjerojatnije krma. Pramac je pod teretom jarbola i jedara potonuo vodoravno, što je omogućilo očuvanje drvene građe broda ispod nasloženih amfora. Dobra očuvanost drveta i pronalazak jednog komada konopa, navodi na pretpostavku da bi se mogli pronaći i drugi manji predmeti kojima se služila posada.

Budući da se već govorilo o promijeni u brodogradnji, treba pojasniti i zašto dolazi do tih promijena u periodu ranog carstva. Rimski trgovina u posljednja dva vijeka stare ere bazira se uglavnom na izvozu viška proizvoda u provincije, međutim, od Avgusta dolazi do promijena

work process. Jose A. Moya, a professor of information science at the University of Alicante, has been involved in this project since the discovery of the wreck and is responsible for the photogrammetry data processing, i.e. the creation of 3D imagery of this archaeological site.

By its dimensions the Bou Ferrer wreck is consistent with large merchant ships, with a globular cross-section, a specific stern elevated from the base of the ship, which provided balance to the central part of the vessel given that the square sail had a tendency to throw it out of balance.

Little is known of the large merchant ships of the early Empire, making the preserved state of the wooden structure of the Bou Ferrer wreck of great importance to science. Material data on shipbuilding of Republic period vessels are provided by the La Madrague de Giens, Dramont A and Titan wrecks. For the second century CE we look to the Saint Gervais 3 and La Bourse wrecks, while shipbuilding in the first century remains unknown to us. By the similarity of its cargo the Bou Ferrer wreck is comparable with the Sud-Perduto 2, Sud-Lavezzi 2 and Lavezzi 1 wrecks, also dated to the early Imperial period. We do know that the chief characteristics of the structure of the Bou Ferrer ship were common to all ships in the Hellenistic period. These ships were built shell-first, with the planks joined using the mortise-and-tenon joint technique pegged together using treenails, while the frame served to reinforce the structure and was usually installed once the hull was complete. The study of shipbuilding, i.e. the techniques applied in the building of individual ships, can sometimes point to the geographic tradition they emerged from. The find of the cockpit (the structure from where the ship was steered) at the Bou Ferrer wreck and a part of the ship's hull, where the construction technique is similar to those found in the harbour of Naples, may indicate that this ship was built in that area.

One zone of the wreck remains covered in amphorae stacked in quite orderly rows, while in another area the distribution is quite chaotic, leading to the conclusion that one part of the vessel was upright while it sank, most likely the stern. Under the weight of the mast and sails the bow sank horizontally which preserved the wooden structure beneath the stacked amphorae. The good preservation of the wood and the find of a section of rope lead us to hope that other small artefacts used by the crew may be found in the future.

Having noted that there were changes in shipbuilding we should explain why these changes occurred in the early empire. Roman commerce in the last two centuries BCE was based largely on the export of surplus production to the provinces. From the time of Augustus, however, there were changes to the routes that arose from the growing needs of Rome. The Italian peninsula was no longer only an exporter – it had now transitioned to an importer of

ruta uslovljenih sve većim potrebama Rima. Italsko poluostrvo prestaje da bude samo izvoznik, već sve više biva uvoznik različite robe. Veliki trgovački brodovi tada počinju da se prilagođavaju krajoliku rimske Hispanije, koji čine lagune, estuari i ušća rijeka, poput Gvadalkivir. Ispupčena i uska dna brodova republičkog perioda nisu bila adekvatna za pješčane sprudove rijeka (kako navodi Patrice Pomey), te tako počinju da se razvijaju brodovi plićeg dna. Ta, iako spora tranzicija, počinje u posljednjoj četvrtini I vijeka stare ere i traje do II vijeka nove ere, kad se konačno može govoriti o novoj kategoriji brodova, ne više helenističke već carske tradicije. Otkriće Bou Ferrera i njegova očuvanost, upotpunjuju ovaj mozaik, tj. pružaju informacije o brodogradnji I vijeka n. e. sa kojima se dosada nije raspolagalo.

Preuzete su sveobuhvatne mjere kako bi se osigurala pravna i praktična zaštita lokaliteta. Civilna garda, (lokalna policija) je zadužena za održavanje sigurnosnih mjera, nadzora i obilaženje lokaliteta najmanje jednom mjesečno, dok je po završetku istraživanja lokalitet zaštićen metalnim mrežama. Od 2013. g. projekat Bou Ferrer, pod pokroviteljstvom Vilamuseu (lokalnog muzeja Villajoyose) sprovodi program širenja svijesti o podvodnoj kulturnoj baštini, koja uključuje posjetu lokaliteta, pozivajući rekreativne ronioce na obilazak brodoloma pod nadzorom podvodnih arheologa. Da se radi o jedinstvenoj prilici, govori i činjenica da je Bou Ferrer jedini antički brodolom u Španiji otvoren za posjetioce.

Sa stanovišta naučnog interesa ovaj brodolom ima neprocjenjivu vrijednost, budući da se radi o jedinom brodolomu ovakve očuvanosti i dimenzija na zapadnom Mediteranu.

Imajući u vidu sve dosada rečeno, može se pretpostaviti ruta broda. Bou Ferrer, jedrenjak grandioznih dimenzija, najvjerovatnije isplovjava iz Kadiza dok je njegova odredišna luka Rim (Ostia). Mjesto brodoloma otvara mnoga pitanja, budući da se ne nalazi na plovnoj ruti između pomenuta dva antička urbana centra. Isto tako, mala je vjerovatnoća da se radi o kabotažnoj plovidbi ili



9. A working meeting on board the ship Thetis / Radni sastanak na brodu Thetis (Photo: J. A. Moya)

diverse goods. The large merchant ships were then adapted to the landscape of Roman Hispania, composed of lagoons, estuaries and river deltas like that at Guadalquivir. The protruding and narrow bottoms of ships of the Republic were unsuited to river sandbanks (as noted by Patrice Pomey), which led to the development of ships with shallower bottoms. This slow transition began in the last quarter of the first century BCE and ran through to the second century CE, when we can finally speak of a new category of ships, no longer Hellenistic, but now of the Imperial tradition. The discovery of the Bou Ferrer wreck and its level of preservation supplement this mosaic, i.e. provide information on shipbuilding of the first century CE we did not previously possess.

Comprehensive measures have been put in place to provide for the legal and practical protection of the site. The Guardia Civil (local police) is responsible for maintaining security measures, surveillance and visiting the site at least once a month, while the site itself is protected by metal netting when a round of excavations have been completed. Since 2013 the Bou Ferrer project, sponsored by the Vila Museu (the local museum in Villajoyosa), has conducted a programme of raising awareness of underwater cultural heritage that includes visits to the site, inviting recreational divers to tour the wreck under the supervision of underwater archaeologists. That this is a unique case is evident from the fact that the Bou Ferrer wreck is the only antique shipwreck in Spain open to visitors.

From the aspect of its interest to science this shipwreck is of inestimable value as the only wreck with this level of preservation and this size in the western Mediterranean.

Bearing in mind what has been noted above we can hypothesise the route on which the ship sailed. The Bou Ferrer wreck was a sailing vessel of grand proportions and most likely set sail out of Cadiz destined for the Roman port of Ostia. The site of the wreck raises many questions given that it is not on the navigation route between the two mentioned Antiquity period urban hubs. It is also very unlikely that the ship was on a cabotage route, redistributing the goods in peripheral ports of call, if we take into consideration that ships of this size required harbours of adequate capacity or unloading assisted by smaller vessels.

It should be noted that the wreck was declared cultural property in 2014 and inscribed by UNESCO in 2017 into its register of best practices in underwater archaeology.

10. The ship *Thetis*, Center for Underwater Archaeology of Catalonia / Brod *Thetis*, Centar za podvodnu arheologiju iz Katalonije
(Photo: J. A. Moya)



redistribuciji dobara u periferne luke, budući da brodovi ovih dimenzija zahtjevaju luke adekvatnih kapaciteta (ili istovar uz pomoć manjih lađa).

Treba naglasiti da je 2014. g. ovaj brodolom proglašen kulturnim dobrom, dok ga 2017. g. UNESCO uvrštava u svoj registar dobrih praksi u podvodnoj arheologiji.

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VASCO DA GAMA SHIPWRECK DISCOVERED

اكتشاف حطام من سفن فاسكو دي جاما

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Portuguese ship wrecked on a remote island in the sultanate of Oman in 1503 is the earliest ship of discovery to be found and scientifically investigated by archaeologists.

15 March 2016

Muscat - Oman's Ministry of Heritage & Culture (MHC) in cooperation with Blue Water Recoveries Ltd (BWR) of West Sussex, UK announce the discovery and archaeological excavation of a Portuguese East Indiaman that was part of Vasco da Gama's 1502-1503 Armada to India. The ship, which sank in a storm in May 1503 off the coast of Al Hallaniyah island in Oman's Dhofar region, is the earliest ship from Europe's Age of Discovery ever to be found and scientifically investigated by a team of archaeologists and other experts.

Details of the wreck site, published in the International Journal of Nautical Archaeology reveal that the ship is believed to be the nau Esmeralda commanded by Vicente Sodré, who was the maternal uncle of Vasco da Gama and a descendent of the nobleman Frederick Sudley of Gloucestershire, UK. A website with high-resolution images and video of the excavation was also launched : (<http://esmeraldashipwreck.com>).



2. Loss of Esmeralda as per Livro das Armadas

غرقت سفينة برتغالية في جزيرة الحلايات بسلطنة عمان في عام 1503 وهي تعتبر من أوائل "سفن الاستكشاف" التي أمكن العثور عليها ودراستها علمياً بواسطة علماء الآثار م 15 مارس 2016

مسقط - أعلنت وزارة التراث والثقافة بالتعاون مع مؤسسة بلووتر ريكفورييز البريطانية تفاصيل مشروع الكشف عن حطام سفن الهند الشرقية البرتغالية والتي كانت جزء من الأسطول الحربي لفاسكو دي جاما (1502-1503) المتجه إلى الهند. تعتبر هذه السفينة والتي غرقت في مايو 1503

The wreck site was initially discovered by a BWR team in 1998, on the 500th anniversary of Vasco da Gama's epic discovery of the direct sea route to India, but full-scale archaeological survey and excavation by the MHC didn't begin until 2013. Since then two more excavations have been conducted in 2014 and 2015, with more than



3. Divers excavate the wreck site (Photo: P. Holt)

2,800 artefacts being recovered. The project has been jointly managed by the MHC and Blue Water Recoveries Ltd BWR and has been conducted in strict compliance with the UNESCO Convention for the Protection of Underwater Cultural Heritage of 2001.

Two Portuguese naus from Vasco da Gama's second voyage to India, left behind to disrupt maritime trade between India and the Red Sea, were wrecked in May 1503 off the north-eastern coast of Al Hallaniyah Island, Oman. The ships, Esmeralda and São Pedro, had been commanded by da Gama's maternal uncles, Vicente and Brás Sodré, respectively. A detailed study and scientific analysis of an artefact assemblage recovered during archaeological excavations conducted in Al Hallaniyah in 2013 and 2014 confirms the location of an early 16th-century Portuguese wreck-site, initially discovered in 1998. Esmeralda is proposed as the probable source of the remaining, un-salved wreckage.



5. 12 Portuguese cruzados, from the reign (1495–1521) of Dom Manuel I (Photo: P. Koch)

The remains of the Portuguese shipwreck (site code AH1) was located in the shallow waters of Ghubbat ar Rahib

بالقرب من ساحل جزيرة الجلانيات من اوائل سفن عصر الاستكشاف الأوروبي والتي يتم العثور عليها وإجراء الدراسات العلمية عليها بواسطة علماء الآثار والمختصين. تفاصيل موقع الحطام والتي تم نشرها اليوم في المجلة الدولية لعلم الآثار البحرية تكشف عن أن حطام السفينة المكتشفة تعود للسفينة إزميرالدا والتي كانت تحت إمرة القبطان فيسنتي سودري خال فاسكو دي جاما وسليل النبيل فيريدريك سادلي من جلوسيسترشاير. كما تم اليوم مرئية أكثر أيضاً تدهشين موقع خاص على شبكة المعلومات لهذا الإكتشاف والذي يحتوي على تفاصيل وصور ومقاطع (www.esmeraldashipwreck.com).

إتم كتشاف موقع الحطام بداية بواسطة فريق من مؤسسة بلو ووتر ريكفورييز البريطانية عام 1998م وذلك في الذكرى الخمسمائة لرحلة فاسكو دي جاما الملحمية لإكتشاف الطريق البحري المباشر إلى الهند. ويعتبر العام 2013م هو الإنطلاقة الحقيقية لأعمال المسح والتنقيب الأثرية بشكل كامل وبإشراف من وزارة التراث والثقافة. بعدها تم القيام



4. The first golden coin discovered from the site by Ahmed Al Siyabi (Photo: M. Al Shaaily)

بعمليتي تنقيب إضافيتين في اعوام 2014م و2015م حيث تم إكتشاف ما يقارب من 2800 قطعة أثرية. ويجدر بالذكر أن الوزارة قامت بإدارة وتنفيذ المشروع بالتعاون مع مدير المشروع الفاضل ديفيد ميرنز من مؤسسة بلووتر ريكفورييز وبالإلتزام التام بالقواعد الدولية المتبعة لحماية الآثار المغمورة بالمياه كما ورد في إتفاقية اليونسكو (2001) . والخاصة بحماية التراث الثقافي المغمور بالمياه

في مايو 1503م تحطمت سفينتان من سفن الناموس البرتغالية من أسطول فاسكو دي جاما من رحلته الثانية لهند على الساحل الشمالي الشرقي لجزيرة الجلانيات في سلطنة عمان ، واللذان تركتا لتعطيل التجارة البحرية في المنطقة بين الهند والبحر الأحمر. السفينتان إزميرالدا وساو بيدرو كانتا تحت قيادة كلاً من فيسنتي و براس سودري على التوالي أحوال فاسكو دي جاما. تأتي هذه الدراسة المفصلة والتحليل العلمية للقطع الأثرية التي تم إكتشافها

bay within a series of narrow interconnected gullies, which intersect reef rock that slopes seaward from the foreshore.



6. Índio ("The Indian") as it was minted over such short period. After its creation by Dom Manuel in 1499 specifically for trade with India, the Índio was discontinued and replaced by the heavier tostão no later than 1504. (Photo: P. Koch)



8. Bronze Ship Bell (Photo: University of Warwick)

Four gullies have been designated: a major gully (Z), which initially runs perpendicular to shore and then parallel with it; a sub gully (X), which separates and re-joins Z; gully W, which leads up onto shore and experiences considerable wave surge particularly at low tide; and gully (V), which is a spur off the intersection between gullies Z and W. The fill of the gullies is largely sand, boulders, rock scree and

broken coral, with an underlying granite bedrock approximately one metre below the current seabed. In gully W the fill consists largely of boulders with relatively little sand. The maximum length of gullies over which finds have been recovered is 115 metres, with the width of gullies ranging from 5 to 18 metres and water depths from two to six metres. Despite the repeated searching of adjacent gullies with metal detectors and test trenches, no artefacts were found outside the confines of the site described above.



9. Stone Ring (Photo: P. Koch)

As artefacts were found in the set of interconnected gullies described above, and nowhere else, this indicates that the site is the exact location where at least one of the

من خلال الحفريات الأثرية التي أجريت في جزيرة الجلانيات بين عامي 2013 و 2014 لتؤكد أن الموقع يعتبر من أوائل مواقع حطام السفن البرتغالية للفترة من أوائل القرن السادس عشر والذي قد تم إكتشافه بدايةً عام 1998. تفضي الدراسة إلى أن بقايا الحطام المكتشفة قد تعود في المقام الأول إلى السفينة إزمارالدا

تم تحديد موقع بقايا حطام السفن البرتغالية (رم AH1) الموقعي المياة الضحلة لخليج غبة الراهب ضمن سلسلة من الأخاديد الضيقة المتداخلة والتي تتقاطع مع الصخور المرجانية التي تنحدر في اتجاه البحر من الشاطئ. تم تحديد أربعة أخاديد بطول كلي بلغ 115 متر وعرض يتراوح بين 5 إلى 18 متر وبأعماق تتراوح من 2 إلى 6 متر. تحتوي هذه



7. Stone Beads (Photo: P. Koch)

الأخاديد إلى حد كبير على الرمال والصخور وركام من الصخور وكسر من المرجان وتحت كل هذا حجر الجرانيت على ما يقرب من متر واحد تحت قاع البحر الحالي. وعلى الرغم من البحث المتكرر في الأخاديد المجاورة بواسطة أجهزة الكشف عن المعادن ، لم يتم العثور على أي قطع أثرية خارج حدود الموقع المذكور أعلاه. وبما أنه تم العثور على القطع الأثرية في مجموعة الأخاديد المترابطة المذكورة أعلاه، وليس في أي مكان آخر، فهذا يدل على أن الموقع هو المكان الصحيح حيث توجد على الأقل واحدة من سفن النوا البرتغالية التي دفعت باتجاه الشاطئ وتحطمت في هذا الموقع. إن النمط الطبيعي لحركة الأمواج في الخليج هو تكون وإرتفاع موج البحر في البحر ومن ثم تحطم وتكسر هذه الأمواج عند الشاطئ. ومن خلال الملاحظات والإكتشافات فإن السيناريو المحتمل لحادثة تحطم السفينتين هو أنه بعد إنقطاع مراسي السفينتين فقد دفعت السفينتين باتجاه الشاطئ مع إحتماالية تموضع إحدى السفينتين في فم أحد الأخاديد بالموقع نظراً لإرتفاع الموج وإنكساره على الشاطئ وتعرض بدن السفينة للتحطم على صخور هذه الأخاديد على عمق مترا إلى مترين قبل إندفاعها إلى الشاطئ وعند

Portuguese naus was driven ashore and wrecked. The natural pattern in the bay is for swell to build just seaward of the site and for waves to break directly over the gullies. Considering all our findings and observations, the likely wrecking scenario is that after their moorings parted the ships were driven against the lee shore, with at least one being funnelled into the mouth of the gullies by the natural pattern of swell and breaking waves. As this ship was driven into the gullies its bottoms would have most probably hit the reef between gully X and gully Z at only 2.1–1.0 m depth, causing fatal damage to the hull before it was driven further ashore. Once stranded in this position the ship would have been at the mercy of the sea and ultimately broken apart with little hope for the men aboard.

10. Granite cannonball with VS latter's (the first latter's of the Vicente Sodré) (Photo: P. Koch)



To date, in excess of 2,800 individual artefacts have been recovered from the wreck site. This collection will be the subject of detailed archaeological study and assessment by a broad group of archaeologists and other experts for years to come. Although the focus of our initial scientific analysis was to determine the age, provenance and identity of the shipwreck, the next phase of the project will be to learn as much as possible about how the Portuguese conducted maritime trade and warfare in the



11. Different size of cannonballs (Photo: A. Al-Siyabi)

Indian Ocean during this historically important period. Key individual artefacts that helped in identification of the wreck site as Vicente Sodré's nau Esmeralda include:

- an important copper-alloy disc marked with the Portuguese royal coat of arms and an esfera armilar (armillary sphere), which was the personal emblem of King Dom Manuel I.
- a bronze bell with an inscription that suggests the date of the ship was 1498.
- gold cruzado coins minted in Lisbon between 1495 and 1501.
- an extraordinarily rare silver coin, called the Indio, that was commissioned by Dom Manuel in 1499 specifically for trade with India.

The extreme rarity of the Indio (there is only one other known example in the world) is such that it has legendary status as the 'lost' or 'ghost' coin of Dom Manuel.

إستقرارها كانت تحت رحمة أمواج البحر والتي فالنهاية تحطمت إلى أجزاء مع أمل ضئيل للرجال على متن السفينة بالنجاة. تم العثور إلى الآن على 2800 قطعة أثرية سوف تخضع جميعها لدراسات أثرية مفصلة وتقييم من قبل مجموعة واسعة من علماء الآثار وغيرهم من الخبراء لسنوات قادمة. وعلى الرغم من التركيز الأولي لدينا على التحليل العلمي لتحديد عمر وأصل وهوية حطام السفينة فإن المرحلة القادمة من المشروع سيكون التركيز على معرفة أكبر قدر ممكن حول الكيفية التي أدار بها البرتغاليون التجارة البحرية والحرب في المحيط الهندي خلال هذه الفترة الهامة تاريخياً.

والجدير بالذكر أن من ضمن مجموعة القطع الأثرية المكتشفة والتي ساهمت في الكشف عن هوية السفينة المكتشفة على أنها السفينة إزميرالدا بقيادة فينسينتي سودري ما يلي:

- قرص من النحاس عليه شعار النبالة الملكي الذي كان شعار شخصي من (esfera armila) البرتغالي الملك دوم مانويل الأول.
- جرس برونزي مع نقش يدل على ان تاريخ بناء السفينة كان 1498 م.
- عملات معدنية ذهبية تسمى كروزايدو (cruzado) سكنت في لشبونة بين عامي 1495 و 1501 م.
- عملة فضية نادرة للغاية تسمى إنديو (Indio) سكت بتكليف من دوم مانويل في عام 1499 م خصيصاً على وجه التحديد للتجارة مع الهند. هذه النادرة الشديدة للإنديو (هناك فقط عملة واحدة أخرى مماثلة معروفة في العالم) تأتي من مكائنها الأسطورية بصفتها عملة دوم مانويل "المفقودة" أو "الشبح".
- (بعض الأجزاء من المدافع).
- (عدد من الأحجار (عدد 36).
- الخزف تم رصد ما مجموعه 1039 قطعة مع العديد من المصادر المختلفة. ويبدو أن معظم القطع الأثرية تتبع من البرتغال (على الأقل 537 من القطع الدقيقة الحمراء المرتبطة الأشكال التي من المعروف أن يتم إنتاجها في البرتغال في ذلك الوقت. (ثانياً مانويل كاسيميروياب / جامعة لشبونة).
- الجزء الأكبر من القطع الأثرية المكتشفة كانت من المدفعية والذخائر من الترسانة التي كانت على متن السفينة. وشملت هذه طلقات من الرصاص والحديد والحجر من مختلف الأحجام، وعدد كبير من قطع المدفع من البرونز وبعض الأسلحة النارية القديمة. إن هذه المكتشفات تقدم دليلاً ملموساً على الهدف العسكري من هذا الأسطول كما أمر به دوم مانويل والذي نفذ من قبل فاسكودا جاما واثنين من

- Cannonballs with SV letters (the first latter of the Vicente Sodré) the captain of the ship.
- Breech chambers
- Stone Beads Thirty-six beads recovered from the site are made of stone not used for bead production in Portugal but were typical of the beads the Portuguese began to acquire in trade with India and have been found on numerous shipwrecks of homeward bound Portuguese East Indiamen. Most of the beads were either hexagonally cut, tubular beads made of carnelian stone or barrel shaped beads believed to be white agate.
- Ceramics A total of 1039 sherds were observed with many different provenances. The majority of artefacts seem in fact to originate from Portugal. In fact, from the 1039 sherds at least 537 present a red micaceous fabrics associated to shapes that are known to be produced in Portugal at this time. (Tânia Manuel Casimiro IAP/ IHC Faculdade de Ciências Sociais e Humanas NOVA University of Lisboa).

The bulk of the recovered artefacts were artillery and ordnance from the arsenal on board the ship. These included lead, iron and stone shot of various calibres, a large number of bronze breech chambers and several ancient firearms. Together they provide tangible proof of the military objectives of this fleet as ordered by Dom Manuel and brutally carried out by Vasco da Gama and his two uncles Vicente and Brás Sodré.

The historical and archaeological importance of the wreck site, based on future studies of the artefact assemblage, could be enormous. As one of the very early Ships of Discovery that pre-dates the nearest Iberian shipwreck in age by 30 to 50 years, the artefacts are expected to reveal new discoveries about how maritime trade and warfare was conducted in the Indian Ocean at the turn of this vital century.

About Oman's Ministry of Heritage & Culture
The MHC is the official government body responsible for the protection of Oman's underwater cultural heritage and their management of this project represents the first government-led archaeological excavation of an historic wreck-site in Omani waters. Within the MHC an underwater archaeology programme has been recently established to begin the process of cataloguing and investigating sites of underwater cultural heritage throughout the territorial waters of Oman. Following conservation and analysis, the recovered artefacts will be preserved in a single coherent collection owned by the MHC for ultimate display in Museums.



13. Vasco da Gama's astrolabe is the oldest known navigation tool with the Portuguese coat of arms (Photo: P. Koch)



12. Gun (Photo: P. Koch)

أخواله فيسنتي وبراس سودري إستناداً إلى الدراسات المستقبلية على القطع الأثرية فإن الأهمية التاريخية والأثرية لموقع الحطام ستكون هائل باعتبارها واحدة من أوائل سفن الإكتشافات تسبق زمنياً أي إكتشاف اخر لفرق السفن الإيبيرية بحوالي 30 أو 50 عاماً ، فمن المتوقع أن تكشف القطع الأثرية عن إكتشافات جديدة حول الكيفية التي كانت تدار بها التجارة البحرية والحرب في المحيط الهندي في مطلع هذا القرن.

عن وزارة التراث والثقافة تعتبر الوزارة هي الجهة الرسمية المسؤولة عن حماية التراث الثقافي المغمور بالمياه في السلطنة كما تمثل إدارة الوزارة لهذا المشروع أول إدارة عمانية لمثل هذا النوع من المشاريع المرتبطة بالآثار المغمورة تحت المياه. قامت الوزارة بإنشاء برنامج علمي لدراسة الآثار المغمورة بالمياه في السلطنة والذي من ضمن أعماله البحث والتوثيق لمواقع التراث الثقافي المغمور بالمياه في المياه الإقليمية العمانية. بعد الإنتهاء من عمليات الترميم والتحليل سيتم عرض المقتنيات التي تم العثور عليها من خلال أعمال المشروع ضمن جنبات متاحف الوزارة.

14. Copper-Alloy Breech Chambers (Photo: P. Koch)





1. The exhibition hall at the Museum of Nin Antiquities during the conservation and restoration work / Izložbena dvorana Muzeja ninskih starina za vrijeme konzervatorsko - restauratorskih radova (Photo: M. Šimičić)

THE CONDURA CROATICA OF NIN - RE-CONSERVATION PART 1

NINSKE CONDURE CROATICE - REKONZERVIRANJE 1. DIO

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Back in 1966 a coastal sand miner in Privlaka could hardly have imagined what a jewel of Croatian history his ship had brought to light on an otherwise ordinary day when he extracted parts of a wooden hull among the sand and stone at the Usta location in Nin. This was the first of the two small ships that were discovered – unique representatives of the Croatian medieval maritime tradition. These archaeological gems, following careful archaeological, conservation and restoration interventions in the 1970s and 1980s, have been kept to the present day at the Museum of Nin Antiquities. Unfortunately, the modest conditions of the museum and the fatal combination of the earlier use of impregnation substances have taken their toll and these beauties deteriorated with each passing year.

After years of warnings from various experts of the worrying condition of these museum exhibits the staffers and expert associates of the International Centre for Underwater Archaeology in Zadar finally began, in 2016, and continued, in 2017, the first concrete work on the repair, i.e. re-conservation of the Condura Croatica ships held at the Museum of Nin Antiquities. In the course of the re-conservation we have used the designations Nin 1 for the ship that is exhibited post-reconstruction (the missing sections were replaced) and Nin 2 for the ship exhibited without reconstruction.

Privlački sabunjar davne 1966. g. za vrijeme jednog uobičajenog radnog dana nije ni mogao slutiti kakav je dragulj hrvatske povijesti njegov brod iznio na svijetlo dana kada je u pijesku i kamenju na položaju Usta u Ninu izvukao dijelove drvene brodske oplate. Radilo se o prvoj od dvije pronađene brodice jedinstvene predstavnice hrvatske srednjovjekovne pomorske tradicije. Ove dragulje, nakon pomno provedenih arheoloških i konzervatorsko-restauratorskih radova 1970-ih i 1980-ih g. do danas čuva i o njima brine Muzej ninskih starina. Na žalost, skromni muzejski uvjeti i kobna kombinacija ranije korištenog impregnacijskog sredstva učinili su svoje, pa ove ljepotice pomalo, iz godine u godinu propadaju.

Nakon što su razni stručnjaci godinama upozoravali na zabrinjavajuće stanje ovih muzejskih eksponata, napokon su djelatnici i stručni suradnici Međunarodnog centra za podvodnu arheologiju u Zadru u 2016. započeli, a 2017. g. nastavili sa prvim konkretnim radovima na sanaciji odnosno rekonzervaciji brodova tipa Condura Croatica iz Muzeja ninskih starina. Tijekom radova rekonzerviranja korišteni su nazivi Nin 1, za brod koji je izložen rekonstruiran (nadograđeni su mu nedostajući dijelovi) i Nin 2 koji je izložen bez rekonstrukcije.

Nakon što su brodovi pronađeni 1966. (Nin 1) i 1968.



2. A detail of the bow of Nin 2 prior to the conservation and restoration work / Detalj pramca broda Nin 2 prije konzervatorsko - restauratorskih radova (Photo: K. Ivković)

Conservation work proceeded after the ships were discovered in 1966 (Nin 1) and 1968 (Nin 2) and extracted from the sea in 1974. After the extraction from the sea it was critical that conservation and restoration work begin as soon as possible given that the material in question was waterlogged wood. If wet wood is exposed to a dry atmosphere after taken out of water or waterlogged ground it very quickly loses the water in its structure, which leads to the formation of cracks, and the object almost entirely loses its shape, size and weight and, in exceptional cases, can lead to its complete disintegration. This is why conservation and restoration work on wet archaeological wood is required to stabilise the structure of the wood in order to prevent cracking, deformation, lamination and disintegration during the drying process. The selection of the appropriate consolidant, i.e. impregnation substance will lead to the replacement of the water present in the structure of the wood gradually and will not impair its stability. Given that the ships were extracted from the sea, desalinisation had to precede the impregnation process, i.e. the salt had to be removed before impregnation and consolidation. A solution of polyethylene glycol with a molecular mass of 4,000 (PEG 4000) was used as the consolidant up to a saturation level of 86%. This was followed by the drying process and the removal of excess consolidant, in turn followed by work on reconstruction and exhibition. The procedure for the consolidation of wet archaeological wood using polyethylene glycol was an entirely new method for the conservation of artefacts of this type at the time of the interventions on the Nin ships and the long-term effects were not known. A decade later restorers around the world began, along with the many positive aspects, to gain insight into the drawbacks of this conservation procedure.

It was precisely these drawbacks that were gradually observed by museum staffers and other experts that visited the condura ships in Nin, a scene that was becoming more dismal with every passing year. It was with these problems and their resolution that my colleagues and I, as a restorer with ICUA Zadar, were

g. (Nin 2), a 1974. g. izvađeni iz mora na njima su započeli radovi na konzerviranju. Vađenjem iz mora bilo je važno što ranije započeti konzervatorsko-restauratorske radove jer se radi od mokrom drvetu. Ako se mokro drvo nakon vađenja iz vode odnosno mokrog tla izloži suhoj atmosferi ono vrlo brzo gubi vodu koja se nalazi u njegovoj strukturi i dolazi do stvaranja pukotina, a predmeti gotovo u potpunosti gube oblik, dimenziju, težinu, a u iznimnim slučajevima može doći i do njihove potpune razgradnje. Stoga je konzervatorsko-restauratorskim radovima na mokrom arheološkom drvu potrebno stabilizirati strukturu drveta kako bi se spriječilo pucanje, deformiranje, raslojavanje i rasipanje tijekom procesa sušenja. Odabirom odgovarajućeg konsolidanta tj. impregnacijskog sredstva zamjena vode prisutne u strukturi drva odvijat će se postepeno i neće doći do narušavanja njegove stabilnosti. S obzirom da su brodovi izvađeni iz mora, prije procesa impregnacije bilo je potrebno provesti desalinizaciju, odnosno postupak odsoljavanja predmeta, a zatim pristupiti impregnaciji i konsolidaciji. Kao konsolidacijsko sredstvo korištena je otopina polietilen glikola molekularne mase 4000 (PEG 4000) do zasićenosti od 86%. Zatim se pristupilo postupku sušenja i uklanjanja viška konsolidanta nakon čega su provedeni radovi na rekonstrukciji i izlaganju. Postupak konsolidacije mokrog arheološkog drveta polietilen glikolom bio je u vrijeme konzervatorsko-restauratorskih radova na ninskim brodovima potpuno nova metoda konzerviranja ovakvih predmeta, stoga dugoročne posljedice nisu bile poznate. Desetak godina kasnije restauratori diljem svijeta počeli su uz brojne dobre strane uviđati i nedostatke ovog konzervatorskog postupka.



3. A detail of the bow of Nin 1 prior to the conservation and restoration work with visible locations from which samples were extracted for dendrochronology / Detalj pramca broda Nin 1 prije konzervatorsko - restauratorskih radova, vidljiva su i mjesta uzimanja uzoraka za dendrokronologiju (Photo: M. Šimičić)

Upravo su ove probleme polako primjećivali muzejski djelatnici i ostali stručnjaci koji su obilazili ninske kondure

faced when the Croatian culture ministry earmarked the initial funds for a programme aimed at protecting the cultural property of the Condura Croatica ships at the Museum of Nin Antiquities. The approval of the first tranche



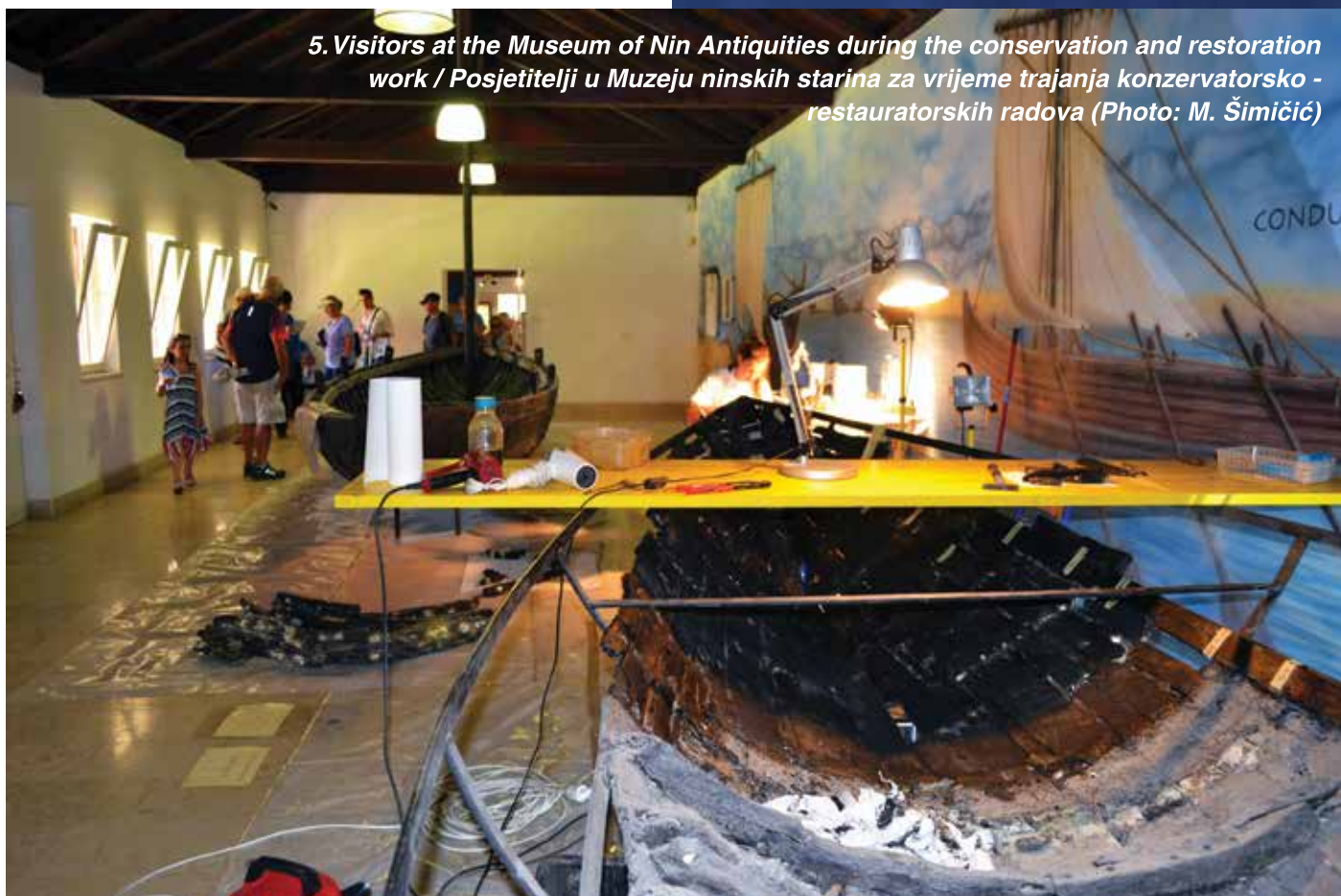
4. Decayed nails in a rib of Nin 2 / Istrunuli čavli u rebru broda Nin 2 (Photo: M. Šimičić)

of funding in 2016 led to a conservation and restoration study on the Condura Croatica ships in Nin (Šimičić, Vrgoč 2016). In the study Zdenka Vrgoč summarized and briefly described the collected documentation as it pertained to the archaeological, conservation and restoration interventions on the Nin condura ships up to the year 2016, while I, drawing in the conducted analyses and the collected samples, described the current condition of the ships and identified the causes of the deterioration, offering a brief description of the necessary conservation and restoration interventions and provided guidelines for

čiji je prizor iz godine u godinu bivao sve tužniji. S ovim problemom i njegovim rješavanjem suočila sam se kao restauratorica MCPA Zadar i moji kolege kada je Ministarstvo kulture Republike Hrvatske izdvojilo prva materijalna sredstva za Program zaštite kulturnog dobra - brodovi tipa Condura Croatica iz Muzeja ninskih starina. Odobranjem prvih materijalnih sredstava u 2016. g. nastao je Konzervatorsko-restauratorski elaborat o brodovima Condura Croatica iz Nina (Šimičić, Vrgoč 2016). U njemu je na osnovu prikupljene dokumentacije Zdenka Vrgoč sažela i ukratko opisala arheološke i konzervatorsko-restauratorske radove koji su na ninskim kondurama provedeni do 2016. g., a ja sam na osnovu provedenih analiza prikupljenih uzoraka opisala postojeće stanje i identificirala uzročnike propadanja, dala kratki opis potrebnih konzervatorsko-restauratorskih radova te navela smjernice za izradu plana sanacije prostora za pohranu i izlaganje.

Oba broda imaju iste karakteristike, prekriveni su velikom količinom prašine na svim dijelovima, drvo je sivkasto, a na vanjskim dijelovima i bjelkasto. S obzirom da su brodovi godinama dodatno premazivani otopinom polietilen glikola, drvo izgleda jako tamno i plastično, originalna površina drva nije vidljiva. Pozicije željeznih konstruktivnih elemenata na oba broda mogu se utvrditi po žućkasto-bijelom prahu koji je rezultat propadanja željeza unutar brodske konstrukcije. Također se na brodovima mogu uočiti i tamnije crne mrlje, radi se o zapunama mjesta sa kojih su uzimani uzorci za dendrokronološku analizu 2008. g. Na većem broju brodskih elemenata došlo je do rastapanja i curenja konsolidanta, a drvo je

5. Visitors at the Museum of Nin Antiquities during the conservation and restoration work / Posjetitelji u Muzeju ninskih starina za vrijeme trajanja konzervatorsko-restauratorskih radova (Photo: M. Šimičić)





6. A rib separated from the shell plating of Nin 2 during cleaning / Odvojeno rebro od brodske oplate, brod Nin 2 za vrijeme čišćenja (Photo: M. Šimičić)

the rehabilitation of the storage and exhibition area.

The two ships share common characteristics – all of their parts are covered by a large quantity of dust, the wood is greyish and on outer sections even whitish. Given that the ships have been additionally coated with a solution of polyethylene glycol over the years, the wood appears very dark and plastic and the original surface of the wood is not visible. The position of the iron structural elements on both ships can be determined by the yellow-white powder that has resulted from the deterioration of the iron within the ship's structure. We can also make out darker black areas on the ships that are the fill of the places from which samples were extracted for dendrological analysis in 2008. On a large number of the ship's elements there has been dissolution and running of the consolidant, while the wood is fragile and friable.

The very poor condition of the Nin condura ships is a result of the reaction of the previously used consolidant polyethylene glycol (PEG) in combination with iron, mostly with iron nails used in the wooden structure of the ships. The presence of iron, namely, disrupts the stability of archaeological wood in which a PEG solution has been used in conservation, as it was in our case. There are a number of chemical reactions that occur as a result of the combination of PEG and iron (iron sulphates are formed as the product of the oxidation of iron sulphides), and in the end we see the formation of sulphuric acid. Sulphuric acid corrodes the ship's wooden structure and leads to its degradation. The presence of sulphuric compounds is evident in the yellow-white stains, i.e. a powder with the scent of sulphur present on almost all of the ship's elements.

With new funds approved by the culture ministry in 2017 the first phase of conservation and restoration work kicked off following the above-cited programme. This phase included the preliminary cleaning and removal of excess consolidant. The interventions were made on both ships while on the Nin 2 ship we also removed the

krhko i lako se lomi.

Iznimno loše stanje ninskih kondura posljedica je reakcije ranije korištenog konsolidanta, polietilen glikola (PEG-a), u kombinaciji sa željezom i to uglavnom sa željeznim čavlima korištenih u drvenoj konstrukciji brodova. Naime, prisutnost željeza narušava stabilnost arheološkog drva za čiju je konzerviranje korištena otopina PEG-a, kao u ovom slučaju. Nastaje niz kemijskih reakcija kao posljedica oksidacije u kombinaciji PEG-a i željeza (stvaraju se željezni sulfati koji su produkt oksidacije željeznih sulfida), a u konačnici dolazi do stvaranja sumporne kiseline. Sumporna kiselina nagrizava drvenu brodsku konstrukciju i dovodi do njene degradacije. Prisutnost sumpornih spojeva evidentirana je u vidu žućkasto bjeličastih mrlja, tj. praha koji miriše na sumpor, a prisutnog na gotovo svim brodskim elementima.

Tijekom 2017. g., nakon što su od Ministarstva kulture odobrena nova materijalna sredstva po istom programu započelo se sa prvom fazom konzervatorsko-restauratorskih radova. Ova je faza obuhvatila preliminarno čišćenje i uklanjanje viška konsolidanta. Radovi su izvršeni na oba broda dok je na brodu Nin 2 izvršena i faza uklanjanja metalnih poveznica iz strukture drva, što podrazumijeva istrunule željezne čavle u brodskoj konstrukciji. Prilikom uklanjanja čavala došlo je do djelomičnog rastavljanja brodske konstrukcije broda Nin 2, na način da su rebra broda odvojena od brodske oplate.

Za potrebe konzervatorsko-restauratorskih radova, restauratori su izložbenu dvoranu Muzeja ninskih starina prilagodili svojim potrebama. U izložbenu dvoranu postavljena su tri pomična reflektora i nekoliko stolnih lampi jer je postojeće osvjetljenje za radove bilo nedostavno. Na pod dvorane postavljen je najlon čime je zaštićen od prljanja, a dva manja i jedan veći radni stol, te dvije metalne police velike nosivosti (250 kg svaka) poslužile su za odlaganje restauratorskog pribora.



7. Removing PEG from Nin 2 with hot air and absorbent paper / Uklanjanje PEG-a vrućim zrakom i upijajućim papirom, brod Nin 2 (Photo: K. Ivković)

metal ties from the wooden structure, meaning the decayed iron nails in the ship's structure. The removal of the nails led to a partial disassembly of the structure of the Nin 2 ship with the ribs being separated from the shell plating.



8. Vacuuming Nin 2 / Čišćenje usisavačem, brod Nin 2 (Photo: K. Ivković)

For the conservation and restoration work the restorers adapted the exhibition space at the Museum of Nin Antiquities to meet their work requirements. Three mobile reflector lamps and several tabletop lamps were installed in the exhibition hall because the existing lighting was inadequate. Nylon sheets were placed on the floor to protect it from dirt, with two small and one large worktable and two metal shelf units of high load-bearing capacity (250 kg each) serving to hold the restoration equipment. Signs were installed on both glass doors to the exhibition space and one floor-mounted warning visitors of the ongoing work. Visitors were provided limited access to viewing of the exhibited artefacts and the restoration work throughout the entire period of the conservation and restoration interventions.

The ships were cleaned applying a combination of mechanical and chemical methods, first with a vacuum cleaner. Following a thorough and careful vacuuming the remaining visible dirt was removed using assorted scrubbers and brushes and light cleaning with ethyl alcohol. The cleaning was followed by the removal of excess consolidant (PEG) – to a lesser extent the PEG used in the previous conservation and restoration procedure and to a larger extent the PEG later applied in coats. These additional layers, namely, almost entirely covered all of the details of the ship's structure (the position of the nails and the like) and the details of the reconstruction work (it is almost impossible to differentiate the original wood from the reconstructed sections). The excess consolidant was removed by the alternate use of a hot air gun, which melted the coating, with the melted liquid coating removed using absorbent paper and softened coating scraped off with various spatula and scalpels of various profiles. On areas where the coating was exceptionally thick electric pins and chisels were used for its removal. All of these interventions were carried out carefully and working

Na pod i na oboja staklena vrata izložbene dvorane postavljena su upozorenja posjetiteljima muzeja o trajanju radova. Za svo vrijeme izvođenja konzervatorsko - restauratorskih radova posjetitelji su mogli uz manja ograničenja pristupa razgledati izložene predmete i rad restauratora.

Čišćenje brodova izvedeno je kombinacijom mehaničkog i kemijskog čišćenja, najprije usisavačem. Nakon temeljitog i pažljivog čišćenja usisavačem preostale vidljive nečistoće uklonjene su upotrebom različitih četkica i metlica te se pristupilo laganom kemijskom čišćenju etilnim alkoholom. Nakon čišćenja pristupilo se uklanjanju viška konsolidanta (PEG-a) korištenog u ranijem konzervatorsko-restauratorskom postupku u manjoj mjeri i u većoj mjeri uklanjanje slojeva PEG-a naknadno nanošenog premazivanjem. Naime, ovi dodatni slojevi gotovo su u potpunosti prekrili gotovo sve detalje brodske konstrukcije (položaj čavala i sl.) i pojednosti radova na rekonstrukciji (gotovo je nemoguće bilo razaznati originalno drvo od nadogradnje). Višak konsolidanta uklanjao se naizmjeničnom upotrebom pištolja na vrući zrak, koji je topio premaz. Otopljeni tekući premaz uklanjao se upijajućim papirom, a vrućim zrakom omekšani premaz uklanjao se struganjem različitim špatulicama i skalpelima raznih profila. Za dijelove gdje je premaz bio izrazito debeo, za njegovo uklanjanje



9. A detail of the shell plating of Nin 2 following cleaning – the wooden pegs, sections of recent planks, the wire used in the reconstruction and the fill between the planks of the plating are visible / Detalj oplata broda Nin 2 nakon čišćenja, vide se drveni čavli, ulomak recentne daske, žica korištena pri rekonstrukciji i zapuna između dasaka oplata (Photo: M. Šimičić)

korištena je električna igla i dljeto. Sve ove radnje izvršene su pažljivo i po slojevima, najprije unutrašnji pa vanjski dio broda, kako ne bi došlo do oštećivanja drva. Nakon čišćenja vrućim zrakom zadnji sloj premaza uklonjen je vrućom vodom. Voda je zagrijana u kuhlalu za vodu i nanošena kistom na drvo, zatim je upijajućim papirom uklonjen višak vode i premaza. Ph indikatorskim



10. A detail of the bow of Nin 2 after the conservation and restoration work / Detalj pramca broda Nin 2 nakon konzervatorsko - restauratorskih radova (Photo: M. Šimičić)

through layers, first on the inside of the ship and then on its outside surface, in order to not damage the wood. Following cleaning with hot air the last layer of coating was removed with hot water. The water was heated in a water kettle and applied to the wood with a brush, with the excess water and coating removed using absorbent paper. The acidity of the cleaned wood was tested using pH indicator strips. The acidity, i.e. presence of the sulphuric acid that corrodes the wood, was tested in the zones around the positions where iron nails had been.

In the course of the cleaning of the coating it was observed that the ribs of the Nin 2 ship do not lie on the shell plating, but are in fact offset, with the empty area thus formed filled in with a mixture most likely made of a solution of polyethylene glycol and sawdust. The removal of this fill led to the partial disassembly of the wooden parts of the ship's structure, i.e. the separation of the ribs from the shell plating. Following the separation of the ribs it was observed that the ribs were attached to the shell plating with wooden pegs in the course of the earlier restoration, while the original iron nails in the structure of the ribs had for the most part entirely decayed into a white-yellow powder. The removal of the ribs and the cleaning of the shell plating were done concurrently, working from the bow to the stern. Following the removal of the ribs and the cleaning of the shell plating a regularity was observed under the ribs in the distribution of metal nails along the

trakama ispitivana je kiselost očišćenog drveta. Kiselost, odnosno prisutnost sumporne kiseline koja nagriza drvo, utvrđena je u zonama uokolo položaja nekadašnjih željeznih čavala.

Tijekom čišćenja premaza, na brodu Nin 2, uočeno je kako rebra broda ne leže na oplati nego su odmaknuta, a nastale šupljine zapunjene mješavinom najvjerojatnije otopine polietilen glikola i piljevine. Uklanjanjem ove zapune došlo je do djelomičnog rastavljanja drvenih dijelova brodske konstrukcije, odnosno odvajanja rebara od oplata broda. Nakon odvajanja rebara, uočeno je da su rebra za oplatu pričvršćena drvenim klinovima u ranijem restauratorskom postupku dok su originalni željezni čavli u strukturi rebara uglavnom potpuno istrunuli i pretvoreni u bijelo-žuti prah. Uklanjanje rebara i čišćenje oplata vršeno je istovremeno od pramčanog prema krmenom dijelu broda. Nakon uklanjanja rebara i čišćenja oplata ispod rebara uočena je pravilnost u rasporedu metalnih čavala po brodskoj oplati. U konstrukciji su korišteni i drveni klinovi, koji su ponegdje na oplati, a većinom u rebrima ostali očuvani. Iako su željezni čavli istrunuli, nakon čišćenja ostale su rupe u oplati, tako da se njihov položaj može detektirati. Nakon što je položaj čavala postao vidljiv po brodskoj oplati primijećeno je kako položaj rebara na nekim mjestima ne odgovara položaju čavala po oplati broda. Ova se greška najvjerojatnije dogodila prilikom radova na rekonstrukciji. Nakon čišćenja oplata broda uočeno je nekoliko recentnih dasaka koje su umetnute u oplatu broda. Ove dijelove je bilo nemoguće vidjeti prije faze čišćenja i uklanjanja viška konsolidanta. Nakon čišćenja vidljiva je postala žica kojom su daske oplata pričvršćene jedna za drugu i način na koji su pukotine između dasaka zapunjene. Za zapunu između dasaka oplata na nekim je mjestima korištena vrsta tkanine, a drugdje mješavina piljevine i PEG-a.



11. Cleaning and removing excess consolidant from Nin 1 / Čišćenje i uklanjanje viška konsolidanta, brod Nin 1 (Photo: M. Šimičić)

Po dijelovima oplata uočene su ljepljive crne mrlje, specifičnog mirisa (smola bora), najvjerojatnije je to premaz koji se koristio još u vrijeme nastanka kondure.

ship's shell plating. Wooden pegs were also used in the structure and have remained preserved in places in the shell plating and for the most part in the ribs. Although the iron nails have decayed they left holes in the shell plating, revealed by the cleaning, such that their positions can be detected. Once the positions of the nails had been rendered visible on the shell plating it was also observed that the position of the ribs at some places was not consistent with the positions of the nails on the shell plating. This error most likely occurred in the course of the reconstruction work. Also observed after the cleaning of the shell plating were a number of recent planks inserted into the shell plating. These sections could not be made out prior to the phase of cleaning and removal of excess consolidant. The cleaning also revealed the wire that had been used to attach the planks of the shell plating to one another and the method by which the cracks between the planks had been filled in. A type of fibre was used for the fill in some places and a mixture of sawdust and PEG in others.

Sticky black spots with a specific scent (of pine) were observed on parts of the shell plating – this was likely a coating used when the condura ships were first built. After the separation of the ribs from the shell plating on the Nin 2 ship all of the ribs were cleaned in detail of excess consolidant and the entirely decayed iron nails were removed. Some of the ribs were preliminarily attached using adhesive tape and restored to their original positions on the ship following the holes left by nails on the shell plating.

Once work had been completed on the Nin 2 ship we moved to the cleaning and removal of excess consolidant on the reconstructed Nin 1 ship. Work on cleaning and the removal of excess consolidant moved from the outside to the inside of the ship and only on the reconstructed areas. Only after the excess coating was removed could we clearly make out the delineation between the original and reconstructed elements of the ship. This was followed by work on the cleaning and removal of excess consolidant from the inside of the original parts of the ship. The cleaning began with vacuuming, followed by the use of a hot air gun to melt the coating. The melted PEG was removed with absorbent paper and with small restoring tools – spatulas and scalpels of various profiles. The original surface of the wood became visible after the cleaning, as did the method used to fill in the gaps between the planks of the shell plating and between the plating and ribs. In this case we did not remove the fill in order not to cause the disassembly of the parts of the ship as we did with the Nin 2 ship. Given the exceptionally large quantity of powder with the scent of sulphur we can confidently say that the ribs, like with the Nin 2 ship, had been attached to the shell plating when the ship was built using iron nails and wooden pegs. Unfortunately, as with the Nin 2 ship, the iron spikes in the structure of the ribs have entirely decayed. After the removal of the excess PEG we can identify the wooden pegs in the ribs, and the



12. Nin 1 with clean reconstructed sections and still-to-be-cleaned original sections / Brod Nin 1, očišćeni su dijelovi nadogradnje, a neočišćeni originalni dijelovi broda (Photo: M. Šimičić)

Nakon odvajanja rebara od oplata broda, na brodu Nin 2, sva su rebra detaljno očišćena od viška konsolidanta i iz njih su izvađeni potpuno istrunuli željezni čavli. Dio je rebara, preliminarno spojen ljepljivom trakom i vraćen na njihove originalne pozicije u brodu slijedeći šupljine od čavala po oplati broda.

Nakon što su radovi na brodu Nin 2 završeni, pristupilo se čišćenju i uklanjanju viška konsolidanta na rekonstruiranom brodu, Nin 1. Radovi na čišćenju i uklanjanju viška konsolidanta najprije su izvršeni na vanjskoj, a zatim na unutarnjoj strani broda i to samo na dijelovima nadogradnje. Tek nakon što je višak premaza uklonjen postala je jasno vidljiva granica originalnih i nadograđenih brodskih elemenata. Nakon toga započeli su radovi na čišćenju i uklanjanju viška konsolidanta s unutarnje strane originalnih dijelova broda. Čišćenje je izvršeno najprije usisavačem, a zatim se pištoljem na vrući zrak topio premaz. Rastopljeni PEG uklonjen je pomoću upijajućeg papira i upotrebom sitnog restauratorskog pribora, špatulica i skalpela raznih profila.

13. A detail of the Nin 1 bow after cleaning / Detalj pramca nakon čišćenja, brod Nin 1 (Photo: M. Šimičić)





14. The Nin 2 ship post-intervention / Brod Nin 2 nakon radova (Photo: A. Jelić)

position of the iron nails can be assumed by the yellowish stains and the constant presence of whitish powder that falls out onto the shell plating from the underside of the ribs.

A major issue in the preservation and protection of the Nin condura ships are the unstable microclimatic conditions in the exhibition hall. No conservation and restoration procedure can have a lasting effect if an artefact is exhibited in unsuitable conditions. The following conditions are recommended for the storage and exhibition of wooden artefacts: a temperature of 20°C with a deviation of $\pm 2^\circ\text{C}$ and a relative humidity of between 50 and 55%, while the recommendation for the storage and exhibition of wooden artefacts contaminated with pyrite has the relative humidity at 40 to 45% and a temperature of 20°C (Fierro-Mircovich 2017, 25). Given that the microclimatic conditions in the exhibition hall are dependent on the general climatic conditions there is an urgent and critical need to rehabilitate the exhibition space – although the path to this is exceedingly lengthy we must continue to insist on it.

The conservation and restoration work on the condura ships at Nin has shed new light on the appearance of the ship's structure and hypotheses on the possible errors made during its reconstruction. An examination of the ship's structure after the cleaning phase reveals certain previously unobserved details. An examination of these details leads us to consider the possibility that there was an error in the reconstruction of the Nin 2 ship. The iron structure in which the ship is exhibited, namely, was made based on drawings made underwater, meaning that an error could very easily have occurred. When the ship sank the stones it was filled with and the seawater itself led to the widening of the shell plating. This was not taken into consideration when the metal cradle was fashioned and it was, consequently, made with a certain deviation. Given that the planks of the shell plating were assembled in a cradle that was wider than the original vessel there was a need to insert sections to fit the cradle (the inserted areas are now visible). Speaking to the correctness of this hypothesis are the offsets in the assembly of the ribs

Nakon čišćenja originalna površina drva postala je jasno vidljiva kao i način na koji su zapunjene šupljine između dasaka oplata i oplata i rebara.

U ovom slučaju nije uklonjena zapuna kako ne bi došlo do rastavljanja dijelova broda, kao kod broda Nin 2. S obzirom na iznimno veliku količinu praha koji miriše na sumpor sigurno je da su rebra, jednako kao i na brodu Nin 2, za oplatu broda prilikom njegove izgradnje bila pričvršćena željeznim i drvenim klinovima. Nažalost, jednako kao i kod broda Nin 2, željezni su klinovi iz strukture rebara potpuno istrunuli. Nakon uklanjanja viška PEG-a, po rebrima se mogu evidentirati drveni klinovi, a položaj željeznih čavala može se pretpostaviti po žučkastim mrljama i neprestanoj prisutnosti bjeličastog praha koja ispada po oplati broda sa donje strane rebara.

Veliki problem za očuvanje i zaštitu ninskih kondura predstavljaju nestabilni mikroklimatski uvjeti koji vladaju u izložbenoj dvorani. Niti jedan konzervatorsko-restauratorski postupak ne može imati trajni učinak ukoliko su predmeti izloženi u neodgovarajućim uvjetima. Za pohranu i izlaganje predmeta od drva preporučaju se slijedeći mikroklimatski uvjeti: temperatura od 20°C uz odstupanje od $\pm 2^\circ\text{C}$ i relativna vlažnost između 50 i 55 %, dok je preporuka da za pohranu i izlaganje drvenih predmeta kontaminiranih piritom relativna vlažnost u rasponu od 40-45 % i temperatura od 20°C (Fierro-Mircovich 2017, 25). S obzirom da mikroklimatski uvjeti u izložbenoj dvorani ovise o klimatskim prilikama, sanacija izložbene dvorane je prijeko potrebna iako do nje predstoji izrazito dug put na njemu treba inzistirati i dalje.

Konzervatorsko-restauratorskim radovima na ninskim kondurama na svijetlo dana izašle su nove spoznaje o izgledu brodske konstrukcije i pretpostavke o mogućoj pogrešci prilikom rekonstrukcije. Pregledom brodske konstrukcije, nakon provedene faze čišćenja postali su vidljivi određeni ranije nepoznati detalji. Nakon pregleda ovih detalja nameće se pretpostavka kako se dogodila greška prilikom rekonstrukcije broda Nin 2. Naime, željezna konstrukcija u kojoj je brod izložen, napravljena je po nacrtima izrađenim pod morem pa s obzirom na tu činjenicu greška se vrlo lako mogla dogoditi. Naime prilikom potonuća broda i pod utjecajem tereta kamenja kojim je brod bio napunjen i same morske vode oplata broda se raširila. Ovakva pretpostavka nije bila uzeta u obzir prilikom izrade metalne kolijevke pa je i ona načinjena s određenim odstupanjem. S obzirom da su daske oplata slagane u malo širu kolijevku bilo je potrebno umetnuti dijelove kako bi pristajali kolijevki (umetnuti dijelovi su sada vidljivi). O točnosti ovakve pretpostavke pridonosi odstupanje prilikom postavljanja rebara i šupljine koje su između oplata i rebara zapunjene velikom količinom PEG-a i piljevine. Prilikom izrade drvenog broda, prvo se izrađuju rebra, na koja se zatim postavljaju i pričvršćuju daske oplata, tako da oplata mora slijediti oblik rebara i između njih nema većih šupljina. Zbog ove pretpostavke, bilo bi uputno doraditi postojeće nacрте ucrtavanjem

and the gaps between the shell plating and the ribs that have been filled with a large quantity of PEG and sawdust. In the construction of these wooden ships the ribs are crafted first, to which the planks of the shell plating are then affixed, such that the shell plating must follow the contours of the ribs, leaving little space between them. Following on this hypothesis it would be advisable that the existing drawings be amended to include the now visible details – this would contribute to our study of the methods of shipbuilding in the time of their creation and the subsequent alterations.

Lectures open to the public have been staged at the ICUA Zadar lecture hall with the aim of introducing the broader public to the ongoing conservation and restoration work on the Nin condura ships. The public interest for this project and its attractiveness is evidenced both by the solid turnout for the lectures and the fact that a number of reports on the course of the conservation and restoration work on the Nin condura ships were broadcast in the regional HRT (Croatian national radio and TV company) TV news shows, on a number of occasions for HRT Radio Zadar shows and twice for the Pomorska večer (Maritime Evening) show.

2017 saw continued collaboration with restorers from the ArcNucleART restoration workshop. In the period from the 18th to 20th of September 2017 restorer Sophie Fierro-Mircovich visited ICUA Zadar and the Museum of Nin Antiquities. This year saw collaboration begin with restorer Emma Hocker, the author of a number of papers on the topic of the contamination of wood with sulphuric compounds. These collaborative efforts should be maintained and further developed, as the problem of sulphuric compound contamination remains very little understood among conservation and restoration experts around the world. Every artefact tells its own tale, and the exchange of experiences is exceptionally important to identifying a permanent solution.

As planned the conservation and restoration work on Nin's condura ships does not end with the completion of the work in 2017. This year's work marks the beginning of the end of the deterioration of the Condura Croatica ships in Nin, an effort that saw very comprehensive and demanding interventions aimed at preserving and protecting these unique representatives of Croatia's medieval maritime tradition. The conservation and restoration work needs to continue in the coming years to restore the ancient glory very much deserved by these unique ships.

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novih sada vidljivih detalja jer bi se na taj način pridonijelo studijama o načinu konstrukcije brodova u vremenu njihova nastanka i naknadnim prepravcima.

Kako bi javnost upoznali sa tekućim konzervatorsko-restauratorskim radovima na ninskim kondurama, u učionici MCPA Zadar održana su javna predavanja. O zanimanju javnosti za ovaj projekt i o njegovoj atraktivnosti osim solidne posjećenosti predavanjima ide u prilog i činjenica kako je tijekom konzervatorsko-restauratorskih radova na ninskim kondurama snimljeno više novinarskih priloga koji su emitirani u emisiji Regionalni dnevnik HRT-a, više puta u raznim radijskim emisijama HRT - Radio Zadra, a dva puta u emisiji Pomorska večer.

Tijekom 2017. g. nastavljena je suradnja sa restauratorima iz restauratorske radionice ArcNucleART. Restauratorica Sophie Fierro-Mircovich je u razdoblju od 18. do 20. rujna 2017. g. posjetila MCPA Zadar i Muzej ninskih starina. Ove je godine uspostavljena je suradnja i s restauratoricom Emmom Hocker koja je napisala nekoliko studija na temu kontaminacije drveta sumpornim spojevima. Ove suradnje potrebno je održavati i dalje, jer je problem kontaminacije drveta sumpornim spojevima i dalje vrlo nejasan stručnjacima konzervatorima restauratorima diljem svijeta. Svaki pojedini predmet priča svoju priču stoga je za pronalazak trajnog rješenja razmjena iskustva izrazito važna.

Konzervatorsko-restauratorski radovi na ninskim kondurama, kako je i predviđeno, nisu završeni okončanjem radova u 2017. g. Ovogodišnji radovi početak su kraja propadanja ninskih Condura Croatica, tijekom kojih je odrađen iznimno velik i zahtjevan posao na očuvanju i zaštiti ovih jedinstvenih predstavnica hrvatske srednjovjekovne pomorske aktivnosti. Konzervatorsko-restauratorske radove je potrebno nastaviti i dalje u godinama koje slijede i na taj način vratiti stari sjaj ovim damama jer to one svakako zbog svoje jedinstvenosti i zaslužuju.

15. The Nin 1 ship post-intervention / Brod Nin 1 nakon radova (Photo: M. Šimičić)



IN SEARCH OF UNDERWATER HERITAGE

U POTRAZI ZA PODVODNOM BAŠTINOM

Roko Surić rsuric@icua.hr



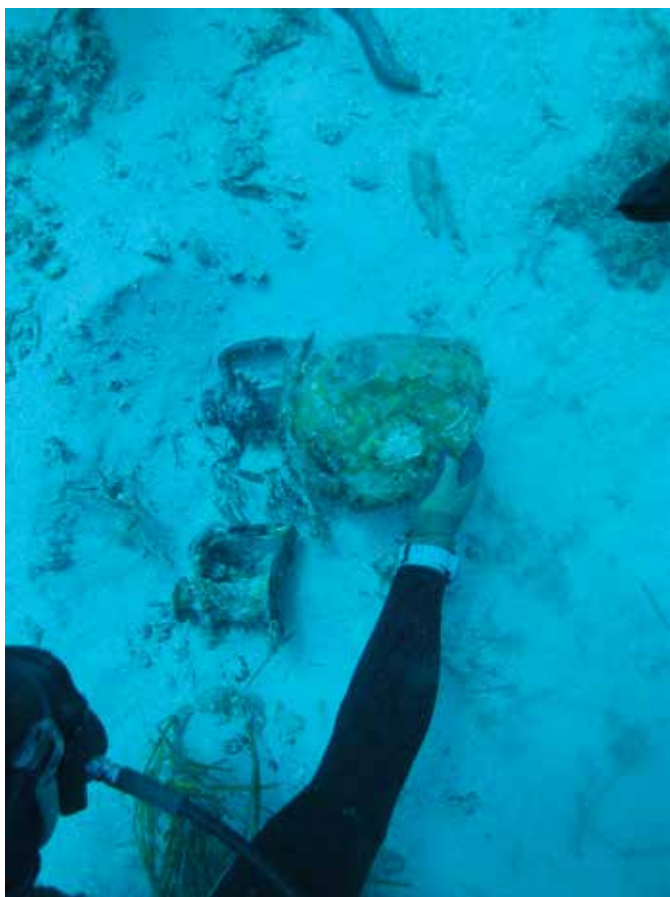
1. The survey of the newly discovered wreck at cape Zapuntel / Pregled novootkrivenog brodoloma na rtu Zapuntel (Photo: R. Surić)

One of the greatest feelings in the life of any explorer is that moment of the discovery of something previously unknown and hidden from view. Underwater archaeologists are blessed in having their professional careers made up of many such moments. It is this pursuit of discovery; the desire to shed light on the unknown, that is the driving force behind the efforts of our archaeological team at the International Centre for Underwater Archaeology in Zadar as we again this year surveyed numerous positions in search of submerged sites.

Jedan od najljepših osjećaja u životu svakog istraživača je trenutak otkrića nečeg do tad nepoznatog i skrivenog od pogleda. Podvodni arheolozi imaju čast da im ti trenuci čine velik dio njihove profesionalne karijere. Na tragu te činjenice može se zaključiti da je upravo želja za otkrivanjem potaknula arheološki tim Međunarodnog centra za podvodnu arheologiju u Zadru da i ove godine pregleda brojne pozicije u potrazi za podvodnim arheološkim nalazima.

Ministarstva Republike Hrvatske već niz godina provode suradnju u pogledu aktivnosti na moru i u sklopu te suradnje se udružene snage raznih službi zajedno otiskuju na more i provode svoje dužnosti, pa se za tu suradnju razvio naziv "Koordinacija na moru". Konzervatorski odjel u Zadru, Carinska uprava, Pomorska i granična policija te Ribarska inspekcija i ove godine su sa zanimanjem popratili svaki zaron kojeg su stručnjaci MCPA Zadar provodili u sklopu koordinacije. Zajedničko vrijeme na brodu iskorišteno je i za razmjenu iskustva u pogledu zaštite podvodnih kulturnih dobara.

U sklopu koordinacije, ove godine ukupno je pregledano 11 pojedinačnih lokacija. Većinom se radi o pozicijama za koje se moglo opravdano posumnjati da se na njima nalazi arheološki lokalitet, ili su dobijene dojave o nalazima a radi se o: tjesnacima, hridima, rtovima ili otočićima. Može se reći da glavnina ovogodišnjih zarona otpada na pregled podmorja uz otoke Ist i Molat na zapadu zadarskog arhipelaga. Vodeći se pretpostavkom da je zapuntelski prolaz, odnosno tjesnac između otoka Molata i Ista tijekom povijesti bio važan plovidbeni pravac, njemu se posvetila posebna pozornost. Istočni ulaz u kanal omeđen je rtom Vranac na Molatu i Jabučnim rtom na otoku Istu. Pregledano je podmorje ova dva rta i osim nekoliko sporadičnih ulomaka amfora i tegula nisu pronađeni arheološki nalazi koji bi upućivali da se na tim pozicijama nalazi brodolom. Pregledana je uvala zapadno od Jabučnog rta i na osnovu raznovrsnog arheološkog materijala ustanovljeno je da se ta uvala kroz povijest koristila kao sidrište.



2. A diver with fragmented amphorae off Visovac / Ronioc s amforama u dijelovima kod otoka Visovca (Photo: M. Pešić)

Croatia's ministries have for a number of years now conducted a collaborative effort of activities at sea, part of which is the Coordination at Sea programme, which pools the efforts of a number of national services carrying out their duties in our waters. The Conservation Department in Zadar, the Customs Administration, the Maritime and Border Police and the Fisheries Inspectorate again this year observed with interest every dive performed by the experts with ICUA Zadar in the frame of the Coordination programme. Our time together at sea was also an opportunity to share experiences related to the protection of underwater cultural property.

Eleven individual locations were surveyed in the frame of the Coordination programme this year. Most of these are positions that can justifiably be deemed potential archaeological sites or were selected on the basis of reports that were received. These positions include straits, rocks, capes and islands. The lion's share of this year's dives involved surveys of the sea floor along the islands Ist and Molat

3. A post-medieval plate found at the anchorage in the Zapuntel straits / Novovjekovni tanjur pronađen na sidrištu u Zapuntelskom prolazu (Photo: R. Surić)



Na osnovu dobivene informacije da se u podmorju rta na otoku Molatu koji na zapadu zatvara zapuntelski prolaz nalazi brodolom s amforama, odlučeno je da se ta pozicija pregleda. Nakon samo nekoliko minuta zarona, na dubini od 4 m otkriveni su ostaci brodoloma, u vidu nekoliko konglomerata ulomaka amfora, uokolo kojih se nalazi dosta pojedinačnih ulomaka. Pronađene amfore pripadaju tipu Lamboglia II s više varijacija.

Zapadno od otoka Molata pregledano je podmorje otočića Maslinjaka i otočića Golca. Unatoč tome što se ti otočići nalaze na zanimljivim lokacijama, a u podmorju je vladala dobra vidljivost, nije pronađen niti jedan podvodni arheološki lokalitet. Na sjeveru otoka Ista pregledano je podmorje ispred rta Tufa, na kojem nisu pronađeni arheološki nalazi.

Rt Lopata na jugu otoka Premude odabran je za pregled na osnovu zanimljive pozicije, koja je predstavljala potencijalnu opasnost za moreplovce koji su se našli u blizini za lošeg vremena ili slabe vidljivosti. Pretpostavka se pokazala točnom, jer se na dubini od 2 do 4 m nalazi rastresiti ostaci brodoloma. Na prostoru veličine 100 x 50 m pronalaze se usitnjeni i izlizani ulomci amfora, pa se na osnovu pronađenih ulomaka teško može zaključiti o kojem tipu amfora se radi.

Pregled je izvršen i na potencijalno zanimljivoj lokaciji u podmorju otočića Runjava Kotula koji se nalazi južno od otoka Pašmana. Pregledom nisu pronađeni arheološki nalazi koji bi upućivali da se na toj poziciji nalazi arheološki lokalitet.

Osim pronalaženja novih arheoloških lokaliteta, u sklopu koordinacije se odlučio napraviti i pregled već poznatih arheoloških lokaliteta s brodolomima. Pregledana je pozicija u podmorju rta Krbar na otoku Žutu, na kojoj se spominje brodolom s teretom amfora s ravnim dnom (Vrsalović 2011, 100). Ronioci su u potrazi za lokalitetom ronili na dubinama od 5 do 17 m, a pregledano je područje uokolo cijelog rta. Unatoč izvršnoj vidljivosti pronađeno je tek nekoliko ulomaka amfora, a veća koncentracija amfora, kao što se spominje u literaturi nije pronađena.

Još jedna zanimljiva lokacija na kojoj se trebao provjeriti



4. Scanning off Zadar's Sea Organ / Skeniranje pred zadarskom instalacijom "morske orgulje"
(Photo: M. Kaleb)

in the west of the Zadar archipelago. Working on the assumption that the Zapuntel passage, i.e. the strait between the islands Molat and Ist, was on a historically important navigation route, we concentrated particular attention on this area. The eastern entrance to this canal is bordered by cape Vranac on Molat and cape Jabučni on Ist. The sea floor was surveyed in the area around these two capes but, besides a few sporadic sherds of amphorae and tegulae, we did not recover archaeological finds that would point to any shipwrecks. A cove to the west of cape Jabučni was examined and was determined on the basis of various archaeological materials to have served historically as an anchorage.

Following on information received of a shipwreck with amphorae in the waters of the cape on Molat that shuts off the Zapuntel strait to the west we also decided to survey this location. It was only a few minutes into our dive that the wreck was identified at a depth of four metres, with the remains consisting of several conglomerates of amphorae sherds and a good number of individual finds in the surrounding area. The amphorae found include several variants of Lamboglia's type II.

To the west of Molat island we surveyed the waters off the islets Maslinjak and Golac. In spite of the fact that these islets are at positions of potential interest and that visibility was good in the water we did not find a single underwater archaeological site. To the north of Ist island we surveyed the waters of cape Tuf, were again no archaeological finds were identified.

Cape Lopata to the south of Premuda island was a location selected as a threat to historical mariners passing nearby caught by inclement weather or suffering poor visibility. Our assumption proved founded as we did in fact find the scattered remains of a shipwreck at a depth of two

lokalitet brodoloma s teretom Dressel 26 amfora, je u podmorju otočića Visovac. Otočić se nalazi na jugu Zadarske županije na samoj granici sa Šibensko-kninskom županijom. Prema dostupnim informacijama, brodolom se trebao nalaziti na dubini od 24 do 28 m na njegovoj sjeveroistočnoj strani. Pretražena je cijela istočna i sjeverna strana otočića i unatoč fenomenalnoj vidljivosti brodolom nije pronađen. Pronađene su tek dvije amfore tipa Forlimpopoli u dijelovima.

Kada se u potrazi za podvodnom baštinom želi pregledati veća površina podmorja u kratkom vremenskom periodu, koriste se razne geofizičke metode. MCPA Zadar je ove godine izvršio pregled područja uz samu staru jezgru grada Zadra skeniranjem morskog dna side-scan sonarom pričvršćenim za plovilo. To područje odabrano je za skeniranje upravo zbog spoznaje da grad Zadar svojom dugom i burnom poviješću ima važno mjesto u plovidbi Jadranom. Za dobivanje što preciznije slike ovom metodom pregleda, potrebno je mirno more bez valova pa se za skeniranje iskoristila prva prilika za lijepog vremena u rujnu.

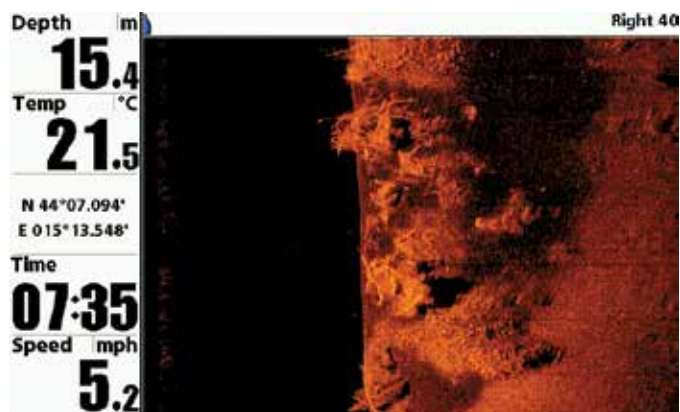
Pregled je započeo još u uvali Jazine, istočno od mosta. Kao što se i očekivalo, na zaslonu se u tim trenutcima nisu uočili predmeti stariji od pokojeg recentnog betonskog sidra za brodove ili pokojeg predmeta (npr. štednjak), koji bi svoje mjesto trebao imati u kuhinji a ne na morskome dnu. U uvali Jazine, zapadno od mosta, 50-ak metara sjeverno od Vrata sv. Krševana uočena je anomalija koja se preko jednog metra izdiže s morskog dna. Izgleda poput hrpe kamenja sa željeznim elementima koji iz nje strše. Nije se uspjelo definirati o čemu se točno radi, a



5. Satellite image with scanned areas indicated / Satelitski snimak s označenim područjem skeniranja
(By: R. Surić)

to four metres. Highly fragmented and worn amphorae sherds are scattered over an area of 100 by 50 metres. The sherds recovered do not provide enough detail for a typological determination.

A survey was also made at a potentially interesting location in the waters off Runjava Kotula islet, located to the south of Pašman island. The survey did not yield any archaeological finds that would point to the presence of an archaeological site at this position.



6. Image of the anomaly on the sea floor in Jazine cove / Snimak anomalije na morskom dnu u uvali Jazine (By: L. Bekić)

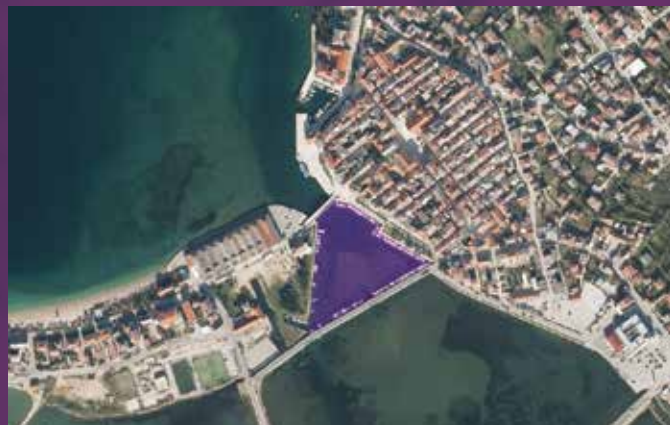
Along with the search for new archaeological sites the Coordination programme also saw a survey of already known archaeological sites with wrecks. A position in the waters off cape Krbar on Žut island was inspected because it is mentioned in the literature as the site of a wreck with a cargo of flat-bottomed amphorae (Vrsalović 2011, 100). Searching for the site divers descended to depths of between five and 17 metres and examined the entire area around the cape. In spite of excellent visibility only a few amphorae sherds were recovered and no larger accumulation, as mentioned in the literature, was found.

Another interesting location that we needed to check is the site of a wreck with a cargo of Dressel 26 amphorae off Visovac islet. The islet lies to the south of Zadar County where it meets Šibenik-Knin County. Based on the available information the wreck should be at a depth of from 24 to 28 metres on its northeast side. The whole of the eastern and northern sides of the islet were examined and in spite of phenomenal visibility a wreck was not located. Only two fragmented Forlimpopoli amphorae were found.

Various geophysical methods are applied when we wish to survey a large expanse of the sea floor in search of underwater heritage. This year ICUA Zadar performed a survey of the sea floor running along the old core of the

zaron na tom mjestu bi vrlo vjerojatno razjasnio tu enigm.

Osim uvale Jazine pregledano je područje uz zapadnu obalu poluotoka, a uz nju nisu uočene anomalije na morskom dnu. Skeniranje se nastavilo uz cijelu južnu



7. Satellite image of the town of Pag with Katine harbour indicated / Satelitski snimak grada Paga s označenim prostorom lučice Katine (By: R. Surić)

obalu poluotoka. Skeniranje se provodilo u paralelnim linijama, počevši od same obale pa do stotinjak metara udaljenosti od nje, odnosno na dubinama od 5 do 40 m. Na više se mjesta uz južnu obalu, na dubinama od 5 do 10 uočio nasip na morskom dnu koji se pruža usporedno s obalom. Možda se radi o ostacima nasipa koji je priječio brodove da pristanu na južnu zadarsku rivu. Osim nasipa, uočeno je nekoliko pozicija koje bi mogle biti potencijalni brodolomi. Pozicija tih lokaliteta je zabilježena, kako bi se na njima u budućnosti mogli odraditi ronilački pregledi. Skenirano je potom područje između zadarskog poluotoka i poluotoka Puntamike u dužini od oko 1 NM. Na ovom prostoru nisu zabilježene pozicije koje bi se mogle okarakterizirati kao podvodni lokaliteti.

Ovakva vrsta pregleda pokazala se dosta efektivnom kad se radi o širokom prostoru, a unatoč tome što se ne može uvijek jasno definirati o kakvoj se anomaliji na morskom dnu radi, već sama činjenica da su otkrivene dovoljno je korisna za daljnje definiranje drugim metodama pregleda.

Prije građevinskih radova u moru Konzervatorski odjeli mogu propisati pregled arheološkog terena ili zaštitna arheološka istraživanja čija je svrha definiranje potencijalnih arheoloških ostataka na predmetnom području. MCPA Zadar je ove godine pregledao podmorje lučice Katine u gradu Pagu i izvršio zaštitna arheološka istraživanja u luci Rab u gradu Rabu.

Kada se radi o građevinskim radovima, onda se moraju poštovati rokovi, a pošto arheološki pregled prethodi bilo kakvim intervencijama na morskom dnu, podvodni arheolozi MCPA Zadar su morali pregledati teren gotovo

city of Zadar using a boat mounted side-scan sonar. The area was selected in light of our knowledge that Zadar has over its long and tempestuous history been a major hub of Adriatic navigation. Calm seas are required to obtain the highest possible image precision using this method and we took advantage of the first such period of nice weather in September.

The survey began in Jazine cove to the east of the bridge. As expected the viewing screen did not initially show anything older than the odd recent concrete anchor for boats or objects (such as a cooking stove) that would be better suited to a kitchen than the sea floor. An anomaly was, however, observed rising over one metre from the sea floor in Jazine cove to the west of the bridge, some fifty metres to the north of St Chrysogonus' Gate (Vrata svetog Krševana). It has the appearance of a heap of stones with protruding steel elements. We were unable to make a definitive identification, but a dive at this location would likely resolve the enigma.

Besides Jazine cove we also surveyed the area along the western shore of the peninsula on which the old town core lies, where no anomalies of interest were observed on the sea floor. Scanning continued along the whole of the southern shore of the peninsula. Scanning was performed in parallel runs, starting from just off the shoreline to about a hundred metres out, at depths of from five to 40 metres. An embankment was observed on the sea floor at several places along the southern shoreline at depths of from five to ten metres running parallel to the shoreline. These may be the remains of an embankment meant to prevent ships from landing along Zadar's southern waterfront. Besides this embankment we also observed a number of positions that may be shipwrecks. These positions were recorded for future dive examinations. The scanning then moved on to the area between the Zadar peninsula and the Puntamika peninsula covering about one nautical mile. No positions were observed along this stretch that could be characterised as underwater sites.

This survey method has been shown to be quite effective when surveying a large area and, in spite of the fact that we still cannot clearly identify the nature of an anomaly on the sea floor, just the fact that we are able to locate it is sufficiently useful in advance of applying other surveying methods.

Prior to construction work in the sea the conservation departments may prescribe an archaeological survey of the terrain or rescue archaeological excavation with the objective of identifying potential archaeological remains in the area in question. This year ICUA Zadar was tasked to survey the waters of the small port at Katine on Pag island and to perform rescue archaeology excavation at

istog trena po dobivanju dozvole. Pag je, kao i ostatak Hrvatske, ove godine zahvatio val hladnoće, pa se plitko more paških uvala i solane našlo pod ledom. Arheološki pregled se poklopio s trenutkom topljenja tog leda na površini mora, što je rezultiralo time da temperatura mora nije prelazila 4°C.



8. A mould from Pag with a scene of Samson and the lion with a silicone cast / Kalup iz Paga sa scenom borbe Samsona s lavom i silikonski odljev (Photo: R. Surić)

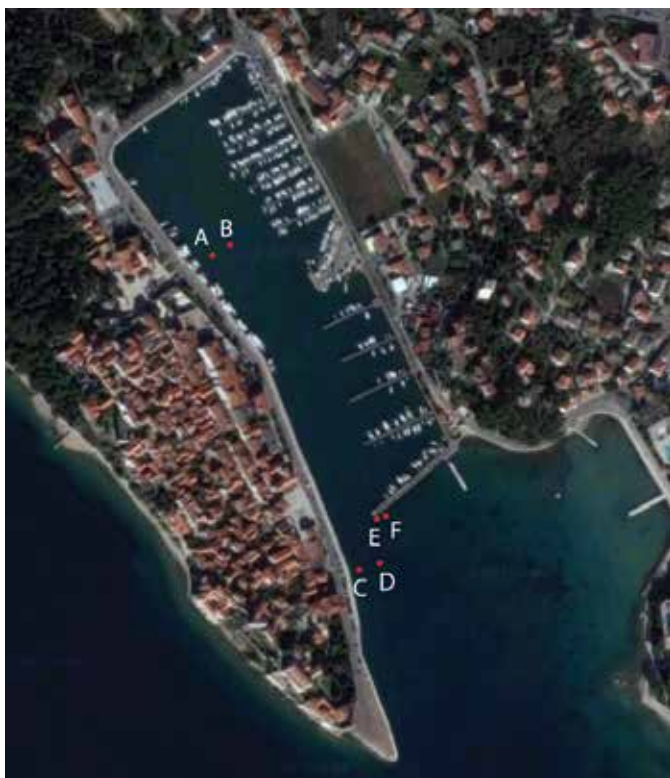
Budući da grad Pag postoji od 15. st., kontinuitet korištenja ovog prostora potencijalno bi trebao sadržavati arheološke ostatke. Poznato je da se dio materijala koji je nastao rušenjem gradskih zidina 1850. g. koristio za nasipavanje prilikom izgradnje nove obale, što je stvorilo veliku mogućnost da se dio arheološkog materijala danas nalazi na dnu lučice. Pregled je izvršio tim od četiri ronionca na način da se sama lučice podijelila u četiri zone, kako bi ih ronilački parovi mogli efikasno pregledati u dvodnevnom periodu. Površinski pregled vršen je među



9. Potsherds found during the survey of the Pag harbour / Keramički ulomci pronađeni prilikom pregleda lučice Pag (Photo: M. Kaleb)

modernim sidrenim strukturama kao što su betonski blokovi, lanci i konopci koje koriste brodove vezane obalu.

Najveća koncentracija arheoloških nalaza zamijećena



10. Satellite image of the town of Rab with indicated trench positions / Satelitski snimak grada Raba s označenim pozicijama pojedinih sondi (Photo: R. Surić)

the harbour of the town of Rab.

When construction work is at issue deadlines must be met, and with the archaeological survey coming first in line prior to any intervention on the sea floor, the underwater archaeologists with ICUA Zadar had to survey the terrain almost immediately upon receiving the required permit. As with the rest of Croatia Pag was gripped by a cold wave this year, and the shallow water of the coves on Pag and its salt pans were soon iced over. The archaeological survey took place as the ice was melting on the surface of the sea, resulting in a seawater temperature that did not exceed 4°C.

As the city of Pag on the eponymous island has been around since the fifteenth century the continual use of this area means there is potential for archaeological remains. We do know that a part of the material that was created with the demolition of the city walls in 1850 was used as fill material during the construction of the new waterfront, which means that there is a significant possibility that archaeological material now lies at the bottom of the small harbour.

The survey was performed by a team of four divers, with



11. Antiquity period jug in front of a find spot, at Rab centre / Antički vrč pred mjestom nalaska, centrom Raba (Photo: R. Surić)

koje bi upućivala na postojanje objekata pod morem. Koncentracija površinskih nalaza dosta se razlikuje na pojedinim dijelovima lučice, ali nalazi uglavnom pokazuju okvirnu dataciju nakon 15. st.



12. Two oil lamps from Rab harbor / Dvije uljanice iz luke Rab (Photo: R. Surić)

Prilikom pregleda nije prikupljen cjelokupni materijal koji je nađen na dnu, već su prikupljeni različiti uzorci koji se tipološki mogu definirati. Glavnina nalaza pripada keramici, a od tog keramičkog materijala najzastupljenije je novovjekovno glazirano stolno posuđe. Ono je zastupljeno u raznim varijantama, pa se prepoznaju: razni tipovi gravirane i oslikane engobirane keramike, ulomci majoličkog posuđa, porculan i kamenina. Jedan od najzanimljivijih nalaza pronađen tijekom arheološkog pregleda je novovjekovni keramički kalup za izradu keramičkih pećnjaka s reljefnim ukrasom. Prikaz koji nastaje apliciranjem je starozavjetna biblijska scena borbe suca Samsona s lavom.

the small harbour divided into four zones so that pairs of divers could effectively survey the area over a period of two days. The surface survey was performed between the modern anchorage structures such as concrete blocks, chains and ropes used by small boats berthed at the waterfront.

The highest concentration of archaeological finds was observed in the northern and eastern ends of the harbour adjacent to the old town core of Pag. For the most part these are sporadic ceramic and glass finds on the sea floor surface. No firm structures were observed that would point to the presence of submerged structures. The concentration of surface finds varies greatly in various parts of the harbour and they are approximately dated for the most part to the period after the fifteenth century.

The survey did not recover all of the material found on the sea floor; rather only samples that are typologically identifiable were collected. The majority of the finds are of pottery, with the highest representation being among post-medieval glazed tableware. Various variants are represented including several types of engraved and painted engobed pottery, sherds of majolica, porcelain and stoneware. One of the most interesting finds recovered in the course of the archaeological survey is a post-medieval ceramic mould for the manufacture of ceramic stone tiles with a relief decoration. The image created by the mould is that of the biblical Old Testament Samson grappling with a lion.

Again in search of underwater heritage ICUA Zadar this year conducted rescue archaeological excavation in the harbour at Rab ahead of the development and expansion planned for the harbour. Rab is a town on the eponymous island and has been a point of maritime commerce from the Antiquity period to the present day. The rescue archaeological excavations gave the archaeologists with ICUA Zadar an opportunity to look below the surface of this potentially archaeologically significant site. Once it had been decided together with the conservation department what positions would be investigated underwater archaeological excavation began at six 2 by 2 metres trenches.

The first two trenches were opened in the sea floor of the harbour adjacent to Trg svetog Kristofora ("St Christopher Square") at a position where a long concrete mole is planned. One trench was placed about 20 metres from the current waterfront and the other about 40 metres out. Already as the grid was installed on the sea floor at the site of the trench it was evident that the archaeologists would be "battling" the copious quantity of silt that has settled on the sea floor here over many years. Excavations in the trenches did not yield a single archaeological find even



13. Ahead of a dive in stormy weather / Ronilac čeka zaron po nevremenu (Photo: R. Surić)

U potrazi za podvodnom baštinom MCPA Zadar je ove godine proveo zaštitna arheološka istraživanja u luci Rab, za potrebe uređenja i dogradnje koja se u toj luci planiraju napraviti. Rab je grad na istoimenom otoku, a od vremena antike do danas predstavlja važnu točku u nautičkom gospodarstvu. Zaštitna arheološka istraživanja pružila su arheolozima MCPA Zadar priliku da zavire ispod površine na ovoj značajnoj i potencijalno arheološki zanimljivoj lokaciji. Nakon što su u dogovoru s konzervatorskim odjelom definirane pozicije na kojima će se postaviti šest arheoloških sondi dimenzija 2 x 2 m, krenulo je podvodno arheološko iskopavanje.

Prve dvije sonde postavljene u podmorju lučice ispred Trga sv. Kristofora, na poziciji na kojoj se planira raditi dugački betonski mol. Jedna sonda postavljena je na oko 20 m udaljenosti od današnje obale, dok je druga smještena na oko 40 m od današnje obale. Već kod samog postavljanja kvadratne konstrukcije na morsko dno, bilo je jasno da će arheolozi u ovim sondama morati ući u "bitku" s velikom količinom mulja koja se kroz dugi niz godina nataložila na morskom dnu. Iskopavanjem u sondama gotovo da i nisu pronađeni arheološki nalazi čak i nakon 70-ak cm kopanja kroz razne varijante mulja, koji je u jednom trenutku postao toliko kompaktan da je klasično iskopavanje dovedeno u pitanje, te je iz tehničkih razloga daljnje iskopavanje prekinuto, a zbog nedostatka nalaza odlučeno je da se na tom prostoru ne nalaze zapreke za postavljanje novog betonskog mola.

Usljedio je potom iskopavanje dviju sondi na prostoru ispred današnjeg hotela Arbiana. Na toj poziciji se planira izgraditi dodatni lukobran koji bi štitiu luku od jačih južnih valova, koje je i arheološki tim doživio za vrijeme iskopavanja u luci. Sonde su postavljene na udaljenosti od 25 i 35 m od današnje obale. Nakon početnih slojeva u kojima se nalazio samo recentni otpad, otkriven je na dubini od preko 1 m u obje sonde sloj s antičkim

after digging through some seventy centimetres of various variations of the silt, which at one point was so compact that further classic excavation was effectively impractical, leading to a decision to terminate the excavation at this point for technical reasons and the decision that there were no obstacles to the installation of a new concrete mole at this site in light of the complete absence of finds.

This was followed by the excavation of two trenches facing the current hotel Arbiana. An additional breakwater is planned here to protect the harbour from strong southern waves, which the team of archaeologists had an opportunity experience during the excavations in the harbour. Trenches were set at distances of 25 and 35 metres from the current shoreline. While the initial layers yielded only recent refuse, at a depth of over one metre we discovered a layer of antique finds in both trenches. Among the finds we can single out an almost complete spherical Aegean kitchenware vessel with two strap handles and the base of a thin-walled amphora with traces of painting. Given the concentration and nature of the finds, especially in Trench C, located closer to the shore, the area covered by the rescue archaeological excavations should be broadened ahead of any construction work.

The last two trenches were opened along the seaward side of the current breakwater at its very head. A survey of the terrain established that there are submerged embankments immediately adjacent to the breakwater, i.e. heaps of stone among which we found an abundance of archaeological material. This led us to place the trenches nearer to the head of the breakwater rather than at the centre or nearer to the shore. In Trench E, positioned nearer to the head of the breakwater, the removal of the upper layer yielded finds from the renaissance to the contemporary period, beneath which large stone blocks were discovered that extend out from the embankment for which we are unsure when it might have been created. In Trench F we did not find archaeological material and it was concluded that there are no obstacles to the start of construction work to develop the breakwater.

This year's search for underwater heritage has resulted in new discoveries and insight. Besides the finds of two new shipwrecks it was also discovered that some wrecks are not at the reported positions. Also significant is that we have begun an examination of the waters off Zadar's old town core and that this has revealed a number



14. Excavation in Trench C / Iskopavanje u sondi C
(Photo: R. Surić)

nalazima. Od nalaza valja izdvojiti nalaz gotovo čitave loptaste egejske kuhinjske posude s dvije trakaste ručke i dno amfore tanjih stijenki s tragovima bojanja. S obzirom na koncentraciju i karakter nalaza, a posebno na prostoru sonde C koja se nalazi bliže obali, valjalo bi prije samih radova proširiti površinu zaštitnih arheoloških istraživanja.

Posljednje dvije sonde postavljene su uz današnji lukobran i to s vanjske strane uz samu njegovu glavu. Pregledom terena ustanovljeno je da se na prostoru uz samu glavu lukobrana, nalaze podvodni nasipi, odnosno hrpe kamenja među kojim je pronađeno mnoštvo arheološkog materijala. Ta spoznaja dovela je do toga da se sonde postave bliže glavi lukobrana, a ne po sredini ili bliže obali. U sondi E, koja je pozicionirana bliže samoj glavi skinut je gornji sloj u kojem su otkriveni nalazi od modernog do renesansnog razdoblja, a ispod tog sloja su otkriveni veći kameni blokovi, koji su produžetak nasipa za koji nije sasvim jasno kad je mogao nastati. U drugoj sondi, sondi F nisu pronađeni arheološki nalazi te je zaključeno da ne postoje zapreke za provođenje radova na uređenju lukobrana.

Ovogodišnja potraga za podvodnom baštinom rezultirala je novim otkrićima i spoznajama. Osim što su pronađena dva nova brodoloma, ustanovljeno je i da neki brodolomi nisu na pozicijama na kojima se mislilo da jesu. Značajno je i to što se krenulo u pretraživanje podmorja uz zadarsku gradsku jezgru i što je tim pretraživanjem uspješno pronađeno nekoliko zanimljivih lokacija, na kojima se može napraviti dodatan pregled zaronom na licu mjesta.



15. Aegean kitchenware / Egejska kuhinjska posuda
(Photo: R. Surić)

of potentially interesting locations where additional examination can be undertaken by dives.

The survey of the small harbour at Katine in the town of Pag yielded numerous archaeological finds that bear witness, above all, to the intensive activity at this site since the town was founded in the fifteenth century. No archaeological remains were found that would point to the presence of an archaeological site in the harbour that would be an obstacle to construction, but given that this was only a surface survey the recommendation is that expert supervision be undertaken in the course of any future works.

The survey in the harbour at Rab established the locations of the archaeological material, creating a picture that will help prevent the devastation of archaeological sites during the construction of new harbour installations. The results achieved in the excavations and survey at the harbour in Rab will help during possible future underwater archaeological excavation.

The ICUA Zadar archaeological team will continue in the future with surveys of numerous positions at which we can expect archaeological finds.

Pregledom lučice Katine u gradu Pagu pronađeni su brojni arheološki nalazi, koji prije svega svjedoče o intenzivnom životu koji se na tom mjestu odvijao od osnutka grada u 15. st. Isto tako, nisu pronađeni arheološki ostaci koji bi upućivali da se na prostoru lučice nalazi arheološki lokalitet koji bi spriječio gradnju, no s obzirom da se radi tek o površinskom pregledu, preporuka je da se prilikom bilo kakvih budućih radova izvrši stručan nadzor.

Pregledom u luci Rab ustanovljeno je na kojim pozicijama se nalazi arheološki materijal, a time se stvorila slika koja će pomoći da prilikom gradnje novih lučkih instalacija ne dođe do uništenja arheoloških lokaliteta. Rezultati dobiveni istraživanjem i pregledom luke Rab mogu pomoći prilikom budućih potencijalnih podvodnih arheoloških istraživanja.

Arheološki tim MCPA Zadar i u budućnosti će nastaviti s pregledom brojnih pozicija na kojima se mogu očekivati arheološki nalazi.

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**16. Amphorae sections among the heaps of stone /
Dijelovi amfora među hrpama kamenja
(Photo: L. Bekić)**





1. The making of the logboat with young volunteers
/ Tesanje deblaka, z mladimi prostovoljci
(Photo: ZaPA)

PROJECT NAVIS / PROJEKT NAVIS

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If you were on Ljubljana Špica this summer, searching for a shadow and a nice cool drink, you might have noticed a group of archaeologists trying to build a large oak logboat. The build was the continuation of Project Navis from last year, when we were making a small (4m long) hypothetical roman logboat. Encouraged by last year's success we decided to set our goals a bit higher and build the reconstruction of the Vrhniko logboat, which we excavated with help from people from ICUA Zadar in the year 2015.

Project Navis, is the concept of reconstructing the historic / archaeological boats of Ljubljana's marshes. But the project is not only the building of historic boats, are goals are much more ambitious. We want to present the stories, thought which a person can relive the history as authentic as possible.

So the Project Navis never rested, during the autumn and winter nights we were researching, developing searching for sponsors and connect stories and characters who are in love with experimental archaeology. The logboat that we chose this year is one of the largest logboats in Europe (almost 15m long) and in excellent condition. Currently

Če ste v tem poletju kdaj zašli na ljubljansko Špico, ste morebiti med iskanjem sence in osvežitve opazili skupinico, ki se je pod pergolo zavzeto trudila ogromen hrastov hlod spremeniti v čoln. Da, to je bilo nadaljevanje lanskoletnega projekta Deblak, le v novi, prijetnejši preobleki in na novi lokaciji. Lani smo namreč deblak gradili na Vrhniku in nato z njim pripluli na Špico, tokrat pa je bil načrt obraten. A projekt Deblak v resnici ni počival niti za trenutek. Preko jesenskih in zimskih mesecev se je nadaljeval s pripravami in iskanjem poti, kako naprej, s pridobivanjem sredstev, povezovanjem zgodb in akterjev, ki so zaljubljeni v eksperimentalno arheologijo.

Lani smo gradili hipotetičen, manjši ribiški rimskodobni čoln, tokrat pa smo se lotili precej večjega zalogaja. Odločili smo se namreč, da se preizkusimo v rekonstrukciji deblaka, ki je bil leta 2015 dokončno raziskan in dvignjen iz dna Ljubljanice na Vrhniku. Gre za enega največjih do sedaj odkritih deblakov v Evropi, ki po zaslugi veličastnosti (dolga je bil skoraj 15 m) in izvrstne ohranjenosti navdušuje tako strokovnjake kot laike. Deblak bo po končani konservaciji v Restavratorskem centru v Ljubljani razstavljen v Kulturnem centru Vrhnika – razstavišču Moja Ljubljana.



2. The romans have a ritual before launching the logboat / Antični obred krsta deblaka ob sploviti (Photo: ZaPA)

it is undergoing a restoration process in the Restoration centre in Ljubljana and after that I will be presented in the Cultural centre in Vrhnika – Exhibition My Ljubljana. For the reconstruction of the logboat, that was sailing on the river in the 2nd century BC and was used by the old cultures or early roman merchants, we needed a fairly large tree. The search took us a long time, since such big trunks can hardly be found in Slovenia. Finally we found it the Krakovski gozd near Kostanjevica. The log was smaller than intended, measuring 10.2 meters in length and a bit more than a meter in width, weighting almost 7 tones but a giant nonetheless.

We are reconstructing the boat so we use the techniques and tools that are represented from a certain time period. So we are also reconstructing the tools, clothes and the know how of ancient builders. At the same times with our co-workers, how specialize in living history we try to present the everyday and life of the ancient people who used the boats in question. But the wider story is connected to reigniting the historic water route between Vrhnika and Ljubljana, by reawakening old crafts and stimulating tourist development. Behind the whole story there was a lot of scientific research. For example, even

3. The visitors are helping to drag the logboat to the river Ljubljanica / Obiskovalci pomagajo vleči deblak do reke Ljubljanice (Photo: ZaPA)



Za rekonstrukcijo plovila, s katerim so v 2. stoletju pred našim štetjem pluli po Ljubljanici staroselci ali prvi rimski trgovci v teh krajih, smo precej dolgo iskali primerno deblo. Na koncu smo ga našli v Krakovskem gozdu, v bližini Kostanjevice ob Krki. Pridobljeno deblo je imelo dolžino 10,2 metra, širino več kot en meter in je tehtalo skoraj sedem ton! Skratka, pravi drevesni orjak! Takšnih danes raste v naših gozdovih sila malo.

Projekt Navis ne obsega le gradnje zgodovinskih plovil, njegovi cilji so precej ambicioznejši. Projekt Navis namreč predstavlja zgodbe, preko katerih preteklost podoživite karseda neposredno in osebno. Jo izkusite, občutite. Pri rekonstrukciji plovil uporabljamo tehnike in orodja, ki so bila značilna za obdobje, iz katerega izvira. Kar pomeni, da poleg plovila rekonstruiramo in izdelamo tudi orodja, ki so se uporabljala v tem času. Hkrati s sodelavci, ki se ukvarjajo s t. i. "živo zgodovino", ponazarjamo vsakdanji način življenja nekdanjih uporabnikov rekonstruiranih plovil. Širša zgodba pa je povezana tudi z oživiljanjem stare plovne poti med Vrhniko in Ljubljano, obujanjem pozabljenih obrti, spodbujanjem turističnega razvoja ...



4. A children tale about history and living on the Ljubljanas marshes / Otroška pravljica o prebivalcih barja (Photo: ZaPA)

V ozadju cele zgodbe je seveda veliko zahtevnega znanstvenega raziskovanja, vendar vse to vodi do edinstvene in avtentične izkušnje vsakega obiskovalca. In to je tista vrednost, ki na koncu šteje največ: ker prinaša veliko dodano vrednost predstavitvi in ohranjanju naše skupne dediščine, tako snovne kot nesnovne. Navdušenih obiskovalcev smo tako v času gradnje deblaka in ob njegovi splavitvi srečali res veliko, zato naša vera v takšen način prezentacije dediščine raste.

In kaj se je dogajalo na Špici v tem letu? V okviru dvomesečne prireditve "Deblak je ŠPICA!" smo gradili deblak na očeh javnosti in s sodelovanjem vseh mimoidočih. Pod vodstvom izkušenih animatorjev se je



5. Maiden voyage of the logboat / Krstna plovba deblaka (Photo: ZaPA)

thou the log was smaller we scaled down the Vrhnika's log boat in such manner so we could test the original logboats performance. The live building of the logboat in the centre of Ljubljana, was a unique and authentic experience that brought a lot of understanding about our cultural heritage to all the excited visitors. There was about 5000 people who came just to see the launch of the boat.

Building the logboat was an open event that lasted for 2 months. Anybody could come and try their hand on the axe, of course under the watchful eyes of our instructors and animators. A lot of people stopped and helped us, some of them on a daily basis. But in the evening when we laid our axes to rest, the space changed and we used for other social events, like lectures, photographic exhibitions, plays and so on...

After we have survived the 40 excruciating days on the log, breaking many handles, sharpening meters of axes and talking about our cultural heritage, we finally, with the help of many visitors launched the logboat. The project ended and we felt fulfilled, the mission of spreading the knowledge about history, heritage and one of the biggest logboats in Europe being a great success.

lahko vsakdo od naključnih mimoidočih ali namenskih obiskovalcev preizkusil v rokovanju s starimi orodji in pomagal tesati deblak. Veliko se jih je lotilo tega podviga, še več jih je spremljalo gradnjo, tudi vsakodnevno. Zvečer, po zaključku skoraj vsakodnevne delavnice, so delo pogosto nadaljevali prostovoljci, prireditveni prostor pa je postal pravcati družabni prostor za stare in mlade, radovedne in mimoidoče, domačine in mnoge tujce z različnih koncev sveta.

Potem ko smo na Špici preživeli več kot štirideset napornih, a nadvse bogatih dni, po mnogih polomljenih ročajih orodja, dobljenih žuljih in nepozabnih izkušnjah, je bil deblak končno zgrajen. Skupaj z obiskovalci smo ga spustili v Ljubljano, da je zaplul novim pustolovščinam naproti.

6. The logboat in the center of the old town Ljubljana / Deblak v središču Ljubljane (Photo: ZaPA)





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