

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

Submerged Heritage Potopljena baština

Number / Broj 3, Zadar, December / Prosinac 2013.

in this
issue
u ovom
broju

Hercules Continues with Deep-Sea Survey

Hercules nastavlja s dubinskim pretraživanjem

Bekić, Šimičić

Research of Veštar Harbour

Istraživanja luke Veštar

Bekić

Research of Babuljaš near Pakoštane

Istraživanja Babuljaša kod Pakoštana

Pešić

Shipwrecks at Cape Uljeva near Ližnjan

Brodolomi na rtu Uljeva kod Ližnjana

Bekić

Survey of the Velebit Channel

Rekognosciranje podvelebitskog kanala

Mihajlović

Exploration of the Waters of Zadar County

Pretraživanje podmorja Zadarske županije

Pešić

Survey of Rovinj and Pula Areas

Rekognosciranje podmorja Rovinja i Pule

Bekić

ICEP Underwater Field School

Podvodna terenska škola ICEP

Campbell, Smith, Royal, Begley, Irwin, Zdravković, Phoenix

Student Workshop in Portorož, Slovenia

Delavnica za studente u Portorožu, Slovenija

Erič, Solina

ACMR Underwater Sciences Field School

Terenska škola za podvodne znanosti ACMR

Campbell, Smith, Tare, Begley, Irwin, Zdravković, Phoenix

The Conservation and Restoration of Three Amphorae

Konzerviranje i restauriranje triju amfora

Mustaček, Ćurković, Martinović

Archaeological Finds in the Tankaraca Cove

Arheološki nalazi u uvali Tankaraca

Borzić



IMPRESSUM

Submerged Heritage / Potopljena baština

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

Number / Broj 3

Zadar, December / Prosinac 2013.

Publisher / Izdavač:

International Centre for Underwater Archaeology in Zadar - UNESCO Category II Centre
Međunarodni centar za podvodnu arheologiju u Zadru - UNESCO centar II kategorije

Urednik / Editor: Luka Bekić

Translation / Prijevod: Neven Ferenčić

Graphic Design / Grafički dizajn: CPP grafički studio, Zadar

Tisak / Print: Printera Grupa, Zagreb

Naklada / Print run: 600

ISSN: 1848-2422

NIJE ZA PRODAJU / NOT FOR SALE

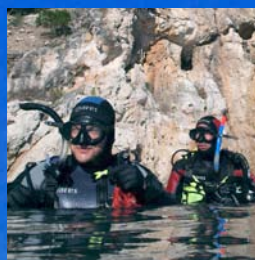
Frontpage / Naslovnica: Uljeva A shipwreck / Uljeva A brodolom (photo: L. Bekić)

Contents Sadržaj



Submerged Heritage
Introduction
Predgovor

page / strana 4-4



Submerged Heritage
News
Vijesti

page / strana 5-10



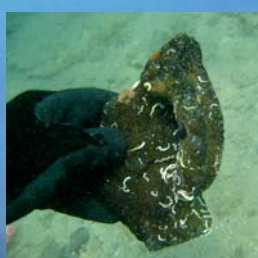
Luka Bekić, Marina Šimičić
Hercules Continues with Deep-Sea Survey of Croatian Waters
Hercules nastavlja s dubinskim pretraživanjem hrvatskog podmorja

page / strana 11-18



Luka Bekić
Final Campaign in the Research of Veštar Harbour
Završna kampanja istraživanja luke Veštar

page / strana 19-24



Mladen Pešić
Research of the Waters of the Islet of Babuljaš near Pakoštane
Istraživanja podmorja otočića Babuljaša kod Pakoštana

page / strana 25-30



Luka Bekić
Continued Research of the Roman Period Shipwrecks at Cape Uljeva near Ližnjan
Nastavak istraživanja antičkih brodoloma na rtu Uljeva kod Ližnjana

page / strana 31-34



Igor Mihajlović
Survey of the Velebit Channel
Rekognosciranje podvelebitskog kanala

page / strana 35-39



Mladen Pešić
New Results from the Exploration of the Waters of Zadar County
Novi rezultati pretraživanja podmorja Zadarske županije

page / strana 40-45



Luka Bekić
Archaeological Survey of the Seabed in the Broader Rovinj and Pula Areas in 2013
Rekognosciranje šireg podmorja Rovinja i Pule 2013

page / strana 46-50



Peter Campbell, Derek Smith, Jeff Royal, Chris Begley, Derek Irwin, Petra Zdravković, Howard Phoenix
Illyrian Coastal Exploration Program Underwater Field School
Podvodna terenska škola Programa istraživanja ilirske obale

page / strana 51-53



Miran Erič, Franc Solina
Student Workshop on 3D Data Capture and Processing in Underwater Archaeology in Portorož, Slovenia
Delavnica za študente "Zajem in obdelava 3D podatkov v podvodni arheologiji", Portorož, Slovenija

page / strana 54-59



Peter Campbell, Derek Smith, Auron Tare, Chris Begley, Derek Irwin, Petra Zdravković, Howard Phoenix
Albanian Center for Marine Research Underwater Sciences Field School
Terenska škola za podvodne znanosti Albanskog centra za istraživanje mora

page / strana 60-62



Mladen Mustaček, Martina Čurković, Ivo Martinović
The Conservation and Restoration of Three Amphorae from the Pakoštane - Janice and Rovinj - Veštar Sites
Konzerviranje i restauriranje triju amfora s lokaliteta Pakoštane - Janice i Rovinj - Veštar

page / strana 63-68



Igor Borzić
Archaeological Finds in the Waters of Tankaraca Cove, Island of Korčula
Arheološki nalazi u podmorju uvala Tankaraca, otok Korčula

page / strana 69-71

Foreword Predgovor

Submerged Heritage has been published as an annual for the third time now, and we can thus speak of a measure of continuity. Our intention, through this print media, is to publish news on diverse events related to underwater archaeology and preliminary communications on research, whether on excavations or surveys of the seafloor.

From our first issue we at ICUA Zadar have been joined in creating Submerged Heritage by other experts. It is our continuing aim to keep this publication open to all others active in the field of underwater archaeology in the broader Mediterranean sphere.

The concept of this annual journal is not to compete with established scientific reviews targeted solely to the specialist community, but rather to bring the science of underwater archaeology to a broader readership – besides underwater archaeologists, we also wish to reach the many enthusiasts interested in underwater discoveries and others enamoured of all things nautical and historic.

Submerged Heritage thus includes numerous news items from the world of underwater archaeology and heritage and serves as a bridge between the many experts active in the broader Mediterranean. Submerged Heritage is also a source of information and inspiration to our young colleagues, students, divers, hobbyists and other enthusiasts interested in this field.

Our journal is open to experts from all institutions, organisations and associations from all countries who have an interest in preserving and researching the cultural heritage of the Mediterranean and Europe. Please feel free, therefore, to contact us with your ideas, news and suggestions.

The Submerged Heritage Editorial Board

Potopljena baština izlazi kao godišnjak već treći puta, pa tako već možemo govoriti o nekom kontinuitetu. Namjera nam je da na ovaj način tiskanim putem objavujemo vijesti o raznim događajima vezanim uz polje podvodne arheologije kao i prethodna priopćenja o istraživanjima, bilo iskopavanjima ili pregledima podmorja.

Već od prvog broja osim nas iz MCPA Zadar, u stvaranju Potopljene baštine sudjeluju i drugi stručnjaci. I nadalje nam je želja, da držimo otvorenom ovu publikaciju i za sve ostale koji se bave podvodnom arheologijom u širem sredozemnom području.

Koncept ovog godišnjaka nije konkurirati etabliranim znanstvenim izdanjima namijenjenim samo specijalistima, već približiti znanost podvodne arheologije širem krugu čitalaca, dakle osim podvodnima arheolozima i brojnim entuzijastima koje se zanimaju za podvodna otkrića kao i ostalim zaljubljenicima u podmorje i povijest.

Na taj način Potopljena baština sadržava brojne novosti iz svijeta podvodne arheologije i baštine te djeluje kao most koji spaja brojne stručnjake koji djeluju na širem području Sredozemlja. Isto tako potopljena baština je i izvor informacija te nadahnuća mladim kolegama, studentima, roniocima, hobiistima, i drugim entuzijastima koje zanima ovo područje.

Naš list otvoren je za stručnjake svih institucija, organizacija i udruga iz bilo koje zemlje a koji imaju interes u očuvanju i istraživanju podvodne kulturne baštine Sredozemlja i Europe. Stoga nam se slobodno javite sa svojim idejama, vijestima i prijedlozima.

Uredništvo Potopljene baštine



Amphora from Tanko Cove, Rava
Amfora iz uvale Tanko, Rava (photo: J. Macura)

The International Centre for Underwater Archaeology in Zadar Organises Lecture on Underwater Archaeology in Croatia

In the frame of their post graduate doctoral studies in underwater archaeology, Marko Meštrov of the Han-Vrana Agency and Mladen Pešić of the International Centre for Underwater Archaeology held lectures on the topics of their doctoral dissertations. Marko Meštrov's lecture was on "Navigation through the Pašman Channel in the Roman Period", while Mladen Pešić presented the topic of "Products of the Province of Africa Proconsularis from Underwater Sites in Croatia". The lectures were staged on Monday, November 26th 2012 at the lecture hall of the International Centre for Underwater Archaeology in Zadar, No.1 Božidara Petranovića Street, starting at 6:30 p.m. Listening to the lectures were students of the University of Zadar and fellow archaeologists.



Underwater archaeologists Marko Meštrov and Mladen Pešić
Podvodni arheolozi Marko Meštrov i Mladen Pešić (photo: L. Bekić)

ICUA Archaeologists Hold Lectures in Vienna

At the invitation of the Working group for underwater archaeology (AK Unterwasserarchäologie) of the Austrian Society for Prehistory and Early History (Österreichische Gesellschaft für Ur- und Frühgeschichte), underwater archaeologists of the International Centre for Underwater Archaeology in Zadar held lectures for students and professors of the University of Vienna. The lectures were staged on Tuesday, December 4th 2012 between 6 and 8 p.m. at lecture hall no. 7 of the Austrian Society for Prehistory and Early History at No.1 Franz-Klein-Gasse Street. Mladen Pešić held his lecture on "The remains of Suleiman's Bridge at Darda Lake in Baranja" in English, while Luka Bekić gave his lecture on the "Deep Sea Survey with Research Ship Hercules near Dubrovnik". The visit also included meetings that aimed to open the possibilities for collaboration between Austria and Croatia in the field of underwater archaeology.

Međunarodni centar za podvodnu arheologiju u Zadru organizirao predavanja na temu podvodne arheologije u Hrvatskoj

U sklopu poslijediplomskog doktorskog studija podvodne arheologije, Marko Meštrov iz agencije Han-Vrana i Mladen Pešić iz Međunarodnog centra za podvodnu arheologiju održali su predavanja vezana uz teme svojih doktorskih radova. Tako je Marko Meštrov održao predavanje "Plovidba pašmanskim kanalom u antici" dok je Mladen Pešić predstavio temu "Proizvodi provincije Africa proconsularis s podvodnih hrvatskih nalazišta". Predavanja su se održala u ponedjeljak, 26. studenog 2012. u dvorani Međunarodnog centra za podvodnu arheologiju u Zadru, Božidara Petranovića 1, s početkom u 18:30 sati. Predavanjima su nazočili studenti zadarskog sveučilišta kao i neki kolege arheolozi.

Arheolozi MCPA održali predavanja u Beču

Podvodni arheolozi Međunarodnog centra za podvodnu arheologiju u Zadru su na poziv radne grupe za podvodnu arheologiju (AK Unterwasserarchäologie) Austrijskog društva za prapovijest i ranu povijest (Österreichische Gesellschaft für Ur- und Frühgeschichte) održali predavanja za studente i profesore Sveučilišta u Beču. Predavanja su održana u utorak 4. prosinca 2012.g., između 18 i 20 sati u dvorani 7 Instituta za prapovijest i ranu povijest u Franz-Klein-Gasse 1. Mladen Pešić je održao predavanje na engleskom jeziku "The remains of Suleiman's Bridge at Darda lake in Baranja" a Luka Bekić predavanje "Deep sea survey with research ship Hercules near Dubrovnik". U sklopu ovog posjeta održali su se i sastanci koji su imali za cilj otvoriti mogućnosti za suradnju između Austrije i Hrvatske na području podvodne arheologije.



The lectures were held at the Austrian Archaeological Institute
Predavanja su održana na Arheološkom institutu u Beču
(photo: M. Pešić)

In Poseidon's Realm XVIII Congress Closes

The 18th annual research congress of German and foreign underwater archaeologists organised by DEGUWA at the Kelten Römer Museum in Manching (Bavaria, Germany) closed on Sunday, March 17th 2013. The congress was staged under the motto *Navigare necesse est, vivere non est necesse* and focused on the topic of the supply of Rome and its provinces and the logistics of the Roman Empire and its fleets. Joining the many German archaeologists among the hundred or so guests of the congress were many foreign experts from fifteen countries. Croatia was represented by staffers of the International Centre for Underwater Archaeology in Zadar and of the Croatian Conservation Institute. The most fascinating part of the gathering was the presentation of Roman ships from nearby Oberstimm, presented by specialists Dr Ronald Bockius, professor Dr Christoph Schäfer and Markus Wittköpper, who took part in their restoration, study and reconstruction.



A part of the presentation was held at the magnificent hall housing the original Roman ships. Dio prezentacija održan je i u grandioznoj dvorani s originalnim rimskim brodovima (photo: L. Bekić)

ESDP Meeting at ICUA Zadar

A meeting was staged at the International Centre for Underwater Archaeology in Zadar on March 20th and 21st of 2013 of the European Scientific Diving Panel (ESDP), the umbrella association of European scientific divers. This federation of



The meeting pooled numerous scientific divers from across Europe. Na sastanku su se okupili brojni znanstveni ronionci iz Europe (photo: M. Mustać)

Završio kongres In Poseidons Reich XVIII

U Kelten Römer Museum-u u Manching-u (Bavarska, Njemačka) u nedjelju 17.3.2013. je završio osamnaesti godišnji znanstveni skup njemačkih i stranih podvodnih arheologa u organizaciji DEGUWA-e. Skup je održan pod motom *Navigare necesse est, vivere non est necesse* i za temu je imao opskrbu Rima i njegovih provincija, te logistiku Rimskog carstva i njegove flote. Na skupu je među stotinjak uzvanika, osim najbrojnijih njemačkih arheologa sudjelovao i veći broj stranih stručnjaka i to iz čak 15 zemalja. Hrvatsku su predstavljali djelatnici Međunarodnog centra za podvodnu arheologiju u Zadru i Hrvatskog restauratorskog zavoda. Najzanimljiviji dio skupa je bilo predstavljanje rimskih brodova iz obližnjeg Oberstimm, koje su predstavljali stručnjaci Dr. Ronald Bockius, Prof. Dr. Christoph Schäfer i Markus Wittköpper, koji su sudjelovali u njihovoj restauraciji, proučavanju i rekonstrukciji.



Socialising in the evening was an opportunity for discussion with colleagues from around the world. Večernje druženje je prilika za razgovor s kolegama iz udaljenih krajeva (photo: L. Bekić)

Sastanak ESDP u MCPA Zadar

U Međunarodnom centru za podvodnu arheologiju u Zadru dana 20. i 21. ožujka 2013.g. održao se sastanak krovne udruge



One of the presentations at the ESDP meeting featured the European Marine Board. Jedno od prezentacija na sastanku ESDP bilo je i predstavljanje European Marine Boarda (photo: M. Mustać)

associations and organisations in European countries works in the frame of the European Marine Board (EMB). The objective of the ESDP is to pool scientific divers in Europe with the aim of hammering out harmonised standards, to advance the profession and mutual collaboration, and to influence future European legislation that will cover this aspect of diving. At the meeting were over twenty scientific diving representatives from various institutes in thirteen countries. Croatian scientific diving was represented by the Coordination of Scientific Divers of Croatia, which was accepted to full membership at this meeting.

ICUA Zadar Participates in Seabed Cleaning Campaign

Divers of ICUA Zadar took part in a campaign to clean the waters of the city of Zadar of large refuse – part of the “Healthy for an A” project jointly spearheaded by the ministries of the interior, health and environmental protection staged on April 26th 2013. The campaign was organised by the City of Zadar Police Department, Zadar County and the Institute of Public Health. The cleaning of the seabed started at the Greeting to the Sun art installation on the Istarska Obala waterfront and continued on at the Obala Kralja Petra Krešimira IV waterfront right up to the beach at Kolovare. Many divers took part in the campaign from the Zadar diving clubs Sveti Roko and ZadarSub, joined by police divers and underwater archaeologists. Also participating in the campaign were pupils of schools in Zadar. The campaign aims to raise public awareness of the need to preserve the maritime environment and the environment in general.



ICUA and ZadarSub divers before the start of the campaign
Ronioi MCPA i ZadarSuba pred početak akcije (photo: M. Mustać)

Cyprus Hosts Major International Amphorae Congress

A major congress named *Per Terram, Per Mare* was staged at Lefkosia (Nicosia) on Cyprus from April 12th to 15th 2013, organised by the University of Cyprus and its M.A.R.E. lab. The congress discussed the production and transport of Roman amphorae in the eastern Mediterranean in the frame of the ROMACY project. At the congress were some one hundred experts from twenty European countries and the USA. Besides the latest development in the research of amphorae, there was an opportunity to see and hear all about the chemical-petrographic composition of amphorae clay of the eastern Mediterranean

europskih znanstvenih ronilaca, European Scientific Diving Panel (ESDP). Ovaj savez udruga i organizacija zemalja Europe organiziran je u sklopu European Marine Board-a (EMB). Cilj ESDP je udružiti znanstvene ronioce Europe kako bi dogovorili zajedničke standarde, unaprijedili struku i međusobnu suradnju te utjecali na buduće europsko zakonodavstvo koje će pokrivati ovaj aspekt ronjenja. Na sastanku se okupilo preko dvadeset predstavnika znanstvenog ronjenja iz raznih instituta iz trinaest zemalja. Hrvatsko znanstveno ronjenje predstavljala je Koordinacija znanstvenih ronilaca Hrvatske koja je na ovom sastanku prihvaćena u punopravno članstvo.

MCPA Zadar sudjelovao u akciji čišćenja podmorja

Ronioi MCPA Zadar sudjelovali su u akciji čišćenja podmorja grada Zadra od krupnog otpada, u sklopu zajedničkog projekta Ministarstva unutarnjih poslova, zdravstva i zaštite okoliša koja je pod nazivom “Zdrav za pet“, održana 26. travnja 2013.g. Samu akciju je organizirala Policijska uprava zadarska, Zadarska županija i Zavod za javno zdravstvo. Čišćenje podmorja započelo je na “Pozdravu suncu“ na Istarskoj obali, a nastavilo se Obalom kralja Petra Krešimira IV sve do gradske plaže Kolovare. U akciji su sudjelovali brojni ronioi iz zadarskih ronilačkih klubova Sv.Roko i ZadarSub te policajci i podvodni arheolozi. U akciji su sudjelovali i učenici brojnih zadarskih škola. Cilj akcije bio je podići svijest ljudi o potrebi očuvanja podmorja i okoliša općenito.

Važan međunarodni kongres o amforama održan na Cipru

U organizaciji Sveučilišta Cipra i njihovog M.A.R.E. lab, u Lefkosiji (Nicosia) na Cipru je od 12-15. travnja 2013. održan važan kongres pod nazivom *Per Terram, Per Mare*. Tema kongresa je bila proizvodnja i transport rimskih amfora na istočnom Sredozemlju, sve u sklopu projekta ROMACY. Na kongresu je bilo stotinjak stručnjaka iz dvadesetak zemalja Europe i SAD. Osim najnovijih vijesti iz istraživanja amfora, moglo se mnogo vidjeti i čuti tijekom radionica o kemijsko-petrografskim sastavima gline amfora iz istočnog Sredozemlja. Istraživanja hrvatske podvodne arheologije svojim izlaganjima su predstavili Dino Taras iz AMZd, Pavle Dugonjić te Mladen Pešić i Luka Bekić iz MCPA Zadar.



Lectures before a packed auditorium
Predavanja su održavana u punoj dvorani (photo: M. Pešić)



The greatest interest was in the microscopic analysis of amphorae sample
 Najviše zanimanja bilo je za mikroskopske analize uzoraka amfora (photo: L. Bekić)

during the workshops. The research of Croatian underwater archaeology was presented by lectures delivered by Dino Taras of the Archaeological Museum of Zadar (AMZd), Pavle Dugonjić and by Mladen Pešić and Luka Bekić of ICUA Zadar.

NAS Introduction and Part 1 Courses Completed in Zadar

From May 6th to 8th 2013 the International Centre for Underwater Archaeology in Zadar (ICUA) conducted its first underwater archaeology course of the year following the Nautical Archaeological Society (NAS) programme, these being the NAS Introduction to Foreshore and Underwater Archaeology and

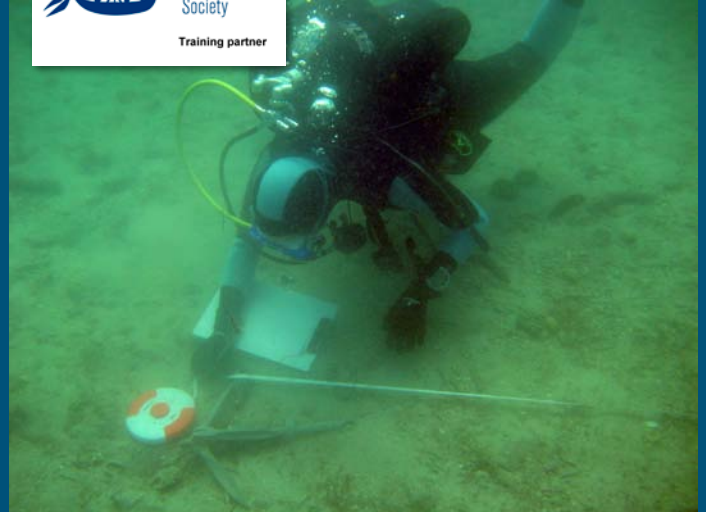


Preparations for a dive at Sveti Bartul Cove in Petřčane
 Priprema za ronjenje u uvali Sv. Bartul u Petřčanima (photo: L. Bekić)

the NAS Part 1 Foreshore and Underwater Archaeology course. The courses consisted of theoretical lectures at the ICUA Zadar lecture hall and practical underwater training at Sveti Bartul Cove in Petřčane near Zadar. Five course participants from Slovenia and two from Croatia successfully completed the courses. The following NAS Introduction to Foreshore and Underwater Archaeology and NAS Part 1 Foreshore and Underwater Archaeology courses are to be held in early July.

Završen NAS Uvodni tečaj i tečaj I. stupnja u Zadru

Od 06. do 08. svibnja 2013.g. Međunarodni centar za podvodnu arheologiju u Zadru (MCPA) proveo je svoj prvi ovogodišnji tečaj podvodne arheologije prema programu Nautical Archaeological Society (NAS) i to NAS Uvod u priobalnu i podvodnu arheologiju i tečaj NAS I stupanj priobalne i podvodne arheologije. Tečajevi su



The course covered elementary training from the NAS programme
 Na tečaju su odrađivane jednostavne vježbe prema programu NAS-a (photo: L. Bekić)

se sastojali od teoretskih predavanja u učionici MCPA u Zadru te praktičnih podvodnih lekcija u uvali Sv. Bartul u Petřčanima kod Zadra. Tečajeve je uspješno završilo pet polaznika iz Slovenije i dva iz Hrvatske. Sljedeći tečaj NAS Uvod u priobalnu i podvodnu arheologiju i NAS I stupanj priobalne i podvodne arheologije održati će se početkom srpnja.



Many young Slovenian archaeologists were at Sveti Bartul Cove
 U uvalu Sv. Bartul su došli brojni mladi arheolozi iz Slovenije (photo: L. Bekić)

U Kemeru održan UNESCO Unitwin sastanak

Prvi UNESCO Unitwin sastanak mreže sveučilišta iz polja podvodne arheologije održan je u Kemeru (Antalija), Turska od 15.-18. svibnja 2013. Sastanak su organizirali UNESCO i Selçuk

UNESCO Unitwin Meeting Held in Kemer

The first UNESCO Unitwin meeting of a university underwater archaeology network was held in Kemer (Antalya), Turkey from the 15th to 18th of May 2013. The meeting was organised by UNESCO and Selçuk University, with the support of numerous local institutions and organisations.

The network was established by a



Ground-breaking ceremony for the construction of a building to house the underwater archaeology department at Selçuk University

Na otvorenju radova na izgradnji zgrade Odjela za podvodnu arheologiju Selçuk sveučilišta (photo: L. Bekić)

group of four universities and the meeting looked into broadening the network, with the representatives of thirty other universities and institutions from around the world on hand in Kemer. Among them were the representatives of the University of Zadar and of the ICUA Zadar UNESCO Centre. The over forty participants of the meeting were also invited to see the traditional 12th Kemer International Underwater Days, a competition in underwater photography.

New Meeting of States Parties to the Convention in Paris

UNESCO headquarters in Paris was the venue from the 27th to 30th of May 2013 for a number of events related to underwater heritage. Monday was Exchange Day, a series of events open to the public. The day included many interesting lectures and photo exhibitions on the underwater heritage theme, closing with a screening of the documentary film *Le Tresor De Bassas Da India*. On Tuesday and Wednesday the State Parties to the Convention on the Protection of the Underwater Cultural Heritage held an official meeting on a number of topics. Thursday was set aside for a meeting of the Scientific and Technical Advisory Body of the Convention, pooling experts in this field.

Istanbul Lecture on Suleiman's Bridge

At the invitation of the Turkish Institute of Nautical Archaeology (TINA) and its president Oğuz Aydemir, Mladen Pešić held a lecture on October 8th 2013 on the research of Suleiman's bridge in Darda conducted by staffers of the International Centre for Underwater Archaeology in collaboration with the Croatian Conservation Institute in 2009 and 2011. The lecture was given

sveučilište, uz podršku brojnih domaćih ustanova i organizacija. Mrežu je osnovala grupa od četiri sveučilišta, a na sastanku se raspravljalo o modusima proširenja mreže, jer su u Kemer doputovali i predstavnici 30 drugih sveučilišta i ostalih institucija cijelog svijeta. Među njima su bili i predstavnici Sveučilišta u Zadru i UNESCO-vog centra MCPA Zadar. Više od četrdeset sudionika sastanka pozvano je da nazoči i tradicionalnim 12-tim Međunarodnim podvodnim danima u Kemeru, odnosno natjecanju u podvodnoj fotografiji.



The open part of the Unitwin meeting was held at the Grand Haber hotel
Otvoreni dio sastanka Unitwina održan je u Grand Haber hotelu
(photo: L. Bekić)

U Parizu novi sastanak zemalja potpisnica konvencije

Od 27. do 30.5.2013. u sjedištu UNESCO-a u Parizu održan je niz događaja vezanih uz podvodnu baštinu. U ponedjeljak je održan Dan razmjene, odnosno niz događanja otvorenih za javnost. Tijekom tog dana su govorili mnogi zanimljivi predavači, a ujedno su održane izložbe fotografija na temu podvodne baštine te je na kraju promoviran dokumentarni film *Le Tresor De Bassas Da India*. U utorak i srijedu zemlje potpisnice Konvencije o zaštiti podvodne baštine održale su službeni sastanak o raznim temama. Četvrtak je bio rezerviran za sastanak Znanstveno-savjetnog tijela Konvencije, sastavljenog od stručnjaka za ove teme.



A film was screened on the search for shipwrecks off Madagascar
Prikazan je i film o potrazi za brodolomima kod Madagascara
(photo: L. Bekić)

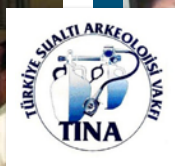
Predavanje o Sulejmanovu mostu u Istanbulu

Na poziv Turske zaklade za podvodnu arheologiju (TINA) i njihovog predsjednika Oğuz Aydemira, Mladen Pešić je 8. listopada 2013. održao predavanje o istraživanjima Sulejmanovog mosta

at Koç Üniversitesi in the core of Istanbul and garnered great interest among the public and specialists as the lecture focused on new research and data from historical sources concerning this structure. The trip also included a visit to the conservation workshop at the University in Istanbul, where the lion's share of thirty-six Byzantine ships discovered in Istanbul during excavation work for the underground railway are currently undergoing conservation treatment. Cooperation with TINA began during the visit of its president to Zadar early this year.



Mladen Pešić's lecture at Koç University in Istanbul
Predavanje Mladena Pešića na Koç sveučilištu u Istanbulu
(photo: S. Yükselsoy)



u Dardi koja su djelatnici Međunarodnog centra za podvodnu arheologiju u suradnji s Hrvatskim restauratorskim zavodom provodili tijekom 2009. i 2011. godine. Predavanje je održano na Sveučilištu Koç (Koç Üniversitesi) u samom središtu Istanbula, i izazvalo je veliko zanimanje javnosti i stručnjaka, budući da su osim novijih istraživanja prikazani i različiti podatci iz povijesnih izvora o ovoj građevini. U sklopu putovanja posjećena je i konzervatorska radionica Sveučilišta u Istanbulu u kojoj pod nadzorom prof. Ufuk Kocabaşa trenutno traje konzerviranje većeg broja od sveukupno 36 pronađenih bizantskih brodova koji su nađeni u Istanbulu prilikom iskopavanja za podzemnu željeznicu. Suradnja s zakladom TINA započela je prilikom posjete njenog predsjednika Oğuz Aydemira Zadrugu početkom ove godine.



Oğuz Aydemir and prof. Ufuk Kocabaş in front of conservation workshop for Yenikapi shipwrecks
Oğuz Aydemir i prof. Ufuk Kocabaş ispred radionice za konzerviranje brodova s Yenikapi (photo: M. Pešić)



Diver at Uljeva A shipwreck
Ronioč na Uljeva A brodolomu (photo: M. Pešić)

Hercules Continues with Deep-Sea Survey of Croatian Waters

Hercules nastavlja s dubinskim pretraživanjem hrvatskog podmorja

LUKA BEKIĆ - lbekic@icua.hr | MARINA ŠIMIČIĆ - msimicic@icua.hr

Staffers of the International Centre for Underwater Archaeology in Zadar again this year took part in the deep-sea survey of Croatian waters, assisted by the highly sophisticated and costly equipment of the research vessel (R/V) Hercules owned by the USA-based RPM Nautical Foundation.

From August 15th to 25th 2013 ICUA Zadar and RPMNF conducted underwater archaeology research of the waters of Konavle and Župa Bay. Funds for the research were provided by RPMNF and the Croatian Ministry of Culture. Serving as directors of the archaeological research were Luka Bekić DSc of ICUA Zadar and Dr Jeffrey Royal of RPMNF. The team of experts consisted of archaeologists Mladen Pešić and Marina Šimičić of ICUA and Domagoj Perkić of the Ministry of Culture. Technical support was provided by the crew of the ship Hercules from Malta, the USA, Canada and the Czech Republic.

This year's research effort continued on last year's campaign, launched in July of 2012, involving sonar scanning of the coastal waters of Konavle, from Prevlaka to Cape Veliki



2. R/V Hercules in Gruž
R/V Hercules u Gružu (photo: M. Šimičić)

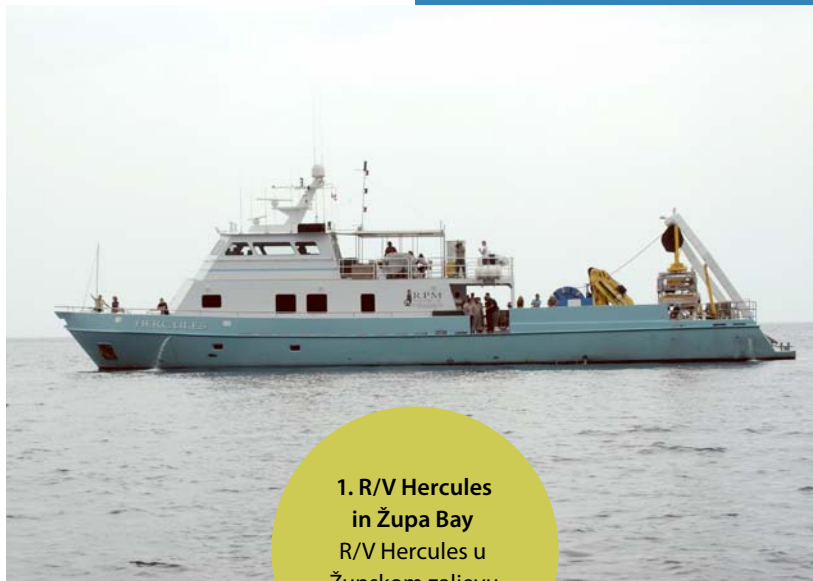
Djelatnici Međunarodnog centra za podvodnu arheologiju iz Zadra i ove su godine sudjelovali u projektu dubinskog pretraživanja hrvatskog podmorja uz pomoć visokosofisticirane i skupe opreme koja je dio istraživačkog broda (R/V) Hercules u vlasništvu Pomorske zaklade RPM (RPM Nautical Foundation) iz SAD-a.

U razdoblju od 15. do 25. kolovoza 2013.g. MCPA Zadar i RPMNF proveli su podvodna arheološka istraživanja podmorja Konavala i Župskog zaljeva. Financijska sredstva za istraživanja osigurao je RPMNF i Ministarstvo kulture Republike Hrvatske. Voditelji arheoloških istraživanja bili su dr. sc. Luka Bekić

iz MCPA Zadar, te dr. Jeffrey Royal iz RPMNF-a. Stručnu ekipu činili su arheolozi Mladen Pešić i Marina Šimičić iz MCPA, te Domagoj Perkić iz Ministarstva kulture. Tehničari su bili članovi posade broda Hercules sa Malte, SAD-a, Kanade i Češke.

Ovogodišnje je istraživanje nastavak prošlogodišnjeg, započetog u srpnju 2012. g. kada je sonarom pretraživano podmorje ispred obala Konavala, od Prevlake do rta Veliki Pač, te naknadnim spuštanjem na pozicije ROV-om, podvodnim robotom (Royal, Bekić 2012). Ove je godine istraživački brod Hercules izveo operaciju skeniranja dna višesnopnim sonarom na području sjeverno od rta Veliki Pač u Konavlima i cjelokupnog područja Župskog zaljeva na dubinama od 30 do 100 metara.

Dubinsko istraživanje podmorja provodilo se pomoću višesnopnog sonara (multibeam). Sonari su pričvršćeni na trup broda Hercules i bilježe neravnine morskog dna. Sonarni snopovi se emitiraju na dvije frekvencije s odašiljačima u dvije glave čime se postiže 200 postotna pokrivenost dna. U brodskom operativnom centru u kojem se nalaze računala i uređaji za upravljanje, tehničari zaduženi za multibeam ucrtavaju linijske putanje po kojima se kreće brod i provjeravaju prikupljene signale. Za vrijeme rada sonara uspostavljena je stalna veza između tehničara multibeam i zapovjednog mosta broda. Ukoliko se sonarna slika pokvarila ili je kretanje broda ometeno drugim plovilima, brod se naknadno vraća na iste lokacije kako bi se skenirao



1. R/V Hercules in Župa Bay
R/V Hercules u Župskom zaljevu (photo: M. Pešić)



Pač, followed by Remote Operated Vehicle (ROV) descents to positions (Royal, Bekić 2012). This year the research vessel Hercules conducted scanning operations of the seafloor using multibeam sonar in the area to the north of Cape Veliki Pač in Konavle and the entire area of Župa Bay at depths of from 30 to 100 metres.

The deep-sea survey of the seafloor was conducted with multi-beam sonar. The sonar devices are affixed to the hull of the Hercules and record contours on the seafloor. The sonar beams are emitted on two frequencies with transmitters in two heads, achieving 200% coverage of the seafloor. In the ship's operations centre, housing the computers and control devices, technicians responsible for the multibeam sonar record the lines of navigation the ship is following and verify the collected signal data. While the sonar is operational there is a constant link between the multibeam technicians and the command bridge of the vessel. If the sonar image is deficient or the movement of the vessel is impeded by other watercraft, the ship returns to these locations in order to scan absolutely every millimetre of



3. The command bridge crew are in constant contact with the technicians during multibeam operations
Posada zapovjednog mosta u stalnoj je vezi sa tehničarima za vrijeme operacije multibeamom (photo: M. Šimičić)

the seafloor. Every day the Hercules stops at selected positions to deploy a sound velocity probe, measure salinity and collect other data used to calibrate instruments.

The data collected by the multibeam sonar is processed during and immediately following the data collection phase to create three-dimensional models of the seafloor (bathymetrics), subsequently analysed for anomalies. Anomalies registered are then inspected in order to determine if they are geoformations (the natural relief of the seafloor), or artificial structures (such as the contours of a sunken vessel).

During the ten days that the research vessel Hercules was in Croatian waters this year, multibeam sonar scanning covered the area north of Cape Veliki Pač in Konavle and all of Župski Bay. So far the survey has revealed at least seven potential positions – known as targets, which could be shipwrecks. Subsequent processing of the data will likely reveal some more anomalies that may be archaeological in character.

The ROV, part of the ship's equipment, was not deployed during this year's survey as it was decided to use only sonar this year

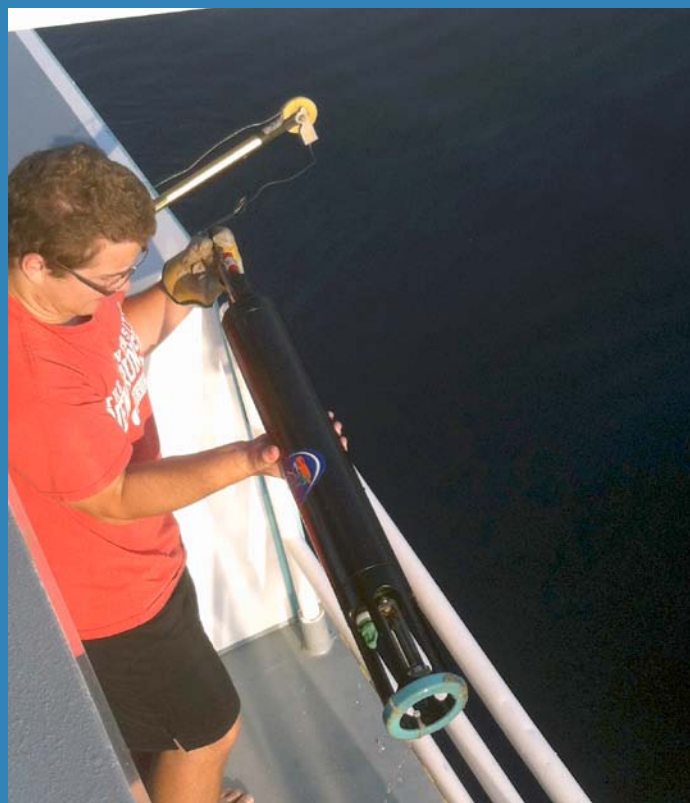


4. Archaeologists Perkić, Bekić and Pešić consider the results of the collected multibeam data
Arheolozi Perkić, Bekić i Pešić razmatraju rezultate prikupljene multibeamom (photo: M. Šimičić)

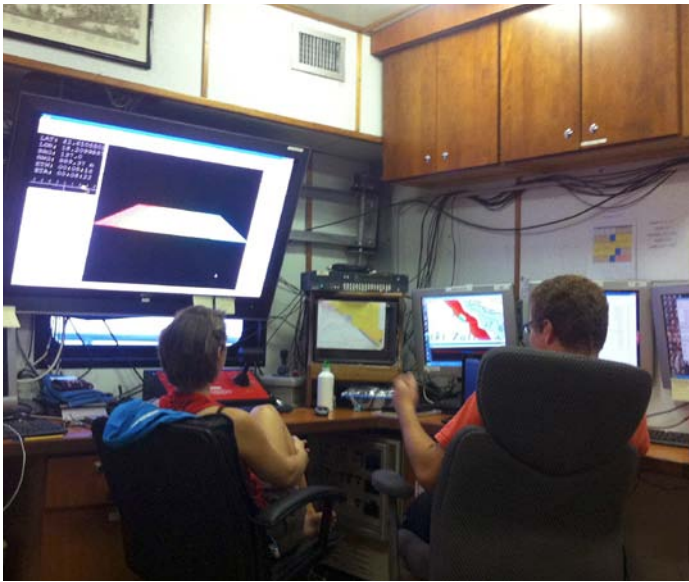
apsolutno svaki milimetar podmorja. Dnevno Hercules nekoliko puta zastaje na odabranim lokacijama kako bi se u more spustio uređaj koji bilježi parametre brzine zvuka, saliniteta mora itd zbog kalibracije uređaja.

Podaci dobiveni istraživanjem višesnopnim sonarom naknadno su obrađivani tijekom i neposredno poslije faze prikupljanja, kako bi se izradili trodimenzionalni modeli podmorja - batimetrija, koji su se zatim analizirali s obzirom na anomalije. Zabilježene anomalije se zatim pregledavaju i utvrđuje se radi li se o geoformacijama (prirodni reljef morskog dna) ili umjetnim tvorevinama (npr. obris potopljenog broda).

U deset dana, koliko je istraživački brod Hercules ove godine boravio u hrvatskim vodama, sonarima - multibeamom skenirano je područje sjeverno od rta Veliki Pač u Konavlima i cijeli Župski zaljev. Tijekom tog pregleda, zasad je određeno najmanje



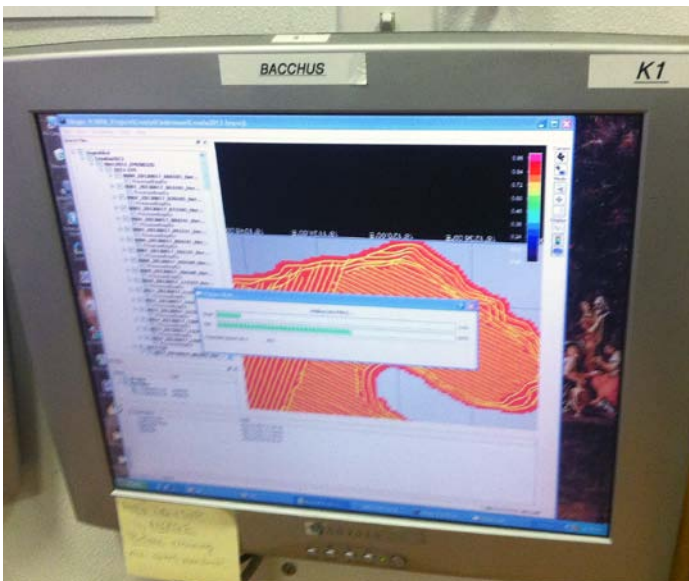
5. The sound velocity probe
Uređaj za mjerenje brzine zvuka (photo: M. Šimičić)



6. The multibeam technicians review the sonar images
Tehničari multibeama nadgledaju slike koje odašilje sonar
(photo: M. Šimičić)

in order to dedicate more time to ROV work in the coming year. Shallower positions were, however, inspected by divers this year, again to save time on ROV deployment which is much more useful for deeper water. The diving team consisted of Luka Bekić, Mladen Pešić and Domagoj Perkić, were assisted on a speedboat by Mirko Maslač from the “Župa Dubrovačka” diving club in Kupari. The dives were conducted only at positions up to a depth of 50 metres. Four of the potential positions, targets, are in Župski Bay, at depths of up to 50 metres, while three are at depths in excess of 50 metres. One of the deeper positions is located to the south of Župa Bay, and two in the northern section of Župski Bay around Cape Pelegrin. For one of the positions registered by sonar it was determined that it was the location of an underwater site of a cage with amphorae in the waters off Cavtat.

Dives were conducted at three locations, i.e. anomalies registered by sonar. All three are in Župski Bay. The first anomaly was observed in the middle of Župski Bay at a depth of about 43

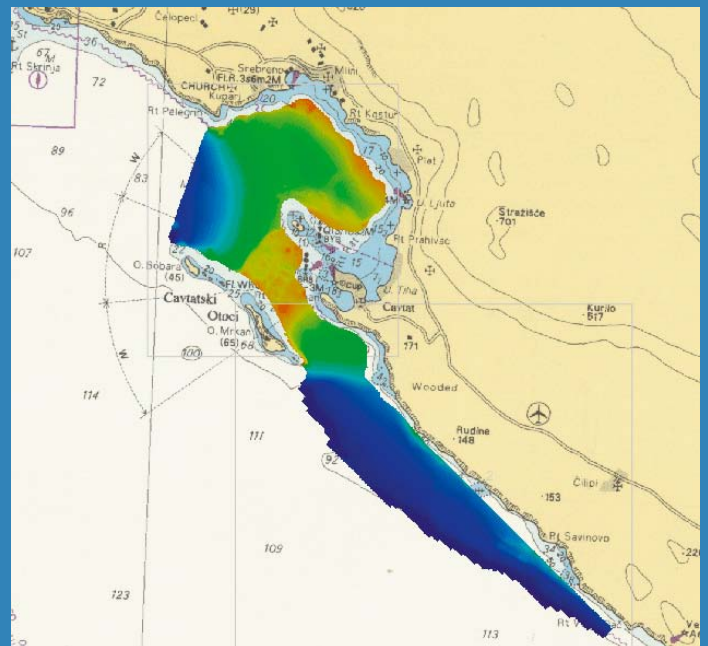


7. The processing of data from the scanning of the seafloor after the collection phase
Obrada podataka dobivenih skeniranjem dna nakon faze prikupljanja (photo: M. Šimičić)

sedam potencijalnih pozicija, takozvanih meta, koje bi mogle predstavljati brodolome. Naknadnom obradom podataka vjerojatno će se zamijetiti i još poneka anomalija koja bi mogla imati arheološki karakter.

U ovogodišnjim istraživanjima nije korištena daljinski upravljana robot ronilica (ROV) koja je dio istraživačke opreme broda, jer je odlučeno da se ove godine isključivo koriste sonari, kako bi se sljedeće godine moglo posvetiti više vremena radu s robotom.

Ipak, pliće pozicije već ove godine su pregledavane ronionicima, kako se na njih također ne bi trošilo vrijeme robota, koji je mnogo korisniji za pregledavanje velikih dubina. Ronilačku ekipu su sačinjavali Luka Bekić, Mladen Pešić te Domagoj Perkić a na gliseru im je asisitirao Mirko Maslač iz ronilačkog kluba “Župa Dubrovačka” u Kuparima. Zaroni su izvedeni isključivo na pozicijama do 50 metara dubine. Četiri se potencijalne pozicije, mete, nalaze u Župskom zaljevu, na dubinama do 50 metara, dok se tri nalaze na dubinama većim od 50 metara.



8. The area surveyed with multibeam sonar during the 2013 campaign
Područje koje je pregledano višesnopnim sonarom u kampanji 2013 (RPMF)

Jedna od dubljih pozicija nalazi se južno od Župskog zaljeva, a dvije u sjevernom dijelu Župskog zaljeva oko rta Pelegrin. Za jednu je sonarom zabilježenu poziciju utvrđeno kako se radi o lokaciji podvodnog nalazišta kaveza s amforama ispred Cavtata.

Zaroni su izvedeni na tri lokacije tzv. anomalija zabilježenih sonarom. Sve tri nalaze se u Župskom zaljevu.

Prva anomalija uočena je na sredini Župskog zaljeva i dubini od oko 43 metra, a prema svojim karakteristikama nalikovala je na manji antički brod s amforama. Ova pozicija provjeravana je ronjenjem ali na njoj arheolozi nisu pronašli ništa. Zbog činjenice da je u moru tada bila jaka struja te je vidljivost bila vrlo slaba, odlučeno je da se ova pozicija pregleda još jednom, jer je postojala mogućnost da je pozicija mimoiđena zbog pogreške u pozicioniranju GPS-om. Drugi puta, ronilačka ekipa se pozicionirala s dva GPS-a, ali potraga ponovno nije dala rezultata. Tada je konzultirana tehnička ekipa sonara, te je odlučeno da se



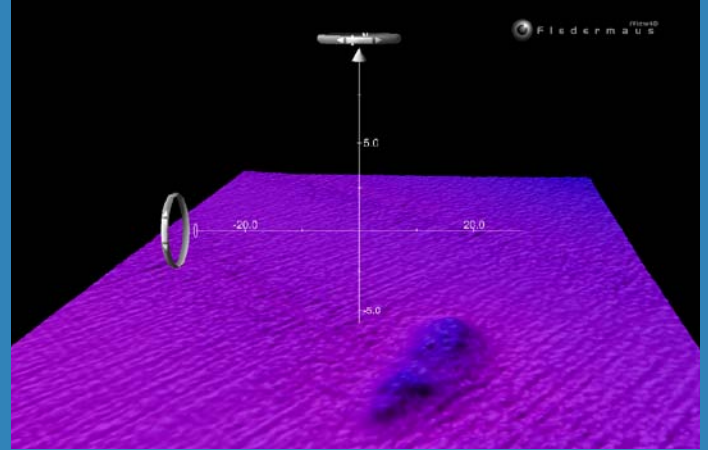
9. Multibeam image of a possible shipwreck with amphorae

Prikaz potencijalnog brodoloma s amforama na Multibeamu (RPMF)

metres, and by its characteristics was similar in appearance to a small Roman vessel with amphorae. The position was checked by divers but archaeologists found nothing at the site. Because there had been a strong sea current at the time and because of poor visibility, it was decided that the position be surveyed once again, as there was the possibility that the position was missed as a result of errors in GPS positioning. The second time the diving team used two GPS devices for positioning, but the search again yielded no results. The sonar technical crew were

Hercules vrati i ponovno prođe ovo područje. Naknadnim pregledom višesnopnim sonarom anomalija se nije ponovno ukazala, čime je zaključeno kako se radilo o "lažnoj" anomaliji koja se može pojaviti zbog buke u moru koja je omela rad sonara.

Na drugoj poziciji, multibeam je pokazivao anomaliju na morskom dnu u obliku broda dužine trideset metara, s oblom krmom na sjeveru i šiljatom pramcem na jugu. Ova meta nalazi se na dubini od oko 45 metara po sredini Župskog zaljeva, a



10. The 3d multibeam image of the sailboat off cape Kostur

3d prikaz jedrenjaka kod rta Kostur na multibeamu (RPMF)

južno od rta Kostur. Vjetar koji je toga dana puhao, jake morske struje i slaba vidljivost, nisu omele ronilačku grupu. Mada su struje odnijele sidro koje je spuštено na sredinu pozicije preko



11. Župa Bay, archaeologists prepare to dive

Župski zaljev, arheolozi se pripremaju za zaron (photo: M. Šimičić)

12. The remains of a mast of a sailboat off cape Kostur
Ostaci jarbola jedrenjaka kod rta Kostur
(photo: L. Bekić)



13. The anchor on the deck of the Cape Kostur sailboat, the stock in the middle of the image and the tapered fluke up and to the left

Sidro na palubi jedrenjaka kod Kostura, u sredini slike greda, a gore lijevo šiljati krak (photo: L. Bekić)

consulted and it was decided that the Hercules should return and repeat coverage of the area. The repeated multibeam sonar scan did not show an anomaly leading us to conclude that this was a “false” anomaly which may appear as a result of noise in the sea that interferes with the sonar.

At the second position, the multibeam sonar indicated an anomaly on the seafloor in the shape of a ship of thirty metres

pedeset metara, ronioci su ipak uspjeli u vrlo kratkom vremenu koje su smjeli provesti na samom dnu, locirati brodolom uočen sonarima.

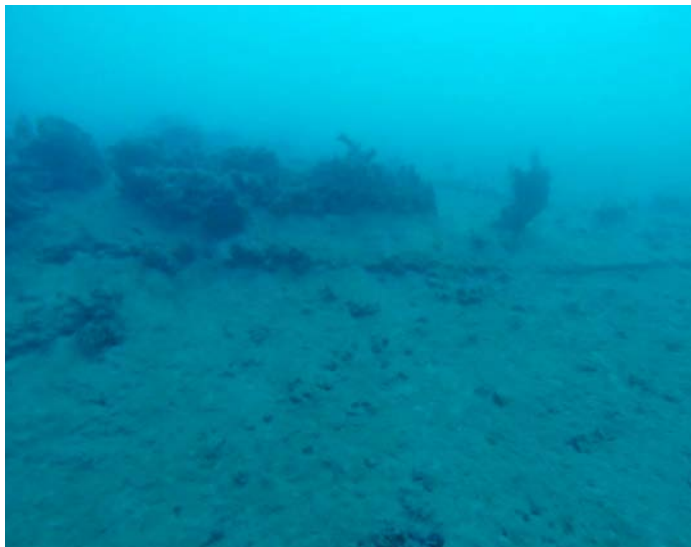
Prema svemu sudeći, najvjerojatnije se radi o drvenom jedrenjaku s dva do tri djelomično sačuvana jarbola i nekim metalnim elementima. Brod ima oblu krmu na kojoj se vidi ostatak kormila, te šiljati, uži pramac. Tri stupa koji izviruju iz palubnog prostora vjerojatno su ostaci jarbola, od kojih je srednji najviše očuvan, preko dva metra u visinu. Na vrhu je čak polomljen



14. The forward section of the Cape Kostur sailboat with metal elements
Prednji dio jedrenjaka kod rta kostur s metalnim dijelovima
(photo: L. Bekić)

length, with a rounded stern facing north and a pointed prow facing south. This target lay at a depth of about 45 metres in the middle of Župa Bay and to the south of Cape Kostur. The wind blowing that day, the strong sea current and the poor visibility did not thwart the diving group. Although the current swept the anchor over fifty metres from the middle of the position, divers nevertheless managed, in the short period spent at the seafloor, to locate the shipwreck identified by the sonar.

This appears to have been a wooden sailboat with two to three partially preserved masts and some metal elements. The ship had a rounded stern at which the remains of the rudder are visible, and a tapering, narrower prow. The three posts jutting out of the deck area are likely the remains of masts of which the middle one is best preserved to a height of over two metres. It is broken near the top with a section hanging off, entangled in fishing net. The wooden hull of the vessel is preserved to only some twenty centimetres above the silt, and it appears to have had a double hull between which wooden ribs are visible in places. Some metal remains are visible at the forward deck in the form of a long box, and one piece of iron bar was col-



15. The side of the Cape Kostur sailboat with partially preserved hull and ribs
Bok jedrenjaka kod rta Kostur s djelomično sačuvanim oplatama i rebrima (photo: L. Bekić)

lected that may have been a part of the railing. There is a large iron anchor on the deck. Its stock is visible and one arm with a very tapered fluke. A fragment of yellow course brick was found outside of the boat, but it is not certain that it can be associated with the vessel or possibly cargo.

Visible outside of the ship's hull are the contours of the half-buried remains of the ship's superstructure or cargo. The sailboat has a length of about 30 metres and, based on the level of preservation, can be dated to the 18th or 19th century. Finds will have to be collected for a more accurate dating and divers will certainly be deployed soon to this newly-discovered wreck for that purpose.

The third dive was conducted at the location below Plat at which sonar detected two parallel formations of about 50 and 20 metres in length respectively, about twenty metres apart. On the sonar image the anomaly appears to be the prow of a vessel. Dives established that these were two elongated rocks on the seafloor. During the dive archaeologists found the



16. A diver inspects the remains of the side of the Cape Kostur sailboat
Ronioč pregledava ostatke boka jedrenjaka kod rta Kostur (photo: M. Pešić)

pa dio njega visi, opleten ribarskom mrežom. Drvena oplata broda je sačuvana samo dvadesetak centimetara iznad mulja, i čini se kako je imao dvostruku oplatu između kojih se ponegdje razabiru i drvena rebra. Na prednjem dijelu palube vidljivi su neki metalni ostaci u obliku duge kutije, a prikupljen je i jedan komad željezne šipke koji je možda bio dio ograde. Na palubi se nalazi i veliko željezno sidro. Vidljiva je njegova greda i jedan krak s vrlo šiljatim vrhom. Izvan broda pronađen je i ulomak žute grube opeke, ali nije sigurno da je ona povezana s brodom, ili njegovim teretom.

Izvan korita broda vidljivi su obrisi poluzakopanih ostataka broskog nadgrađa ili tereta. Dužina jedrenjaka je oko trideset metara, a na osnovu očuvanosti, možda bi se mogao datirati u razdoblje 18. ili 19. stoljeća. Za točniju dataciju potrebno je prikupiti neke databilnije nalaze. Stoga će se na ovaj novootkriveni brodolom ronjaci zasigurno s tom namjerom uskoro i vratiti.

Treći je zaron izveden na lokaciji ispod Plata, na kojoj je sonar zabilježio dvije paralelno položene formacije dužine od oko 50 i od oko 20 metara međusobno udaljene dvadesetak metara. Na sonarnoj slici anomalija izgleda poput pramca broda. Ronjenjem



17. A sherd of a ribbed amphora on the seafloor below Plat
Ulomak rebraste amfore u podmorju ispod Plata (photo: M. Pešić)



18. A diver with sections of large African amphorae off Cape Sveti Petar at Kupari
Ronilac s dijelovima velikih afričkih amfora uz rt Sv. Petra ispred Kupara (photo: M. Pešić)

upper section of an amphora with ribbed walls at the middle of a large submarine rock. The amphora is Agora 273 type, amphorae like this one are rare in the Adriatic. By its characteristics it can be dated to late 4th century AD.

Dives were also conducted during this year's research campaign in the waters off Cape Sveti Petar near Kupari at the position of an amphorae site. The dive examined about 500 metres of coastal waters at an average depth of 6 metres and a part of the cove up to a depth of 25 metres. Amphorae were observed here incrustated into the slopes of the rocks seafloor. At greater depths the rocky slope transitions into a sandy seabed with dense Neptune Grass. The inspection determined that this was most likely a late Roman shipwreck with a cargo of large African amphorae. Observed along with the sherds of African amphorae were two sections of Forlimpopoli type amphorae.

The entire research effort was hampered by the intense traffic of various watercraft. This is largely on account of the fact that the research zone is part of developed tourism area and that the research was conducted at the peak of the tourism season. Precise operation of multibeam sonar, however, depends on calm seas, which are predominant in the summer. Considering that the

19. A ribbed amphora of Agora 273 type from the waters off Plat

Rebrasta amfora Agora 273 tipa iz podmorja ispod Plata (photo: L. Bekić)



je utvrđeno kako se radi se o dvjema izduženim kamenim stijenama na morskom dnu. Prilikom ronjenja arheolozi su po sredini veće sike pronašli gornji dio amfore s narebrenom stijenkom. Amfora je tipa Agora 273, ovakve su amfore rijetke u Jadranu, i prema svojim karakteristikama mogu se datirati u kasno 4. stoljeće.

U sklopu ovogodišnjih istraživanja zaronilo se u podmorje uz rt Sv. Petra kod Kupara na poziciju amforišta. Ronjenjem je pregledano područje oko 500 metara obale prosječne dubine od 6 metara i dio uvale do dubine od 25 metara. Tu su zamijećene amfore inkrustrirane u padinu stjenovitog morskog dna.

Na većim dubinama stjenovita padina prelazi u pjeskovito morsko dno obraslo gustom morskom travom posidonijom. Pregledom je utvrđeno kako se najvjerojatnije radi o kasnoantičkom brodolomu s teretom velikih afričkih amfora. Osim ulomaka afričkih amfora na ovoj su poziciji uočena i dva dijela amfora tipa Forlimpopoli.

Cjelokupna istraživanja bila su otežana zbog velikog prometa raznih plovila. Razlog tomu je činjenica da je zona istraživanja dio turistički razvijenog područja, a razdoblje istraživanja unutar pune turističke sezone. No za precizan rad višesnornim sonarom, potrebno je mirno more, a njega je najviše u ljetnim mjesecima.

ROV was not deployed during this year's research the positions of the other targets registered by sonar at depths in excess of 50 metres will be checked by the ROV next year.

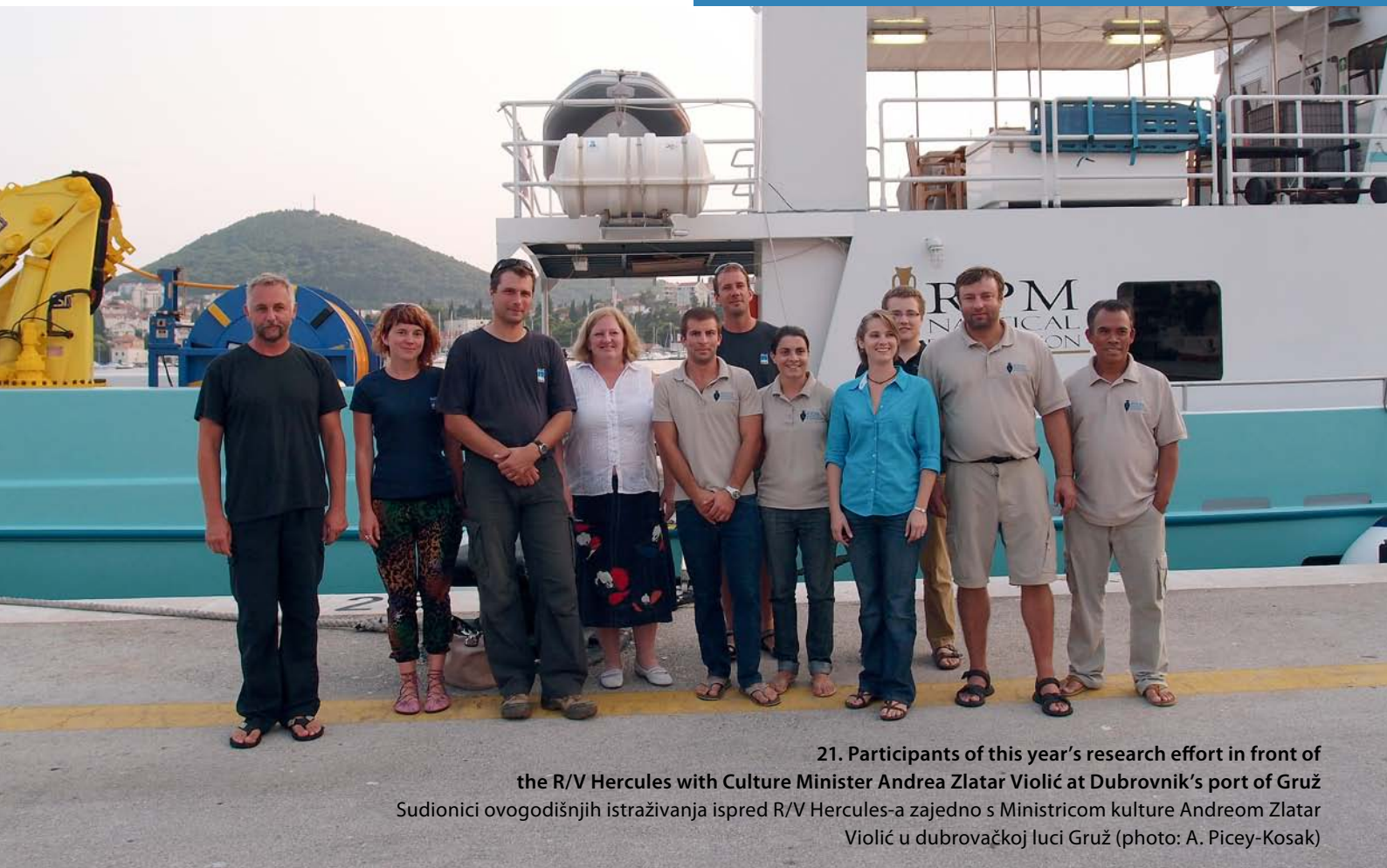
This year the research vessel Hercules scanned the seafloor of Konavle to the north of Cape Veliki Pač and the seafloor of Župa Bay. The importance of this unique international project was personally attested to by Culture Minister Andrea Zlatar Violić, who was on the R/V Hercules with the research team for a full working day. The sonar and multibeam scans of the seafloor revealed a large number of anomalies on the bottom that may be shipwrecks. This year's most interesting discovery is certainly the wooden sailboat with at least two masts in the middle of Župa Bay near Cape Kostur and the late Roman shipwreck at Kupari. Several other interesting positions were registered at greater depths that will require the deployment of the ROV. The data collected needs to be subjected to further scientific analysis. The continuation of the project is planned for next year when the area of the deep-sea survey of Croatian waters will likely be broadened to the north.

20. A Forlimpopoli type amphora off Cape Sveti Petar at Kupari
Amfora tipa Forlimpopoli uz rt Sv.Petar kod Kupara
(photo: M. Pešić)



S obzirom da u ovogodišnjim istraživanjima nije korištena robot ronilica, pozicije ostalih meta zabilježenih sonarom, a koje se nalaze na dubinama većim od 50 metara, provjerit će se ROV-om naknadno, slijedeće godine.

Ove je godine istraživački brod Hercules pregledao područje podmorja Konavala sjeverno od rta Veliki Pač i podmorje Župskog zaljeva. Važnost ovog jedinstvenog međunarodnog projekta potvrdila je osobno i ministrica kulture dr. sc. Andrea Zlatar Violić koja je na brodu sa istraživačkom ekipom R/V Hercules provela jedan radni dan. Pregledom sonarima i multibeamom otkriven je veći broj anomalija na dnu, koje bi mogle predstavljati brodolome. Najzanimljivije je ovogodišnje otkriće svakako drveni jedrenjak s barem dva jarbola na sredini Župskog zaljeva, kod rta Kostur te kasnoantički brodolom kod Kupara. Nekoliko drugih zanimljivih pozicija zabilježeno je na većim dubinama što će se morati pregledati dubinskim robotom - ROV-om. Dobivene je podatke potrebno dodatno znanstveno obraditi. Nastavak projekta planira se i sljedeće godine kada će se područje dubinskog pregleda hrvatskog podmorja najvjerojatnije širiti prema sjeveru.



21. Participants of this year's research effort in front of the R/V Hercules with Culture Minister Andrea Zlatar Violić at Dubrovnik's port of Gruž
Sudionici ovogodišnjih istraživanja ispred R/V Hercules-a zajedno s Ministricom kulture Andreom Zlatar Violić u dubrovačkoj luci Gruž (photo: A. Picey-Kosak)

Bibliography / Literatura

Royal, J., Bekić, L. 2012 - Deep Sea Survey off Konavle, Croatia / Dubinsko pretraživanje podmorja uz Konavle, Potopljena baština / Submerged Heritage 2, Zadar, 13 - 20.

Final Campaign in the Research of Veštar Harbour

Završna kampanja istraživanja luke Veštar

LUKA BEKIĆ - lbekic@icua.hr

After five years of research we have decided to temporarily conclude underwater research at Veštar harbour. The research began back in 2008 with a field survey, and excavations have



1. The 2013 Veštar team: (from the left) Max Fiederling, Daniel Neubauer, Detlef Peukert, Anna-Sophie Fuchs, Tobias Pflederer, Jürgen Reitz, Luka Bekić, Marina Šimičić, Marcus Prell, (in the water) Anita Jelić, Mladen Pešić

Veštarski tim 2013: (s lijeva) Max Fiederling, Daniel Neubauer, Detlef Peukert, Anna-Sophie Fuchs, Tobias Pflederer, Jürgen Reitz, Luka Bekić, Marina Šimičić, Marcus Prell, u moru: Anita Jelić, Mladen Pešić (photo: D. Matošević)

been undertaken at several sites since 2009. Participating in the project were the archaeologists and divers of the International Centre for Underwater Archaeology in Zadar, the Bavarian Society of Underwater Archaeology, the Croatia Conservation Institute and the Heritage Museum of Rovinj. This year this included the efforts of Luka Bekić and Mladen Pešić as campaign director and co-director respectively, Marina Šimičić, Anita Jelić, Max Fiederling, Daniel Neubauer, Detlef Peukert, Anna-Sophie Fuchs, Tobias Pflederer, Jürgen Reitz, Marcus Prell and land archaeology associates Damir and Danijel Matošević, Josip Višnjić and Tihomir Percan.

During these five years of research we succeeded in establishing the existence of at least two piers and located the site of a potential third and perhaps even a fourth pier. It is evident that this naturally sheltered cove was used as a harbour for centuries. Future research should begin with land archaeology research with the aim of shedding more light on the nature of the underwater structures.

Nakon pet godina istraživanja odlučili smo privremeno zaključiti podvodna istraživanja luke Veštar. Istraživanja su započela još 2008.g. pregledom terena, a od 2009.g. u uvali se iskopavalo na nekoliko mjesta. U projektu su sudjelovali arheolozi i ronici Međunarodnog centra za podvodnu arheologiju u Zadru, Bavarskog društva za podvodnu arheologiju, Hrvatskog restauratorskog zavoda i Zavičajnog muzeja u Rovinju. Ove godine su to poimence bili Luka Bekić, Mladen Pešić kao voditelj i suvoditelj, Marina Šimičić, Anita Jelić, Max Fiederling, Daniel Neubauer, Detlef Peukert, Anna-Sophie Fuchs, Tobias Pflederer, Jürgen Reitz, Marcus Prell, te kopneni suradnici - Damir i Danijel Matošević, Josip Višnjić i Tihomir Percan.

Tijekom pet godina istraživanja uspjeli smo ustanoviti postojanje najmanje dva mola te locirati potencijalni treći ili čak i četvrti mol. Očigledno je da se ova prirodno zašti-



2. Bekić and Pflederer working out the details of the campaign at Veštar
Bekić i Pflederer se dogovaraju oko tijeka akcije u Veštru (photo: M. Prell)

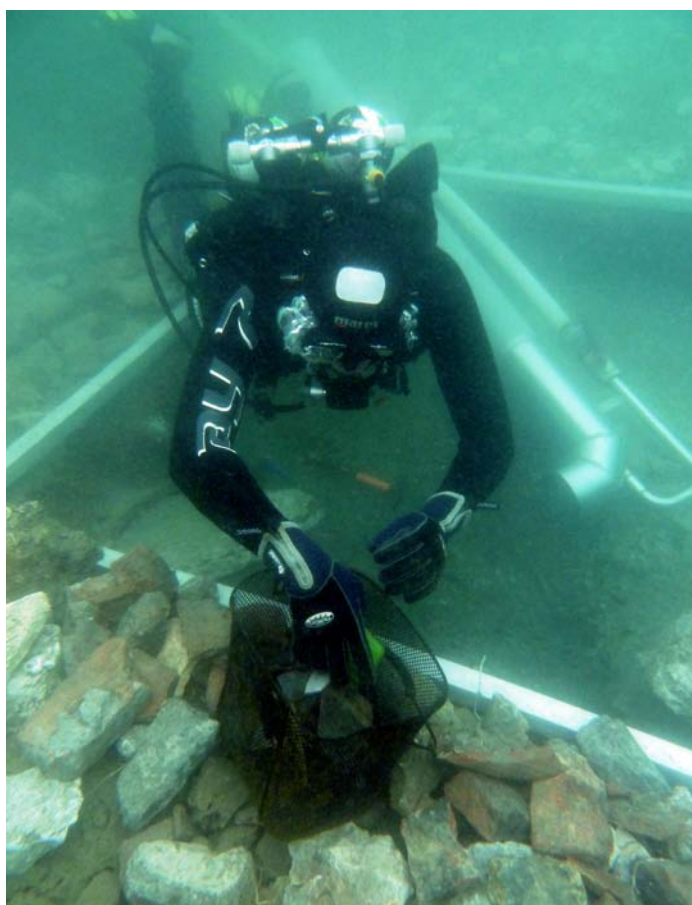
ćena uvala stoljećima koristila kao luka. Za buduća istraživanja valjalo bi započeti i s kopnenim istraživanjima, kako bi se podvodne strukture mogle bolje razjasniti.

Dosadašnja istraživanja pokazala su slabije vidljiv sloj prapovijesnog naseljavanja uvale, koji se očituje u mjestimičnim pronalascima prapovijesne keramike isprane na obali te kamenih alatki i odbitaka, uglavnom u moru (Benjamin, Bekić, Komšo,

The research to date has identified a less discernable layer of prehistoric colonisation of the cove, evident in the form of sporadic finds of prehistoric pottery washed out of the soil on shore by the sea and of lithic tools and flakes, for the most part in the sea (Benjamin, Bekić, Komšo, Koncani-Uhač, Bonsall 2011). These finds, unfortunately, do not originate from layers that could stratigraphically be linked to prehistory, but they do indicate the use of the cove, likely during the Neolithic and Eneolithic periods.

After an undetermined hiatus the cove was resettled in the first century BCE, when this was the site of a Roman villa rustica with a large, 50-metre long stone pier (Mole 1) constructed to service it. The pier was situated on the south side of the cove and protected it from western winds. It was constructed with a frame of large stone blocks filled with smaller stone rubble.

Use of this pier ceased in the beginning of the 3rd century, but the cove remained inhabited and, it appears, in ever increasing scope during the late Roman period. This settlement, which we



3. An abundance of bricks was discovered during the excavation of trench D

Tijekom iskopavanja sonde D pronađeno je veliko mnoštvo opeka (photo: M. Prell)

learn from written sources was called Vistrum, ceased to exist in the mid 7th century, attested to by numerous surface finds, in particular the coins of Emperor Constans II minted in Ravenna between the years 659 to 668 (Bekić 2013, cat. 60). Thus far we have not been able to locate the pier used during this period. There is no evidence of the use of the cove between the 8th and 15th centuries. From that period on we find sporadic potsherds on the seabed of the cove indicating that Veštar was in use again as an anchorage. There is an increasing number of finds from the following centuries, with the peak of its use falling in the



4. Much of the research was conducted in very shallow water
Dobar dio istraživanja odvijao se u sasvim plitkom moru (photo: L. Bekić)

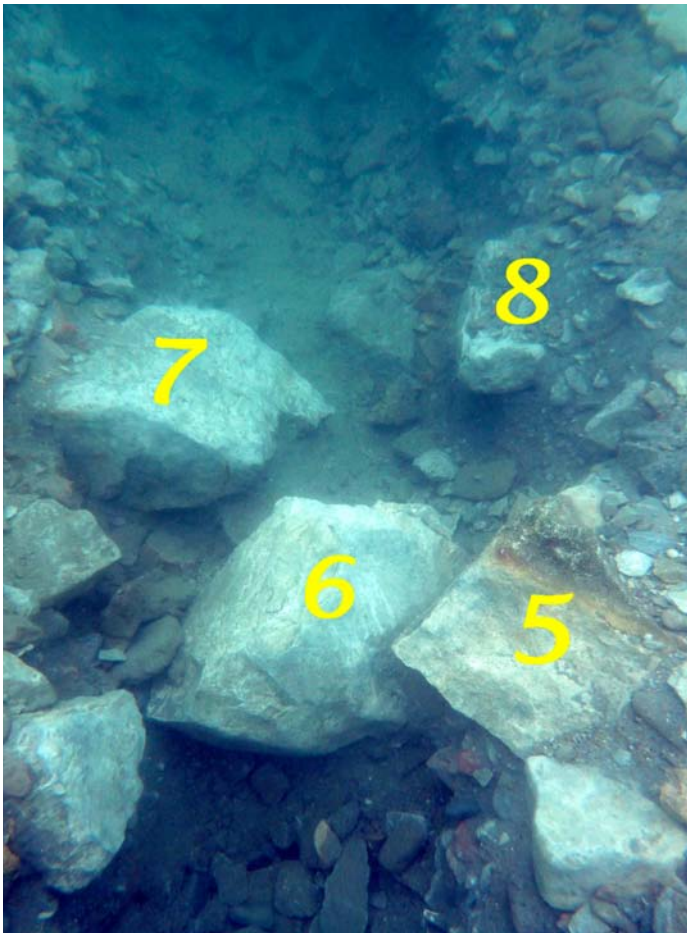
Koncani-Uhač, Bonsall 2011). Nažalost ovi nalazi ne potječu iz slojeva koji bi se stratigrafski mogli povezati s prapoviješću, ali ukazuju na neko korištenje uvala, vjerojatno u doba neolitika i eneolitika.

Nakon određenog hijatusa, uvala je ponovno naseljena u prvom stoljeću prije Krista, kada se ovdje nalazi rimska vila rustica, te se za njene potrebe gradi veliki kameni mol u dužini od 50 metara (mol 1). Mol se nalazio s južne strane uvala i štitio ju je od zapadnih vjetrova. Građen je od velikih kamenih blokova na rubovima, ispunjenih manjim kamenom lomljenjem.

Ovaj mol se prestaje koristiti početkom 3.st., ali je uvala i dalje naseljena, i čini se u sve većem opsegu tijekom kasne antike. Ovo naselje, za koje iz pisanih izvora saznajemo da se zvalo Vistrum, prestaje s postojanjem sredinom 7.st. što nam svjedoče brojni površinski arheološki nalazi, a posebice novac cara Constansa II., kovanog u Ravenni između 659. i 668.g. (Bekić 2013, kat.60). Za sada nismo uspjeli locirati pristanište koje je korišteno u ovom razdoblju.



5. The leaders of the Bavarian underwater archaeologists Tobias Pfloderer and Marcus Prell
Predvodnici bavarskih podvodnih arheologa Tobias Pfloderer i Marcus Prell (photo: T. Pfloderer)



6. Dislocated pier perimeter blocks were discovered in trench F
U rovu F otkriveni su dislocirani blokovi ruba mola
(photo: M. Prell)

period from the 16th to 18th century. From the 19th century on its importance drops again, but it continues to be used on a lesser scale to the present day.

The period from the 16th to 18th century at Veštar is very interesting as we have almost no records pertaining to it, while it is evident from the very numerous finds that this was a major maritime hub. Some historical sources bear witness to the loading of timber transported from the interior for the Venetian arsenal, but it appears that this was also an important hub of commerce. Traces of the production of glazed pottery and glass have, namely, been found on the seabed of the cove (Bekić, Višnjić, Pešić, Bloier, 2011) indicative of the existence of a manufacturing complex within the cove. We have not, unfortunately, succeeded in launching research on shore that would assist us in resolving this question, as a result of which all conclusions in this regard are based on small finds from the sea.

Numerous archaeological finds from the 16th to 18th centuries were discovered during the research of the Roman pier, but only in the surface layer, which excluded the possibility that the Roman pier was used in the early Post-Medieval period. Last year's and this year's research therefore endeavoured to discover where these goods were in fact loaded and unloaded. Prior inspections of the terrain had already revealed the poorly discernable traces of piers. One pier was found in the north-east section, recognised only as a mound of large irregular stone blocks (Pier 2), and another in the shallower part of the south shore, constructed of irregular stone blocks with a fill of smaller stone (Pier 3). It was at this pier that two trial trenches and a trench were excavated this year. The goal was to date the pier

Nakon 8.st. ponovno nedostaju tragovi korištenja uvale sve do 15.st. Od tada se u podmorju uvale pojavljuju sporadični ulomci keramike koji govore o ponovnom korištenju Veštra kao sidri-



7. Also participating in this project is Damir Matošević of the museum in Rovinj

U ovom projektu sudjeluje i Damir Matošević iz rovinjskog muzeja
(photo: M. Šimičić)

šta. Nalaza kroz slijedeća stoljeća ima sve više, a luka Veštar najviše se koristi u razdoblju od 16. do 18.st. Od 19.st. njen značaj ponovno jenjava, ali se u manjem obimu koristi sve do danas.

Razdoblje od 16. do 18.st. u Veštru je vrlo zanimljivo stoga jer o njemu nemamo gotovo nikakvih zapisa, a prema vrlo brojnim nalazima očito je kako je ovo važna pomorska točka. Neki



8. The pier had a fill of construction debris - brick for the most part

Mol je bio ispunjen građevinskim otpadom - uglavnom opekama
(photo: L. Bekić)

with the aim of establishing the period during which it was in use.



9. Up-and-coming Austrian and Bavarian underwater archaeologists Daniel Neubauer, Anna-Sophie Fuchs and Max Fiederling

Mlade snage austrijske i bavarske podvodne arheologije, Daniel Neubauer, Anna-Sophie Fuchs i Max Fiederling (photo: T. Pflederer)

The trench was set from the highest section of Pier 3 to the lowest section on the northeast side with the aim of identifying the perimeter stones no longer visible at this section. The trench was 6 metres in length and excavated to a width of one metre. It was established that the fill of the pier consisted of construction debris consisting for the most part of large bricks, some of which are coated with plaster and lime – evidently therefore originating from demolished buildings. There are sporadic finds of potsherds, bone and other finds in this layer. A trench was also set at the head of the pier, to the northwest side. In situ stone edge blocks were not, unfortunately, found in either trench, but blocks were found that were moved from their places during the collapse of the mole. Their positions assist us in determining the outer contours and extent of the mole.

Trench D was set in the area where we expected to find the inner corner of the mole. The trench was excavated to a width of 2x2 metres and dug to a depth of a metre and half. At the surface section we established first a black silty layer in which seagrass grows, without many finds, followed by the layer of the collapsed pier, evident from scattered construction debris consisting for the most part of bricks, but also including other finds. Only one of the pier blocks was found, evidently in its secondary position, and one large stone slab which may indicate that the mole was once paved. Under the collapse layer is a thick deposit layer of wooden branches. All of the branches have traces of cutting with sickles or axes, and some are partially burnt. By all accounts these crooked branches, with a thickness of up to 10 cm, originate from the clearing of underbrush along the shore. This may constitute evidence of the clearing of the shore for a port structure or similar operational area that we cannot currently ascertain more about. Under the layer of branches, in which no archaeological finds were discovered, we find a layer of fine marine gravel and sand that was not further researched.

Based on the archaeological finds discovered within the mole structure and in trench D, we can conclude that the mole was

povijesni izvori svjedoče kako se u luci tovarilo drvo koje je iz unutrašnjosti otpremano za mletački arsenal, ali čini se kako je tu bila i riječ o značajnijem trgovačkom punktu. Naime u podmorju uvala su pronađeni tragovi proizvodnje cakljene keramike te stakla (Bekić, Višnjčić, Pešić, Bloier, 2011) što ukazuje na postojanje nekog proizvodnog sklopa u uvali. Nažalost, nismo uspjeli pokrenuti kopnena istraživanja koja bi nam pomogla razriješiti ova pitanja, stoga se svi zaključuju o tome donose na osnovu pokretnih nalaza iz mora.

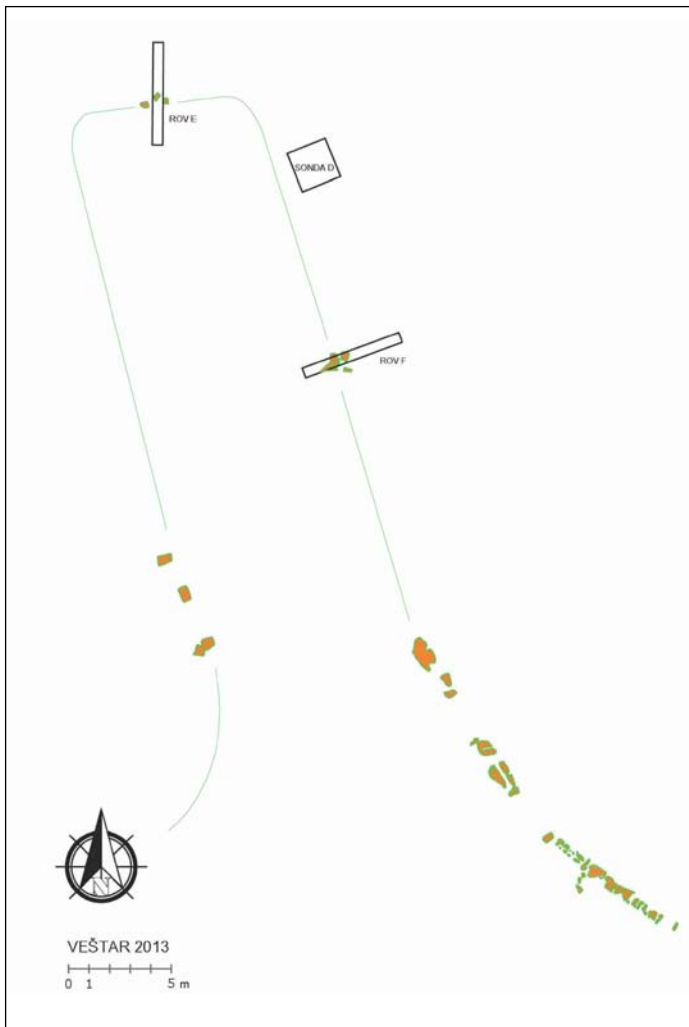
Prilikom istraživanja rimskog mola pronađeni su brojni arheološki nalazi 16.-18.st., ali samo u površinskom sloju, što je isključilo mogućnost da se rimski mol koristio i u ranonovovjekovnom razdoblju. Stoga su prošlogodišnja i ovogodišnja istraživanja nastojala provjeriti gdje je zapravo ta roba bila ukrcavana i iskrcavana. Već prijašnjim pregledima terena uočili su se slabo vidljivi tragovi molova. Jedan mol nađen je na sjeveroistočnom dijelu, prepoznat samo kao gomila većih nepravilnih kamenih blokova (mol 2), te jedan na plićem dijelu južne obale, koji je bio građen od nepravilnih blokova kamena, ispunjen sitnijim kamenom (mol 3). Upravo na njemu su ove godine postavljena dva probna rova i jedna sonda. Cilj je bilo datirati mol, kako bi ustanovili kroz koje vrijeme je bio u funkciji.

Rov je postavljen od najvišeg dijela mola 3 do najnižeg dijela na sjeveroistočnoj strani, kako bi se ustanovilo rubno kamenje koje na ovom dijelu više nije vidljivo. Rov je bio dužine 6 metara i kopan je u širini od jedan metar. Ustanovljeno je kako ispunjenje mola čini građevinska štuta, koja se uglavnom sastoji od velikih opeka od kojih su neke i namazane žbukom i vapnom, dakle, očito dopiru iz nekih srušenih zgrada. U tom sloju mjestimično



10. The layer with pottery finds was followed by a layer with burnt branches

Nakon sloja s keramikom pojavio se sloj s nagorenim granama (photo: M. Prell)



11. Pier 3 contours with trench positions

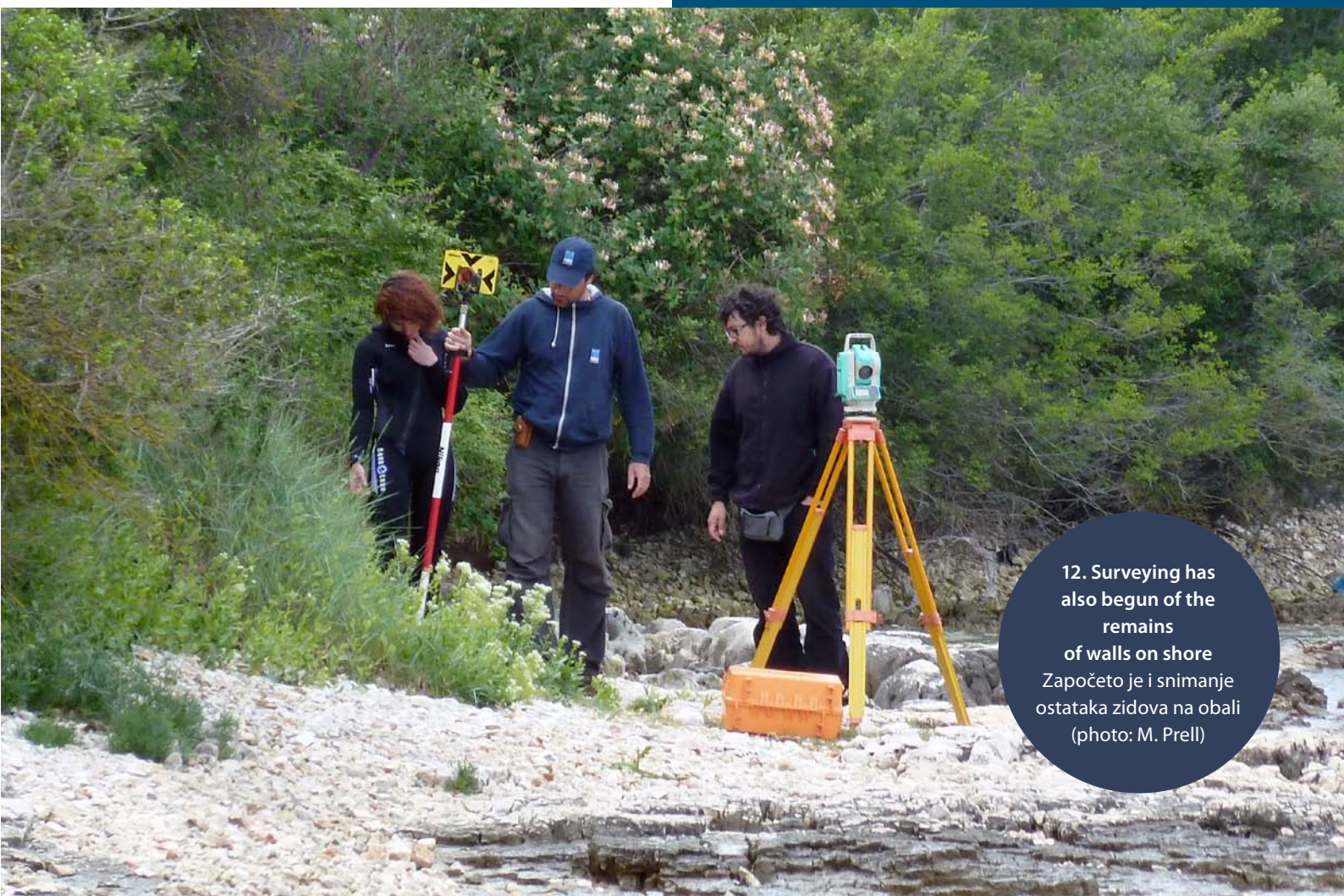
Konture mola 3 s položajima sondi (author: M. Šimičić)

se pronalaze i ulomci keramike, kosti i drugih nalaza. Isti rov postavljen je i na čelu mola, na sjeverozapadnoj strani. Nažalost, u oba rova nisu pronađeni *in situ* kameni rubni blokovi, ali su pronađeni blokovi koji su pomaknuti sa svojeg mjesta prilikom urušenja mola. Njihova pozicija pomaže nam u određivanju vanjske linije i opsega mola.

Sonda D je postavljena otprilike gdje se očekivao unutarnji kut mola. Veličine je 2x2 metra a kopana je do dubine od metar i pola sloja. Na površinskom dijelu ustanovljen je prvo crni muljeviti sloj u kojem raste morska trava, bez mnogo nalaza, te zatim sloj urušenja mola, koji se očituje u raspršenoj građevinskoj šuti, uglavnom opekama ali i drugim nalazima. Od blokova mola, pronađen je samo jedan, očito u svom sekundarnom položaju te jedna veća kamena ploča, koja bi mogla ukazivati kako je mol nekada bio popločan. Ispod sloja urušenja nalazi se moćan naplavni sloj drvenih grana. Sve grane imaju tragove sječe kosiorom ili sjekirom, a neke su i djelomično nagorene. Prema svemu sudeći, ove grbave grane, debljine do 10 cm, potječu od rasčišćavanja neke makije uz obalu. Moguće su to tragovi čišćenja obale za potrebe uređenja nekog lučkog objekta ili sličnog operativnog prostora o kojem više za sada ne možemo znati. Ispod sloja s granama, u kojem nisu bili zabilježeni arheološki nalazi, nailazimo na sloj sitnog morskog šljunka i pijeska, koji nije dalje istraživan.

Na osnovu arheoloških nalaza koji su pronađeni unutar strukture mola, a i u sondi D, možemo zaključiti kako je mol saždan u 17.st. i to od građevinske šute, te je bio korišten barem do 18.st. Nakon toga je prepušten propadanju, pa se danas više ne koristi i prepoznaje se u terenu samo kao podvodni kameni nasip.

Tijekom istraživanja pronađeno je mnoštvo keramičkih nalaza koji se uglavnom mogu datirati u razdoblje 17. i 18.st. Od



12. Surveying has also begun of the remains of walls on shore
Započeto je i snimanje ostataka zidova na obali (photo: M. Prell)



built in the 17th century using construction debris and that it was in use at least up to the 18th century. It was allowed to deteriorate after that and is no longer in use and recognisable only as an underwater mound of stones.

13. The most interesting find is a metal plaque bearing a coat of arms and the initials V Z

Najzanimljiviji nalaz je metalna pločica s grbom i inicijalima V Z (photo: M. Prell)

An abundance of ceramic finds were found during the research that can for the most part be dated to the period from the 17th to 18th century. Among the pottery the most common finds are sections of bowls of late polychrome engraved maiolica, as well as various vessel forms with monochrome brown, green and reddish glaze. Monochrome white plates belong to the latest phase of use. Also found along with the glazed ceramics was black coarse pottery - for the most part cauldrons with lugs for cooking over an open fire. Several tobacco pipes were also found, a frequent find at the port of Veštar, as well as prehistoric flint tools and flakes. Also found again were remains that can be linked to the manufacture of glazed ceramics and the remains of glass melting, glass raw materials and melted rods. The most interesting find is a metal plaque bearing a coat of arms and the initials V Z. In the upright shield, divided into upper and lower sections, is a rampant horse facing left. The plaque may have been attached to a wooden chest.

The Veštar harbour research project staged over the past five years has been very successful in terms of underwater research, but its results have raised a number of questions that can only be addressed by parallel land archaeology research. This complementary approach could finally unravel the secrets of this important harbour. If funds are secured in the future for land archaeology excavation, our team of archaeologists will continue with its underwater research. The plan now is to publish all archaeological finds to date in a comprehensive monograph and to organise an exhibition to present them to the specialist and broader public.

keramike najčešći su nalazi dijelovi zdjela kasne višebojne gravirane majolike, ali i različiti oblici posuđa s jednobojnom smeđom, zelenom i crvenkastom caklinom. Jednobojni bijeli tanjuri pripadaju najkasnijoj fazi korištenja. Uz caklenu keramiku tu pronalazi i gruba crna, i to uglavnom kotlovi s ušicama za kuhanje na otvorenoj vatri. Pronađeno je i nekoliko lula za duhan koje se često nalaze u luci Veštar, ali i prapovijesnih kremenih alatki i odbitaka. Također su ponovno pronađeni ostaci koji se mogu povezati s izradom cakljene keramike te ostaci taljenja stakla, staklena sirovina i rastaljeni štapići. Najzanimljiviji nalaz je metalna pločica s grbom i inicijalima V Z. U uspravnom grbu, koji je podijeljen na gornje i donje polje, nalazi se konj koji se propinje na lijevo. Pločica je možda bila pričvršćena za neki drveni sanduk.

Projekt istraživanja luke Veštar posljednjih pet godina bio je vrlo uspješan u pogledu podvodnih istraživanja, međutim, njihovi rezultati postavili su brojna pitanja na koja bi odgovor mogla dati samo i paralelna kopnena istraživanja. Takvim komplementarnim pristupom moglo bi se konačno razotkriti tajne ove važne luke. U slučaju da se u budućnosti osiguraju sredstva i za obalno sondiranje, naša arheološka ekipa nastaviti će s podvodnim istraživanjima. Sada je u planu objaviti sve dosadašnje arheološke nalaze u opsežnoj monografiji te organizirati izložbu na kojoj će se oni predstaviti stručnoj i široj javnosti.



14. The trenches yielded predominantly Post Medieval finds

U sondama smo pronašli uglavnom novovjekovne nalaze (photo: T. Pflederer)

Bibliography / Literatura

Bekić, L. 2010 - Veštar - podmorje, Kukuletočina, Rovinj, Hrvatski arheološki godišnjak 6/2009, Zagreb, 414 - 416.

Bekić, L. 2011a - Višegodišnja istraživanja luke Veštar kod Rovinja / Multiannual Research at Veštar Harbour Near Rovinj, Potopljena baština / Submerged Heritage 1, Zadar, 20 - 24.

Bekić, L. 2012 - New Harbour Structures at Veštar / Novi lučki objekti u Veštru, Potopljena baština / Submerged Heritage 2, Zadar, 30 - 33.

Bekić, L. 2013 - Numizmatički nalazi iz uvale Veštar, Summary: Numismatic finds from Veštar bay, Vjesnik Arheološkog muzeja u Zagrebu 45/2012, Zagreb, 69 - 90.

Bekić, L. in print A - Veštar, Kukuletočina, Rovinj, Hrvatski arheološki godišnjak 7/2010, Zagreb.

Bekić, L. in print B - Veštar, Kukuletočina, Rovinj, Hrvatski arheološki godišnjak 8/2011, Zagreb.

Bekić, L., Višnjić, J., Pešić, M. & Bloier, M. 2011 - Podvodna arheološka istraživanja uvale Veštar 2008. - 2010. / Ricerche archeologiche subacquee nella baia di Vestre 2008 - 2010, Rovinj.

Benjamin, J., Bekić, L., Komšo, D., Koncani Uhač, I. & Bonsall, C. 2011 - Investigating the submerged prehistory of the eastern Adriatic: progress and prospects, Underwater archaeology and the submerged prehistory of Europe, Oxford, 193 - 206.

Miholjek, I. 2009 - Akvatorij Istre, Hrvatski arheološki godišnjak 5/2008, Zagreb, 309 - 311.

Research of the Waters of the Islet of Babuljaš near Pakoštane

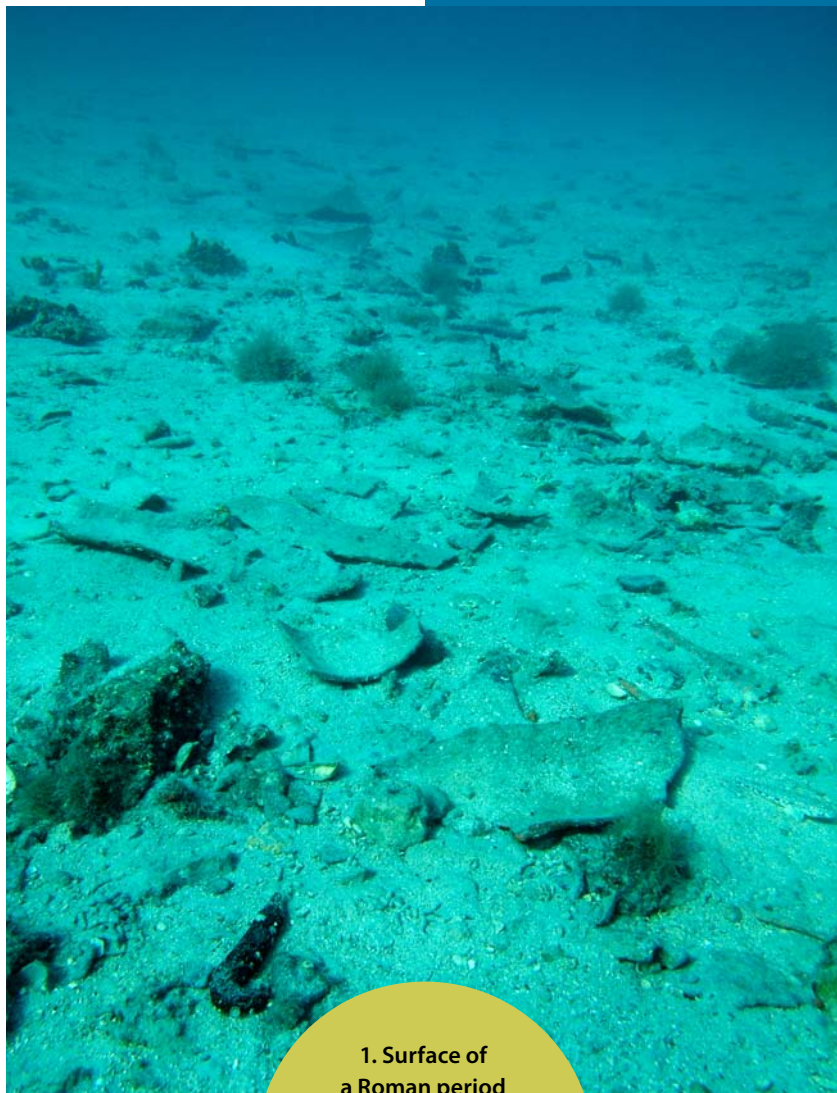
Istraživanja podmorja otočića Babuljaša kod Pakošтана

MLADEN PEŠIĆ - mpesic@icua.hr

A number of underwater sites were surveyed during the Zadar County survey programme conducted by staffers of the International Centre for Underwater Archaeology in 2012. One of areas surveyed were the waters of the islet of Babuljaš. We were taken to the position during our reconnaissance by underwater archaeologist Marko Meštrov, who observed a large concentration of potsherds at the location during previous surveys of the terrain (Pešić, Meštrov 2012, 47). The islet of Babuljaš is situated in the immediate vicinity of Pakoštane, about 250 metres from the mainland, and already by the first dive in its waters we observed a large quantity of ceramic material scattered over a wide area. Upon inspecting the archaeological finds we concluded that they could be dated to two different periods. A large concentration of ceramic material of coarse fabric with a significant quantity of calcite temper, covering a relatively large area in the waters of the islet, can most likely be dated to the Bronze Age. To the eastern section of the prehistoric site is a different type of archaeological material that overlaps the first type. Here we observe the devastated remains of the wreck of a Roman period ship that transported large cylindrical amphorae of North African provenance.

During the examination of the seafloor it was observed that the western section of the site contains the greatest concentration of prehistoric pottery, with only a small number of fragments that can be dated to the Roman period. The prehistoric material extends to the northern part of the islet and gradually disappears. At one section the prehistoric

Tijekom izvođenja programa rekognosciranja Zadarske županije, koji su provodili djelatnici Međunarodnog centra za podvodnu arheologiju tijekom 2012. godine pregledano je više podvodnih lokacija. Jedna od pregledanih lokacija bila je i u podmorju otočića Babuljaša. Na ovu poziciju nas je tijekom rekognosciranja odveo podvodni arheolog Marko Meštrov, koji je na toj lokaciji prilikom prethodnih pregleda terena uočio veliku koncentraciju keramičkih fragmenata (Pešić, Meštrov 2012, 47). Otočić Babuljaš nalazi se u neposrednoj blizini Pakošтана, oko 250 metara od kopna, i već prilikom prvog zarona u njegovom je podmorju uočena velika količina keramičkog materijala koji je rasprostranjen na širokom prostoru. Pregledom arheoloških nalaza zaključeno je da se oni mogu vremenski datirati u dva različita razdoblja. Veliku koncentraciju keramičkog materijala koji ima grubu fakturu s dosta kalcitnih primjesa i zauzima relativno veliku površinu u podmorju otočića, možemo najvjerojatnije vremenski datirati u period brončanog doba. Na istočnom dijelu prapovijesnog nalazišta postoji i drugačija vrsta arheološkog materijala koji se s njim preklapa. Tu su vidljivi ostatci devastiranog antičkog brodoloma koji je prenosio velike cilindrične amfore sjevernoafričke provenijencije.



1. Surface of a Roman period shipwreck off the islet of Babuljaš

Površina antičkog brodoloma kod otoka Babuljašu (photo: R. Kovačić)

Prilikom pregleda podmorja uočeno je da zapadni dio nalazišta sadrži najveću koncentraciju prapovijesne keramike, uz tek manji broj fragmenata koji se mogu datirati u antički period. Prapovijesni materijal se širi prema sjevernom dijelu otočića, te postupno nestaje. U jednom dijelu se prapovijesni

material overlaps a greater concentration of the Roman ceramic material. The prehistoric site occupies a greater area in terms of its surface coverage, while the majority of the Roman material is concentrated over a smaller part of the seafloor. After a detailed analysis of the concentration of finds and a surface survey of

materijal preklapa s većom koncentracijom antičkog keramičkog materijala. Prapovijesno nalazište prema površinskom rasprostriranju zauzima veći prostor, dok je glavnina antičkog materijala koncentrirana na manji dio podmorja. Nakon detaljne analize koncentriranosti nalaza i površinskog pregleda nalazišta,



2. Part of the team at Babuljaš in 2013: (from the left) Marina Šimičić, Dragomir Garbov, Anita Jelić, Luka Bekić, Maria Michael, Damir Ugljen and Ana Fundurulić. Not in the photo are Mate Parica and Marko Meštrov

Dio ekipe s Babuljaša 2013.g. S lijeva Marina Šimičić, Dragomir Garbov, Anita Jelić, Luka Bekić, Maria Michael, Damir Ugljen i Ana Fundurulić. Nedostaju Mate Parica, Marko Meštrov (photo: M. Pešić)

the site, it was decided that research should be launched this year of the remains of the Roman period shipwreck as the primary task. Trenches were set at the section of the site at which there is a partial overlap of the archaeological material originating from the prehistoric period with that of the Roman period. In this manner we planned to gain insight into the stratification and characteristics of both sites.

This year's research was financed by the Tourism Board of the Municipality of Pakoštane, which has for several years now demonstrated understanding and care for underwater sites in the municipality, and has been generous in providing assistance during archaeological research. The archaeological research was conducted by the International Centre for Underwater Archaeology in Zadar in collaboration with the University of Zadar and the Han-Vrana Agency. Serving as research director was Mladen

Pešić with deputy director Luka Bekić DSc, joined by an expert team composed of Anita Jelić, Marina Šimičić, Mate Parica, Mato Ilkić and Marko Meštrov.



za ovu godinu je odlučeno da se krene u istraživanje ostataka antičkog brodoloma kao primarnog zadatka. Sonde su postavljene na dijelu nalazišta gdje dolazi do djelomičnog preklapanja arheološkog materijala koji potječe iz prapovijesnog razdoblja, s onim iz antičkog razdoblja. Na taj način smo planirali dobiti uvid u slojevitost i karakteristike obaju nalazišta.

Ovogodišnja istraživanja financirala je Turistička zajednica općine Pakoštane, koja već nekoliko godina pokazuje razumijevanje i brigu za podvodna nalazišta na prostoru općine Pakoštane, te nesebično pomaže prilikom arheoloških istraživanja.



3. Examining the trenches with the aid of a water dredger
Istraživanje sondi pomoću mamut-sisaljki (photo: M. Pešić)



4. A fragment of a prehistoric ceramic vessel found in the surface layer of the site

Fragment prapovijesne keramičke posude nađen u površinskom sloju nalazišta (photo: M. Pešić)

Also participating in the archaeological research were young underwater archaeologists Dragomir Garbov (Bulgaria), Damir Ugljen (Bosnia and Herzegovina), Maria Michael (Cyprus) and Ana Fundurulić (Croatia) who took part in diver and archaeological training in the frame of an ICUA Zadar/UNESCO Introductory course on underwater archaeology staged during the research campaign at the Babuljaš site.

During the 2013 archaeological campaign 2x2 metres trenches were set at a part of the site where the surface concentration of Roman period material indicated rich stratification. Four trenches were examined this year, joined to one another in the form of a square such that, in the end, an area of 4x4 metres was excavated to the sterile layer. Excavation revealed two layers at this section of the site. The upper layer contains for the most part ceramic finds dated to the Roman period, and only sporadic sherds of prehistoric pottery, while finds of prehistoric pottery are dominant in layer 2 where Roman period finds are infrequent. The thickness of the layer varies, and is greater as the depth increases as a result of the configuration of the terrain on which the site is located, with the total thickness of the archaeological layer being about 50 cm.

From the start of excavation it was observed that there are a great number of ceramic fragments in the sand. For the most part these are sherds from the belly section of amphorae, followed by fragments of the neck and base sections. There was also a significant quantity of fine ceramic known as terra sigillata chiara or African red slip



5. Documenting and marking special finds

Dokumentiranje i obilježavanje posebnih nalaza (photo: L. Bekić)

Arheološka istraživanja proveo je Međunarodni centar za podvodnu arheologiju u Zadru u suradnji sa Sveučilištem u Zadru i javnom ustanovom Han-Vrana. Voditelj istraživanja bio je Mladen Pešić, zamjenik voditelja dr.sc. Luka Bekić, a s njima su kao stručni dio ekipe u istraživanju sudjelovali Anita Jelić i Marina Šimičić, Mate Parica, Mato Ilkić i Marko Meštrov. U arheološkim istraživanjima sudjelovali su i mladi podvodni arheolozi Dragomir Garbov (Bugarska), Damir Ugljen (Bosna i Hercegovina), Maria Michael (Cipar) i Ana Fundurulić (Hrvatska) koji su u organizaciji MCPA Zadar i UNESCO-a sudjelovali u ronilačkoj i arheološkoj izobrazbi na Početnom tečaju podvodne arheologije koji se prilikom istraživanja odvijao na podvodnom nalazištu na Babuljašu.

Tijekom arheološke kampanje 2013.g. arheološke sonde dimenzija 2x2 metra su postavljene na dijelu nalazišta gdje je površinska koncentracija antičkog materijala davala naznake bogate uslojenosti. Ove godine istražene su 4 sonde tako da su bile međusobno povezane u obliku kvadrata, pa se u konačnici dobila površina od 4 x 4 metra koja se istraživala do sterilnog sloja. Prilikom iskopavanja uočena su dva sloja na ovom dijelu nalazišta. Gornji sloj sadrži većim dijelom keramičke nalaze datirane u antički period, i tek pokoji ulomak prapovijesne keramike, dok u sloju 2 prevladavaju nalazi prapovijesne keramike, a antički nalazi su rijetki. Debljina slojeva varira, i povećava se prema dubini, što je uvjetovala konfiguracija terena na kojem je nalazište smješteno, a ukupna debljina arheološkog sloja je oko 50 cm.

Već prilikom početka iskopa uočeno je da se u pijesku nalazi velika količina keramičkih fragmenata. Najvećim dijelom to su fragmenti tijela amfora, zatim fragmenti grla i dna, ali i znatna količina fine keramike, poznate pod nazivom terra sigillata chiara ili afrička sigilata. Radi izrade konačnog plana nalazišta, svaki od pronađenih fragmenata koji je mogao biti tipološki definiran, izmjeren je od rubova kvadranta, te je fotografiran in situ. Ovaj način dokumentiranja omogućiti će nam smještanje svih tih fragmenata unutar pojedinog kvadranta, te u konačnici njihovo ucrtavanje u detaljni plan nalazišta. Tijekom ove arheološke kampanje snimljeno je 37 posebnih nalaza.

Od arheoloških nalaza, najveći dio pripada fragmentima amfora. Prema fakturi i formi, svi tipovi amfora koji su pronađeni mogu se definirati kao cilindrične amfore sjeverno afričke provenijencije. Ovakve amfore proizvodile su se u rimskoj provinciji Africa Proconsularis, najvećim dijelom u radionicama koje se nalaze na teritoriju današnjeg Tunisa. Služile su za transport ponajviše maslinovog ulja i vina, a u vrijeme kasne antike ovim proizvodima opskrbljivan je veći dio Rimskog carstva. Prilikom istraživanja

6. The regularity of ship cargo composition is partly preserved
Na brodolomu je djelomično sačuvana i pravilnost u slaganju tereta na brod
(photo: L. Bekić)



ware. For the creation of a final map of the site the position of each of the fragments found that could be typologically defined was measured out from the edges of the quadrants and was photographed in situ. This method of documentation will allow us to situate all of these fragments within each of the quadrants, and plot them out in a detailed map of the site. Thirty-seven individual finds were thus recorded.

7. A bowl with depiction in relief
Zdjela s reljefnim prikazima
(photo: M. Pešić)

Of the archaeological finds, most are from fragmented amphorae. By fabric and form, all of the types of amphorae discovered can be defined as cylindrical amphorae of North African provenance. This type of amphora was manufactured in the Roman province of Africa Proconsularis, for the most part in workshops on the present-day territory of Tunisia. They were used predominantly for the transport of olive oil and wine, and in the late Roman period these products were supplied to most of the Empire. Several types of these amphorae were found during the research, but given that the finds are still in the desalination process we cannot with certainty ascertain typology for all the finds. Based on the analysis to date some of the fragments found could be of the Keay 25 (variants 1, 2 and 3), Keay 35B and Keay 27 types (Keay 1984). These amphorae can be approximately dated to the period from the late 3rd to 5th century (Bonifay 2004, 119 -122, 132, 135). A very interesting detail is that a stamp was found on two

pronađeno je nekoliko tipova ovih amfora, no budući da su nalazi još uvijek u procesu desalinizacije, ne možemo za sve sa sigurnošću reći kojim tipovima pripadaju. Prema dosadašnjim analizama neki od pronađenih fragmenata mogli bi pripadati tipovima Keay 25 (varijante 1, 2 i 3), Keay 35B i Keay 27 (Keay 1984). Okvirno se ove amfore mogu datirati u period od kraja III. do V. stoljeća (Bonifay 2004, 119 -122, 132, 135).



Vrlo je zanimljivo da je na dvije amfore pronađen i pečat koji je utisnut u strukturu gline prije samog pečenja. To nam daje naznake da se radi o pečatu proizvođača amfora ili onoga za koga je roba bila proizvedena. Jedan pečat ima izgled velikog tiskano slova H u krugu za koji do sada na žalost nismo uspjeli naći analogije. Drugi pečat ima izgled tri identične kružnice koje su postavljene u trokutastu formaciju. Iako ni za ovaj pečat nemamo direktne analogije, slični pečati s kružnicama javljaju se na amforama Keay 35B proizvedenima u priobalnom području Tunisa, a te amfore su po formi gotovo identične s ovim primjerkom (Bonifay 2004, 18, fig 5.11,).

Osim amfora, pronađen je i veći broj fragmenata različitih keramičkih posuda poznatijih pod nazivom terra sigillata chiara te afričkog kuhinjskog posuđa. Među ovim nalazima svakako je najzanimljiviji fragmentirani tanjur koji pripada tipu Hayes 53A, koji se datira u period od 350. - 430.g. (Hayes 1972,

amphorae, impressed into the structure of the clay prior to firing. This would indicate an amphora manufacturer's stamp or the stamp of the party of whom the merchandise was produced. One stamp appears to be a large printed letter H in a circle for which we have, unfortunately, thus far been unable to find an analogy. The second stamp has the appearance of three identical circles set in a triangular formation. Although we again do not have a direct analogy for this stamp, similar stamps with circles do appear on Keay 35B amphorae manufactured in the coastal area of Tunisia, and these amphorae are almost identical in form to our specimen (Bonifay 2004, 18, fig. 5.11).

Found along with the amphorae were a large number of fragments of various ceramic ware known as terra sigillata chiara and African kitchenware. Certainly the most interesting among these finds is a fragmented plate of the Hayes 53A type, dated to the period from 350 to 430 (Hayes 1972, 78-82). This is a shallow bowl with a decoration in relief on the inner face in the form of a lion and leopard on opposite sides within two pairs of concentric circles.

Based on the preliminary analysis of these finds, the cargo it was transporting, the shipwreck can approximately be dated to the first half of the 5th century period. For now we can say that its point of departure was certainly one of the North African ports, and that the bulk of its cargo consisted of olive oil, while the remainder of the cargo area would have been packed with sigillata ware.

Although the wooden parts of the ship's structure have not yet been found in the researched trenches, the cause of which may be the insufficient thickness of the sand in which the structure could have been preserved, indicators were found that continued research could uncover significant sections of the vessel. Two bronze nails have been found, one of which had traces of wood, one iron nail and part of a lead plate often use for the repair of outer sections of the wooden hull on ships. This proves that the ship did in fact sink somewhere in the vicinity, and we hope to find significant preserved sections of the ship's wooden structure in deeper layers during the next campaign.

As noted, this year's campaign was focused on the research of the Roman period shipwreck, and the scope of the research effort did not allow us to launch a systematic examination of the prehistoric site. A significant quantity of prehistoric material was, however, discovered during the examination of the lower layers of the trenches. This is for the most part ceramic material of dark brown and black colour with a significant quantity of quartzite particles. Many of the finds are small sherds, the edges of which are worn as a result of the activity of the



8. A bowl with relief depiction in the moments after discovery
Zdjela s reljefnim prikazima prilikom pronalaska (photo: L. Bekić)

78-82). To je plitka zdjelica koja s unutrašnje strane ima reljefne ukrase u formi lava i leoparda na suprotnim stranama koji su smješteni između dva para koncentričnih krugova.

S obzirom na preliminarne analize ovih nalaza prema teretu koji je prenosio, brodolom se može okvirno datirati u period prve



9. Divers during the excavation of trenches A and B
Ronici prilikom iskopavanja sondi A i B (photo: M. Pešić)

polovine petog stoljeća. Za sada možemo reći da je njegova polazišna točka zasigurno bila jedna od luka u sjevernoj Africi, a kao glavninu tereta prenosio je maslinovo ulje, dok je preostali dio teretnog prostora mogao biti popunjen sigilatnim posuđem.

Iako drveni dijelovi brodske konstrukcije do sada nisu pronađeni u istraženim sondama, za što bi uzrok mogli tražiti u nedovoljnoj debljini pijeska u kojem se konstrukcija mogla očuvati, ipak su nađene naznake da bi se u nastavku istraživanja mogli pronaći i značajniji dijelovi broda. Do sada su pronađena dva

sea before they were covered by the deeper layers of sand. A small number are rim and base sherds. Broad strap handles characteristic of the Bronze Age are prominent, the period to which this site can be attributed. Found along with the ceramic finds were remains of animal bones and a small quantity of retouched flint tools and flint flakes. Given that stratification of this ceramic material in the trenches was not observed, it is presumed that it was washed into the sea from land over many years. An inspection of the onshore part of the island established that to this day a large quantity of identical pottery is found on its surface. It is known that there was a prehistoric hillfort on the nearby island of Veli Školj from the same period, and the material found could, following research, be linked to this hillfort.

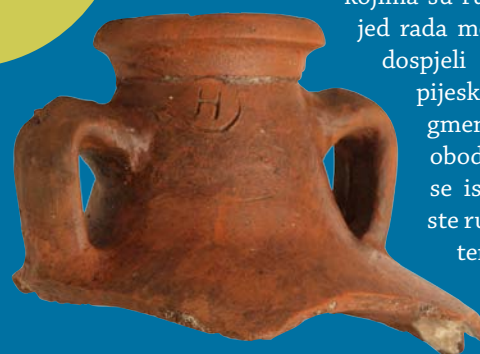
The two-week research of the waters of the islet of Babuljaš has resulted in the discovery of a very interesting site. Although the research is in its early stages, we can already conclude that the importance and wealth of this site deserves attention and further research in the coming years. This site, with the remains of the wreck of a Roman period vessel that was likely transporting a cargo of olive oil in amphorae from North Africa along with a large quantity of sigillata ware, has after this brief research campaign shown massive potential. The large quantity of Bronze Age finds that appear in the waters of Babuljaš also point clearly to the need for further research of this previously unknown underwater site.



11. The divers and geodesist in discussion during the surveying of positions
Dogovor ronjoca i geodeta prilikom snimanja točaka
(photo: M. Pešić)



10. African Keay 35B amphorae with stamps
Afričke amfore Keay 35B s pečatima
(photo: M. Pešić)



brončana čavla, od toga jedan s tragovima drva, jedan željezni čavao, te dio olovne pločice kakve su se često koristile za popravke vanjskih dijelova drvene oplata na brodovima. Ovo dokazuje da je brod ipak potonuo negdje u blizini, te se nadamo da ćemo u dubljim slojevima prilikom sljedećih kampanja pronaći sačuvanu i veću količinu drvene građe broda.

Kao što smo već napomenuli, ovogodišnja istraživanja bazirala su se na istraživanju antičkog brodoloma, dok se zbog obima istraživanja nije moglo pokrenuti sustavno istraživanje prapovijesnog nalazišta. Ipak je prilikom istraživanja sonde u donjim slojevima otkrivena i znatna količina prapovijesnog materijala. To je uglavnom keramički materijal, tamno smeđe i crne boje s većom količinom kvarcnih čestica. Veći dio nalaza su manji fragmenti kojima su rubovi izlizani uslijed rada mora, prije nego su dospjeli u dublje slojeve pijeska. Manji dio fragmenata predstavljaju obodi i dna. Posebno se ističu široke traka-ste ručke koje su karakteristične za brončano doba, kada se ovo nalazište i može datirati. Osim keramičkih nalaza, pronadeni su i ostatci životinjskih kostiju, kao i manja količina obrađenih kremenih alatki i kremenih odbitaka. S obzirom da se nije primijetila uslojenost ovog keramičkog materijala u sondama, pretpostavlja se da je on u podmorje dospio s kopna, uslijed dugogodišnjeg ispiranja morske obale. Pregledom kopnenog dijela otočića ustanovljeno je da se i danas na njegovoj površini može naći veća količina identične keramike. Poznato je da se na obližnjem otoku Veli školj nalazi prapovijesna gradina iz istog perioda, te bi pronadeni materijal mogao nakon istraživanja povezati i s tom gradinom.

Dvotjedna istraživanja podmorja otočića Babuljaša rezultirala su otkrićem vrlo zanimljivog nalazišta. Iako su istraživanja u samom začetku, već sada možemo reći da je važnost i bogatstvo ovog nalazišta zaslužilo pažnju i nastavak istraživanja i u sljedećim godinama. Nalazište s ostacima antičkog brodoloma koji je vjerojatno s teritorija sjeverne Afrike prenosio teret maslinovog ulja u amforama, te veću količinu sigilatnog posuđa je već nakon kratkog istraživanja pokazalo golemi potencijal. Velika količina brončanodobnih nalaza koji se javljaju u podmorju Babuljaša također iziskuje potrebu za daljnjim istraživanjem ovog do sada nepoznatog podvodnog nalazišta.

Bibliography / Literatura

Bonifay, M., 2004. - Etudes sur la céramique romaine tardive d'Afrique, BAR International Series 1301, Oxford.

Hayes, J. W., 1972. - Late Roman Pottery, London-Roma.

Keay, S.J. 1984. - Late Roman Amphorae in the Western Mediterranean part I, BAR International Series 196 (i), Oxford.

Pešić, M., Meštrov, M., 2012. - Survey of the seabed of Zadar county / Rekognosciranje podmorja Zadarske županije, Potopljena baština / Submerged Heritage 2, Zadar, 44-47.

Continued Research of the Roman Period Shipwrecks at Cape Uljeva near Ližnjan

Nastavak istraživanja antičkih brodoloma na rtu Uljeva kod Ližnjana

LUKA BEKIĆ - lbekic@icua.hr

Very strong winds blow at times over the south of the Istrian peninsula, a threat to navigation during the period of sailing ships. Kuje Cove below the town of Ližnjan is the last haven before the southernmost point, Cape Marlera, and the open sea. Some mariners failed to make it to the shelter provided by this cove, coming to grief just before its entrance on the hidden underwater rocks off Cape Uljeva.

Systematic archaeological excavations were launched at this site last year that aim to research the looted remains of two Roman period shipwrecks. Uljeva A is the designation of an early Roman ship for which we can currently say that when it was wrecked was transporting a great number of full amphorae of the Lamboglia 2 type, usually used for the transport of wine. We can conclude that they were full from the large quantity of plugs found along with the remaining amphorae sherds, scattered among the crevices in the rocks.



2. Digital technology in the service of field documentation – practicing work in Site Recorder

Digitalna tehnologija u službi terenske dokumentacije - vježbanje rada u Site Recorder-u (photo: M. Šimičić)

Na jugu istarskog poluotoka ponekad vladaju vrlo moćni vjetrovi, koji su ugrožavali plovidbu u doba jedrenjaka. Uvala Kuje ispod Ližnjana, posljednja je uvala u kojoj se može potražiti



1. The research team at Uljeva in 2013: (from the left) Luka Bekić, Miran Erič, Maria Alexandrou, Sarita Karpuzova, Maria Ktori, Anita Jelić, Marina Šimičić, Mladen Pešić, Vladimir Danilović missing

Ekipa istraživača na Uljevi 2013: (s lijeva) Luka Bekić, Miran Erič, Maria Alexandrou, Sarita Karpuzova, Maria Ktori, Anita Jelić, Marina Šimičić, Mladen Pešić, nedostaje Vladimir Danilović. (photo: L. Bekić)

zaklon prije najjužnijeg rta Kamenjaka i otvorenog mora. No neki pomorci nisu uspjeli stići u zaklon ove uvale, već su nastradali nadomak ulaska, na skrivenim podmorskim stijenama rta Uljeva.

Na tom mjestu započeta su prošle godine sustavna arheološka iskopavanja koja imaju za cilj istražiti opljačkane ostatke dvaju antičkih brodoloma. Uljeva A naziv je ranorimskog broda za koji za sada možemo reći kako je prilikom brodoloma prevezio veliku količinu punih amfora tipa Lamboglia 2, u kojima se obično prevozilo vino. Da su bile pune, zaključujemo prema velikoj količini njihovih čepova, koji se nalaze zajedno s ostacima dijelova amfora, razbacanih između procijepa stijena.



3. The daily loading of equipment at Ližnjan's port

Svakodnevno ukrcavanje opreme u ližnjanskoj luci (photo: L. Bekić)

Uljeva B is located almost two hundred metres further and is difficult to make out. This ship sank much later, perhaps as much as four hundred years after Uljeva A. This vessel transported a smaller number of various amphorae, but the cargo consisted mostly of a large quantity of ware manufactured in the Aegean Sea area. The cargo has been fragmented and scattered among the many crevices between the rocks at a depth of from 2 to 5 metres.

The archaeologists of the International Centre for Underwater Archaeology in Zadar, with the help of their colleagues from the Institute for the Protection of Cultural Heritage of Slovenia (ZVKDS) have for several years now researched the remains of these shipwrecks with the aim of documenting the finds and shedding light on the full story behind these two events. Staged along with the systematic research financially and organisationally supported by the Municipality of Ližnjan is an advanced course on underwater archaeology held under the auspices of the UNESCO office in Venice. Through this course many students from different countries have already gained experience at Ližnjan and contributed to the archaeological research. The diving team that researched Uljeva this year included team leader Luka Bekić, deputy team leader Mladen Pešić, Marina Šimičić and Anita Jelić – all from ICUA Zadar, Miran Erić of the ZVKDS, and course participants Maria Alexandrou and Maria Ktori from Cyprus, Sarita Karpuzova from Macedonia and Vladimir Danilović from Serbia.

Given that both shipwrecks have been looted, the remains of the former cargo are found only as fragments among the rocks. The archaeological excavations are thus complex and require special methods of documentation and excavation. With the aim of achieving as clear a picture as possible of both sites an excavation strategy has been established that includes the primary interpretation of all collected finds and the precise interpretation of the typologically characteristic fragments. The goal of this project is to



primary interpretation of all collected finds and the precise interpretation of the typologically characteristic fragments. The goal of this project is to

Uljeva B nalazi se gotovo dvjestotinjak metara dalje i teško se uočava. Ovaj brod potonuo je mnogo kasnije, možda i četiri stotine godina nakon Uljeve A. Ovaj brod prevezio je manji broj različitih amfora, ali je tovar prvenstveno sadržavao mnoštvo posuda izrađenog u radionici na području Egejskog mora. Tovar je usitnjen i razbacan po velikom broja jama između stijena na dubini od 2 do 5 metara.



4. Access from the mainland side was challenging for divers

Pristup s kopnene strane za ronioce nije jednostavan (photo: M. Šimičić)

Arheolozi Međunarodnog centra za podvodnu arheologiju u Zadru uz pomoć slovenskih kolega iz zroda za varstvo kulturne dediščine Slovenije (ZVKDS) već par godina istražuju ostatke ovih brodoloma, kako bi se dokumentirali nalazi i razotkrila cjelokupna priča koja stoji iza ta dva događaja. Uz sustavna istraživanja koja financijski i organizacijski podržava općina Ližnjan, odvija se i napredna škola podvodne arheologije, pod pokroviteljstvom UNESCO-vog ureda u Veneciji. Na ovaj način su već brojni studenti iz različitih zemalja stjecali svoje iskustvo u Ližnjanu i pridonijeli arheološkom istraživanju. Ronilačka ekipa koja je istraživala Uljevu ove godine jest Luka Bekić kao voditelj i Mladen Pešić kao zamjenik voditelja te Marina Šimičić i Anita Jelić, svi iz MCPA Zadar, Miran Erić iz ZVKDS, te polaznici tečaja Maria Alexandrou i Maria Ktori s Cipra, Sarita Karpuzova iz Makedonije te Vladimir Danilović iz Srbije.

find a method for the collection of data from which we can gain final results comparable to the results of the research of a pristine shipwreck.

During this year's campaign at the Uljeva B shipwreck site drawing documentation was made of a large number of pits in the Site Recorder program and with the help of a water dredge twenty new pits were excavated (four were excavated last year). This has provided for the speedier coverage of the area of the site, which needs to be fully researched in order to arrive at final conclusions.

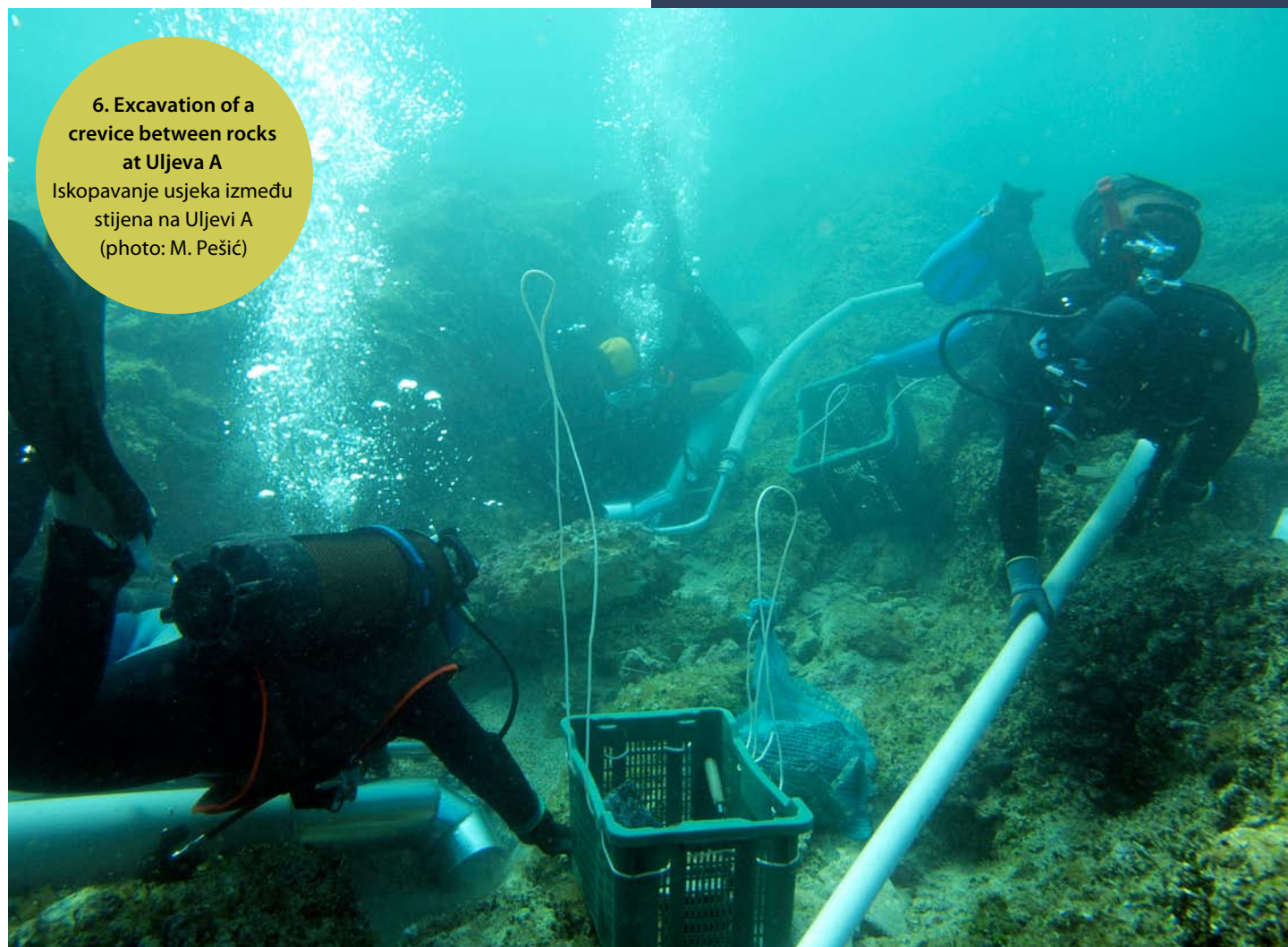
Ship Uljeva B transported a cargo of a large number of specimens of Aegean Coarse Ware. From the cargo we have thus far identified a large number of small and large pots with two small handles, the plugs of these pots and some bowls. Some of the pots had biconical bellies, while others had rounded classically ribbed walls. The discovery of sections of three glass cups may indicate that they were part of the ship's cargo. This remains to be established, however, by further research.

As far as the amphorae are concerned, so far we have documented three related types of North African amphorae, and numerous Spatheion amphorae. It appears that we have also discovered fragments we can attribute to Hornhandled Cretan and Late Roman 1 types. All told there are not many amphorae, but several different types are represented. This is unusual, and likely indicates diverse goods in amphorae procured from various areas seeking their way to buyers through commercial activity at numerous Adriatic ports.



5. At Uljeva B the pits often extend under the rock
Na Uljevi B jame se često podvlače pod stijene (photo: L. Bekić)

S obzirom kako su oba brodoloma opljačkana, ostaci nekadašnjeg tereta pronalaze se samo u ulomcima između stijena. Stoga arheološka iskopavanja nisu jednostavna i zahtijevaju posebne metode dokumentacije i iskopavanja. Kako bi se postigla čim jasnija slika obaju nalazišta određena je strategija iskopavanja, koja uključuje primarnu obradu svih prikupljenih nalaza i preciznu obradu tipološki značajnijih ulomaka. Cilj ovog projekta je naći način za prikupljanje podataka iz kojih bi se dobili konačni rezultati usporedivi s rezultatima istraživanja nekog netaknutog brodoloma.



6. Excavation of a crevice between rocks at Uljeva A
Iskopavanje usjeka između stijena na Uljevi A (photo: M. Pešić)

At Uljeva A the geological situation is somewhat different as the crevices in the rocks are elongated such that the fragments of amphora are deposited in long rows. Several crevices were selected, therefore, following the site drawing documentation of the core of the shipwreck, that were divided into coherent contexts, such that the distribution of finds could later be studied as a whole. Contexts JA1A, JA1B and JA1C were researched this year. It is interesting that, along with the very numerous fragments of amphorae of the Lamboglia 2 type, we find fragments of vessels such as small pots, jugs and plates here. Also conducted here was a partial revision excavation at the site of a trench excavated in 2008.

In closing it should be noted that a potential Uljeva C shipwreck site is located closer to the shore. This shipwreck is recognised by a large quantity of brick and a small amount of glazed pottery and glass. Based on these finds the wreck could be dated to the period from the late 17th or early 18th century. This wreck is not currently in the focus of our research, but is an interesting example of the dangers to mariners lurking at this cape.

Research of shipwrecks Uljeva A and B will continue over the coming years whereupon we shall be able to provide a conclusive picture of this fascinating site.



8. Sketching crevices at Uljeva A required teamwork
Ucrtavanje usjeka na Uljevi A je timski rad (photo: M. Šimičić)



7. A glass bottle from the Post-Medieval shipwreck Uljeva C
Staklena boca sa novovjekovnog brodoloma Uljeva C (photo: L. Bekić)

Tijekom ovogodišnje kampanje na brodolomu Uljeva B napravljena je nacrtana dokumentacija većeg broja jama u programu Site recorder-u, a pomoću vodene pumpe iskopano je dvadeset novih jama (prošle godine iskopano ih je 4). Time se počelo brže pokrivati prostor nalazišta, kojeg je potrebno istražiti u potpunosti kako bi se mogli donijeti konačni zaključci.

Brod Uljeva B, je kao teret prevezio velik broj primjeraka tzv. Egejske grube keramike (Aegean Coarse Ware). Od tog tereta prepoznali smo dosada velik broj manjih i većih lonaca s dvije ručice, pripadajućih čepova lonaca, te nekih zdjela. Dio lonaca imao je bikonične trbuhe, dok su drugi imali oble, klasično narebrne stijenke. Pronalazak dijelova triju staklenih čaša navodi na pomisao kako su i one mogle biti dio tovara broda. No to će pokazati tek daljnja istraživanja.

Što se tiče amfora, zasada su dokumentirana tri srodna tipa sjevernoafričkih amfora, kao i brojne tzv. Spatheion amfore. Čini se kako smo pronašli i ulomke koje možemo pripisati tzv. rogolikim (Hornhandled) kretskim i Kasnorimskim 1 tipovima (Late Roman 1). Sveukupno amfora nema mnogo, ali je zastupljeno više različitih tipova. To je neobično, pa je vjerojatno riječ o različitoj robi u amforama nabavljenim u raznim područjima, koja je tražila svoj put do kupca putem trgovine u brojnim lukama Jadrana.

Na Uljevi A je geološka situacija ponešto drugačija, jer su ovdje napukline u stijenama izdužene a dijelovi amfora nalaze se tako naslagani u dugim nizovima. Stoga je nakon nacrtne dokumentacije središta brodoloma izabrano nekoliko procijepa koji su podijeljeni u suvise cjeline, kako bi se raspored nalaza mogao kasnije proučavati u cjelini. Ove godine istražene su tako cjeline JA1A, JA1B te JA1C. Zanimljivo je da se osim vrlo brojnih ulomaka amfora koje su pripadale tipu Lamboglia 2 ovdje nalaze i ulomci posuda poput manjih lonaca vrčeva i tanjura. Ovaj prostor je djelomično i revizijsko iskopavanje na mjestu sonde koju smo na ovom mjestu iskopali 2008.g.

Na kraju valja upozoriti kako se bliže obali nalazi i lokacija potencijalnog brodoloma Uljeva C. Ovaj brodolom prepoznaje se po većoj količini opeka te malo ulomaka cakljene keramike i stakla. Prema tim nalazima mogao bi se datirati u kraj 17. ili početak 18.st. On zasada nije u središtu naših istraživanja, ali je zanimljiv primjer opasnosti koje vrebaju pomorce na ovom rtu.

Istraživanja brodoloma Uljeva A i B nastaviti će se tijekom nekoliko slijedećih godina, kada će se moći donijeti konačna slika ovog zanimljivog nalazišta.

Bibliography / Literatura

- Bekić, L. 2011 - Podvodna arheološka rekognosciranja podmorja Istre / Underwater Archaeological Reconnaissance of Istrian Maritime Waters, Potopljena baština / Submerged Heritage 1, Zadar, 35-38.
- Bekić, L. 2012a - Launch of Systematic Research of Roman Period Shipwrecks at Cape Uljeva / Početak sustavnih istraživanja antičkih brodoloma na rtu Uljeva, Potopljena baština / Submerged Heritage 2, Zadar, 34-38.
- Bekić, L. 2012b - Najnovija podvodna rekognosciranja podmorja Istre, Histria Antiqua 21, Pula, 581-597.
- Bekić, L. in print - Istarsko podmorje, Rovinj, Pula, Bale, Ližnjan, Kavran, Umag, Hrvatski arheološki godišnjak 7/2010, Zagreb.
- Mihajlović, I. & Čule, S. 2010 - Istarsko podmorje, Hrvatski arheološki godišnjak 6/2009, Zagreb, 343-345.
- Miholjek, I. 2009 - Akvatorij Istre, Hrvatski arheološki godišnjak 5/2008, Zagreb, 309-311.

Survey of the Velebit Channel in 2012 and 2013

Rekognosciranje podvelebitskog kanala 2012. i 2013. godine

IGOR MIHAJLOVIĆ - imihajlovic@h-r-z.hr

Recent years have seen a renewed interest among underwater archaeologists for the underwater heritage of the Velebit Channel. Funding for underwater archaeological surveying and exploration in 2012 and for a three-year project (2013-2015) are provided by the Croatian Ministry of Culture and conducted by the underwater archaeology department of the Croatian Conservation Institute. Participating in the exploration are archaeologists Igor Mihajlović as survey director, Kruno Zubčić, Jurica Bezak and Pavle Dugonjić (staffers at the department), Jerko Macura and Ozren Pleše (outside associates) and three members of the diver group of the police intervention unit in Zadar; Denis Glavan, Dejan Bačić and Zvonimir Ražov. The members of the police intervention unit participated in the effort on the basis of a Croatian Government decision on the collaboration of the Ministry of the Interior and Ministry of Culture aimed at the protection of the maritime rights and interests of the Republic of Croatia.

There has been no systematic examination of the waters of Lika-Senj County since 1985, and a number of trustworthy reports of archaeological sites that have been received needed verification. Positions and zones that had been surveyed in the 1960s and 1970s and registered as cultural goods also required re-examination. New GPS data was collected at these old positions in order to render protection efforts more precise.

Three coastal zones in Lika-Senj County were identified in 1967, and have been entered into the register of immobile culture monuments and thereby placed under legal protection. These zones were systematically inspected during our research in 2012 and 2013.

Baška Draga Cove was the first position to be inspected (Fig. 1). The survey covered practically the same area cited in 1975 report to a depth of 25-30 metres. Large and small sherds from

Posljednjih godina obnovljen je interes podvodnih arheologa za podvodnu baštinu podvelebitskog kanala. Financijska sredstva za podmorska arheološka rekognosciranja i istraživanja u 2012. kao i za trogodišnji projekt (2013-2015.) osiguralo je Ministarstvo kulture RH, a provodi ih Odjel za podvodnu arheologiju Hrvatskog restauratorskog zavoda. U istraživanjima su sudje-



1. Remains of the shipwreck at Baška Draga Cove near Karlobag
Ostaci brodoloma u uvali Baška draga nedaleko Karlobaga
(photo: D. Bačić)

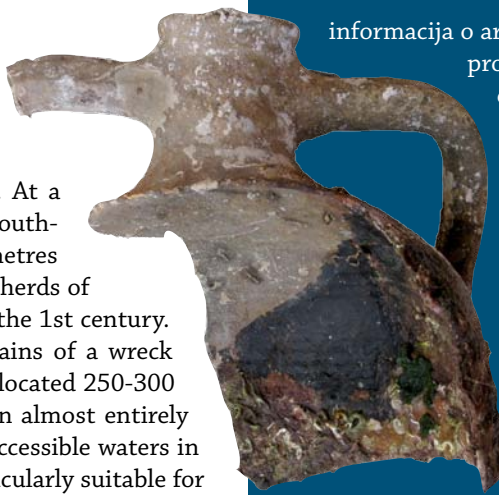
lovali arheolozi Igor Mihajlović kao voditelj rekognosciranja, Kruno Zubčić, Jurica Bezak i Pavle Dugonjić (djelatnici istog Odjela), Jerko Macura i Ozren Pleše (vanjski suradnici) te tri pripadnika Ronilačke grupe Interventne policije iz Zadra, Denis Glavan, Dejan Bačić i Zvonimir Ražov. Pripadnici Interventne policije sudjelovali su na temelju uredbe Vlade RH kojom se predviđa suradnja Ministarstva unutarnjih poslova i Ministarstva kulture, sa zajedničkim ciljem zaštite prava i interesa RH na moru.

Nakon 1985.g. akvatorij Ličko - senjske županije nije bio sistematski pregledavan, a kako je zaprimljeno više pouzdanih

various amphorae can be found along the entire stretch around the southeastern cape and several hundred metres along the shore to the southeast that can be dated from the 1st century through to the Late Roman and Early Byzantine periods. At a location about 250-300 metres from the south-east cape on the cove at a depth of 15 metres there is a concentration of neck and belly sherds of amphorae of the Dressel 6A type dated to the 1st century. We can, therefore, conclude that the remains of a wreck with Dressel 6A type amphorae are in fact located 250-300 metres from the cape, and that it has been almost entirely devastated as a result of the shallow and accessible waters in which it lies. Although the cove is not particularly suitable for anchorage, the time span and quantity of discovered and documented material suggests that there is a possibility that Baška Draga served as a harbour for a Late Roman complex at present day Vidovac (Vidovgrad).

The second position that was surveyed is off the island of Pag, at Veliko Lukovišće Cove. Reports from local free divers indicate that sherds of cylindrical amphorae can be found here. No significant concentration of ceramic material was observed during dives at a location not far from the shore at a depth of 15 to 18 metres – only a few sherds from the belly and neck of amphorae, distributed across a broad area. This is a scattered site (likely a small shipwreck) that has been looted over the years as a result of its shallow position. The amphorae are North African of the type that Panella places in the Africana Grande category (Africana IIC and Africana IID) (Panella 1973). Following the Keay typology these are amphorae of the Keay VI and Keay VII type (Keay 1984). Both types begin to appear in the late 3rd century and last through to the early 5th century, with some evidence indicating that they lasted into the 6th century (Africana IID).

The Roman shipwreck at Vlaška Mala Cove has been known of since 2004 when it was entered into the Register of Cultural Goods and covered with a protective netting (Radić Rossi, 2004, 39-57). The site is located along the northern cape of Vlaška Mala Cove to the south of the ferry landing at Žigljen, on a rocky-sandy slope of the seafloor at a depth of 24 to 30 metres. The chief concentration of Lamboglia 2 type amphorae covers about 8 by 9 metres and consists of about a hundred integral or partially damaged specimens lying in several layers. The cage is covered with a relatively thick layer of marine growth, weighing down the iron netting. The inscribed plaques were not at all visible, and one of the five support pipes of the cage has collapsed onto the existing finds. The blocks holding the cage in place are unsteady and at some points the gap between the bottom of the cage and the sandy seafloor is up to forty centimetres wide. There are no traces of deliberate devastation on the cage. As one of the support



2. Sherd of a Late Roman 1 type amphora from Spasovac Cove
 Ulomak amfore tipa Late Roman 1 iz uvale Spasovac (photo: J. Macura)



3. Ceramic tripods from a site off the small island of Lisac near Sveti Juraj
 Keramički tronošci s lokaliteta kod otočića Lisac kod Sv. Jurja (photo: J. Macura)

informacija o arheološkim nalazištima, to je bilo potrebno provjeriti. Također je valjalo ponovno pregledati pozicije to jest zone koje su rekognoscirane još 60-tih i 70-tih i registrirane kao kulturno dobro. Na tim starim pozicijama uzimale su se nove GPS pozicije kako bi zaštita određenog područja bila preciznija.

Prema Rješenju iz 1967.g. u Ličko-senjskoj županiji određene su tri priobalne zone koje su upisane u Registar nepokretnih spomenika kulture te su shodno tome stavljene pod pravnu zaštitu. Te zone su bile sustavno pregledavane tijekom naših istraživanja 2012. i 2013.g.

Uvala Baška draga bila je prva pozicija koja je pregledana (Sl. 1). U rekognosciranju pregledano je gotovo isto područje navedeno u izvještaju iz 1975.g. do dubine od 25-30 metara. Na cijelom potezu oko jugoistočnog rta pa nekoliko stotina metara uz obalu prema jugoistoku mogu se naći veći ili manji ulomci raznih amfora koji se mogu datirati od 1.st. pa sve do kasnoantičkog i ranobizantskog razdoblja. Na lokaciji oko 250-300 metara od jugoistočnog rta uvale na 15 metara dubine nalazi se koncentracija ulomaka grla i trbuha amfore tipa Dressel 6A koja se datira u 1.st. Možemo tako zaključiti kako se na lokaciji 250-300 metara od rta uistinu nalaze ostaci brodoloma s amforama Dressel 6A koji je gotovo kompletno devastiran zbog svoje male dubine i pristupačnosti. Iako uvala nije najpogodnije za sidrenje, vremenski raspon te količina pronađenog i dokumentiranog materijala sugerira da postoji mogućnost da je Baška draga služila kao luka za kasnoantički kompleks rimskim stanovnicima u današnjem Vidovcu (Vidovgrad).

Druga pozicija koja je pregledana nalazi se na Pagu, u uvali Veliko Lukovišće. Prema dojavama lokalnih ronilaca na dah, ovdje su se mogli naći ulomci amfora s cilindričnim tijelom. Prilikom zarona na lokaciju koja se nalazi nedaleko od obale na dubini od 15 do 18 metara nije primijećena znatna koncentracija keramičkog materijala, tek nekoliko ulomaka trbuha i grla amfora, a ti nalazi raspoređeni su na širem području. Riječ je o rastresitom nalazištu (vjerojatno manji brodolom) koje je radi male dubine devastiran niz godina. Riječ je o sjevernoafričkim amforama koje prema Panelli spadaju u kategoriju Africana Grande (Africana IIC i Africana IID) (Panella 1973). Po tipologiji Keay-a ove amfore nose nazive Keay VI i Keay VII (Keay 1984). Obje amfore se počinju pojavljivati krajem 3.st. traju sve do početka 5.st, a po nekim dokazima i do 6.st. (Africana IID).

Antički brodolom u uvali Vlaška mala poznat je od 2004.g. kada je upisan u listu registriranih kulturnih dobara i prekriven zaštitnom mrežom (Radić Rossi, 2004, 39-57). Nalazište je smješteno

pipes is out of order, and the roof netting is significantly weighed down by marine growth, there is a real possibility that the cage could cave in and it should be repaired or replaced. A part of Svetojanska Cove on the island of Pag, the site of a Byzantine fortress, was also surveyed. Various sherds of amphorae, amphorae bellies, necks with handles, parts of tegulae, amphorae handles and very small amphorae sherds are visible in the centre of the cove at a depth of from 15 to 25 metres. The greatest concentration is found at a depth of from 15 to 19 metres, which comes as no surprise as this is the depth of a sandy basin in which the material was retained; up to this depth the rock is slightly steep and the material has nowhere to rest. The rest of the material (amphorae sherds and necks) slid down the sandy slope, which continues to descend into the depths. It is presumed that there was an anchorage at this site for the ships that serviced the fort and that the material was thrown from them into the sea.



4. Ceramic tripods from a site near Karlobag
Keramički tronošci s lokaliteta kod Karlobaga
(photo: J. Macura)

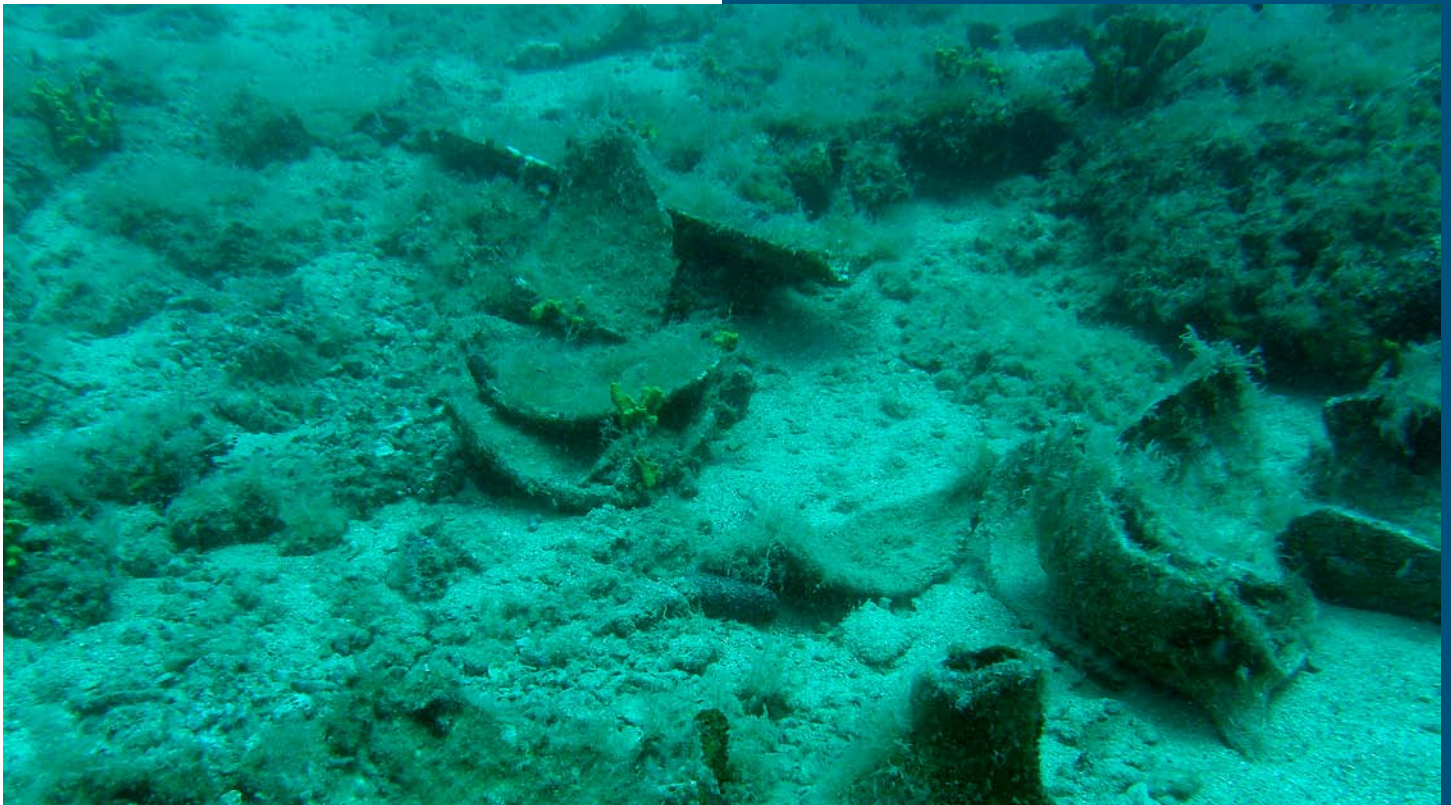
The next location to be surveyed was Spasovac Cove where a report from 1970 places three groups of large concentrations of finds in an area about 200 metres to the north from the northern cape on the cove, at depths of 12, 20 and 40 metres. An inspection of the area yielded one neck from a Late Roman 1 (LR1) amphora, dated to the period from the early 5th to mid 7th century (Piéri, 2005; Reynolds, 2005) (Fig. 2). According to recent research the production centres for these amphorae were in the Roman province of Cilicia and on Cyprus, and they were used for the transport of wine and oil (Empereur & Picon, 1989). There are no shipwrecks with this type of amphora in the Adriatic, but they have been found as independent finds at the Lučnjak shallows off the island of Korčula, off the island

uz sjeverni rt uvale Vlačke male južno od trajektnog pristaništa u Žigljenu, na kame-nito - pjeskovitoj padini morskog dna, a na dubini od 24 do 30 metara. Glavna koncentracija amfora tipa Lamboglia 2 je dimenzija oko 8 x 9 metara i sastoji se od oko stotinu cjelovitih ili djelomično oštećenih primjeraka koji leže u nekoliko slojeva. Kavez je prekriven relativno debljim slojem morskog obraštaja što otežava željezne mreže. Ploče s natpisom uopće nisu bile vidljive, a jedna od pet potpornih cijevi kaveza je srušena na postojeće nalaze. Blokovi koji drže kavez na mjestu su vrlo klimavi, a na nekim mjestima se dno kaveza odvaja od pjeskovitog dna i do četrdesetak centimetara. Na kavezu nisu vidljivi tragovi namjerne devastacije. Kako je jedna od potpornih cijevi van funkcije, a krovne mreže znatno otežane morskim obraštajem, postoji realna mogućnost da se kavez uruši zbog čega bi trebalo sanirati ili zamijeniti postojeći kavez. Na otoku Pagu pregledan je i dio Svetojanjske uvale gdje se nalazi bizantska utvrda. U središtu uvale na dubini od 15 do 25 metara vidljivi su razni ulomci amfora, trbuha amfora, grla s ručkama, dijelovi tegula, ručke amfora i sitni ulomci amfora. Najveća se koncentracija materijala nalazi na dubini od 15-19 m što ne čudi s obzirom da se na toj dubini pojavljuju pješčani bazeni u kojima se materijal zadržao; do te dubine stijene su blago strme i na njima se materijal nema gdje zadržati. Ostatak je materijala (grla i ulomci amfora) skliznuo po pješčanoj padini koja dalje blago pada u dubinu. Pretpostavlja se da je na ovom mjestu postojalo sidrište za brodovlje koje je opsluživalo gradinu i da je s njih materijal bacan u more.

Iduća lokacija pregleda bila je uvala Spasovac gdje je iz izvještaja iz 1970. g. vidljivo kako postoje tri skupine veće koncentracije nalaza na području od oko 200 metara sjeverno od sjevernog



5. Part of the tail section of an American B-24 bomber off Duboka Cove
Dio repa američkog bombardera B-24 ispred uvale Duboka
(photo: D. Bačić)



6. Remains of a looted shipwreck off Starigrad Senjski
Ostaci devastiranog brodolom ispred Starigrada senjskog
(photo: Z. Ražov)

of Kobra, the rock Šij (Mljet) and at Lukovo Otočko Cove. Besides other sporadic finds, to the south of Spasovac Cove at a depth of 15 metres, below the southern cape of the cove, a large fragment of a Late Roman amphorae was found with both handles, the entire rim and neck and most of the belly. The area to the south of Spasovac Cove to Planikovac Cove was surveyed in 2013 to a depth of 36 metres. No archaeological material was found along this stretch, which is understandable given that the entire coastal belt was covered with stone from land during the construction of the trunk road.

To the eastern side of the island of Lisac, facing the settlement of Sveti Juraj, at a depth of from 2 to 5 metres, local divers report a large number of potsherds scattered across the seafloor. Dives established the area to be a flat sandy plateau with an abundance of ceramic finds. The concentration of finds drops to the south of the island, and the configuration of the terrain is increasingly steep, consisting of rock faces descending towards the open sea to a depth of 30 metres forming a steep wall. There were no greater concentrations of finds to the outer side of the island facing west, although we do find sporadic scattered finds of potsherds. The neck of a Lamboglia 2 amphora was found to the northwest of the island at a depth of 13 metres, and a further three handle sherds, a rimsherd of a vessel with protruding decoration, and ceramic tripods (Fig. 3) and one amphora neck. The area around the small island of Lisac with its finds of ceramic tripods thus presents an interesting scientific problem. A field of potsherds was found in 2013 between Brkinac Cove and Ravna Punta, to the north of Karlobag, at a depth of only 5.5 metres, mostly of fine granulation – but there were also seven ceramic tripods identical to those from Sveti Juraj. This is the first known find of ceramic tripods outside of Sveti Juraj (Fig. 4). The purpose of these ceramic tripods has yet to be scientifically explained in a satisfactory manner. The thin-walled vessels are almost entirely shattered as a result of the

rt-a uvale, na dubinama od 12, 20 i 40 metara. Pregledom područja nađeno je jedno grlo amfore tipa Late Roman 1 (LR1) koja se datira od ranog 5. do sredine 7.st. (Piéri, 2005; Reynolds, 2005) (sl.2). Prema novijim istraživanjima proizvodni centri ovih amfora nalazili su se u rimskoj provinciji Kilikiji te na Cipru, a korištena je za prijevoz vina i ulja (Empereur & Picon, 1989). U Jadranu nema brodoloma s ovim tipom amfora, ali kao samostalni nalaz pronađena je na pličini Lučnjak kod Korčule, kod otoka Kobra i hridi Šij (Mljet), te u uvali Lukovo otočko. Osim drugih sporadičnih nalaza, južno od uvale Spasovac na dubini od 15 metara, ispod južnog rta uvale, našao jedan veći ulomak kasnoantičke amfore s obje ručke, cijelim obodom i vratom i većim dijelom trbuha. U 2013. pregledano je područje južno od uvale Spasovac do uvale Planikovac do dubine od 36 metara. Na ovom potezu nije pronađen nikakav arheološki materijal što je i razumljivo jer je cijeli obalni pojas zasut kamenom s kopna prilikom gradnje magistrale.

S istočne strane otoka Lisac, koja gleda prema mjestu Sv. Juraj, na dubini od 2 do 5 metara prema dojavi lokalnih ronioaca, nalazi se velik broj keramičkih ulomaka, razasutih po dnu. Ronjenjem smo ustanovili kako je teren je ravna pješćana zaravan na kojoj se uistinu nalazi mnoštvo keramičkih nalaza. Na južnom dijelu otoka koncentracija nalaza opada, a i konfiguracija terena postaje sve strmija, sastavljena od kamenih stijena koje prema otvorenom moru padaju do 30 metara dubine tvoreći strmi zid. S vanjske strane otoka koja gleda prema zapadu nije bilo veće koncentracije nalaza, iako se sporadično nalaze razbacani ulomci keramike. Sa sjeverozapadne strane otočića na dubini od 13 metara nađeno je grlo amfore Lamboglia 2., a dalje prema sjeveru još tri ulomka ručki, ulomak oboda posude s izbočenim ukrasom, te keramički tronošci (sl.3) i jedno grlo amfore. Područje oko otočića Lisac s nalazima keramičkih tronožaca tako predstavlja zanimljiv znanstveni problem. U 2013.g. između uvale Brkinac i Ravne punte, sjeverno od Karlobaga, na svega 5.5 metara dubine pronađeno je polje ulomaka keramičkih posuda uglavnom finije granulacije, ali i sedam keramičkih tronožaca identičnih kao i kod Sv. Jurja. Ovo je prvi poznat nalaz

shallow waters and the action of the sea. They are typologically undeterminable, without visible bases, rims or handles. The site is about 40 by 20 metres. The context of these finds is currently unknown, but as there are no visible Roman structures on shore, and the position is not suitable for anchorage, this may be a shipwreck.

Based on a report a tail section of a B-24 Liberator aircraft was found off Duboka Cove near Žrnovnice at a depth of 19 metres. Unfortunately the markings with which the aircraft and its squadron could be identified were no longer visible (Fig. 5).

With the aim of establishing the present-day condition dives were conducted at the known site of a Roman shipwreck at Starigrad Senjski that was thoroughly looted in the early 1970s by Belgian divers (Fig. 6). The shipwreck can be dated to the very end of the 1st century BCE or the start of the 1st century CE. The greatest concentration of finds is located along a stretch between a depth of 12 to 18 metres about 700 metres to the southeast of Starigrad Senjski, immediately after the tip of the cape, and to the south over a length of about 50 metres, i.e. to the northern point of the neighbouring Dražica Cove. During this dive an abundance of amphorae sherds were found at this site, none of which were typologically determinable with the exception of one amphora neck from an entirely different period.

Also surveyed was the site around Cape Malta near Lukovo (Lukovo otočko). Two concentrations of archaeological material were observed. Several sherds of late Roman period amphorae were found to the outer side, nearer to the cape, at a depth of 16 to 20 metres. The second concentration is located about 100 metres to the south. It consists of a number of sherds of amphorae necks that are typologically of the earlier variants of the Lamboglia 2 type (Fig. 7). According to information provided by local fishers several dozen amphorae have been illegally taken from these two locations over the past forty years.

Surveys of the Velebit Channel area will continue in 2014 and 2015.

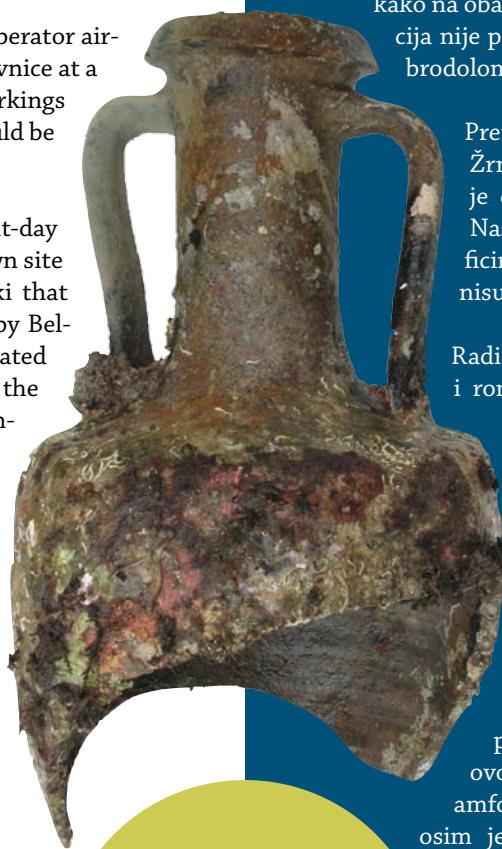
keramičkih tronožaca izvan Sv. Jurja (sl.4). Namjena ovih keramičkih tronožaca još nije zadovoljavajuće znanstveno objašnjena. Posude tanjih stijenki su gotovo kompletno podrobljene uslijed male dubine i djelovanjem mora. Tipološki su neodredivi, bez vidljivih dna, oboda ili ručki. Lokalitet je okvirnih dimenzija 40x20 metara. Kontekst ovog nalaza je za sada nepoznat, ali kako na obali nema vidljivih antičkih građevina a pozicija nije pogodna za sidrenje moguće je da je riječ o brodolomu.

Prema dojavi ispred uvale Duboka nedaleko Žrnovnice na dubini od 19 metara pronađen je dio repa zrakoplova tipa B-24 Liberator. Nažalost oznake pomoću kojih bi se identificirao zrakoplov i pripadnost eskadrili više nisu bile vidljive (sl. 5).

Radi utvrđivanja današnjeg stanja izvršeno je i ronjenje na poznatu poziciju antičkog brodoloma kod Starigrada Senjskog s koje su još ranih sedamdesetih temeljito devastirali belgijski ronionci (sl.6). Brodolom se može datirati u sam kraj 1. st. pr. Kr. ili u početak 1. st. Najveća koncentracija nalaza locirana je u potezu između 12-18 metara dubine, oko 700 metara jugoistočno od Starigrada Senjskog, neposredno iza vrha rta, a prema jugu u dužini od oko 50 metara tj. do sjeverne punte susjedne uvale Dražice. Na poziciji je ovom prilikom pronađeno mnoštvo ulomaka amfora ali niti jedan tipološki odrediv komad, osim jednog grla amfore koje pripada sasvim drugom razdoblju.

Pregledana je i pozicija oko rt-a Malta kod Lukova (Lukovo otočko). Zamijećene su dvije koncentracije arheološkog materijala. S vanjske strane, bliže rt-u, na dubini od 16-20 metara pronađeno je nekoliko ulomaka kasnoantičkih amfora. Druga koncentracija nalazi se oko 100 metara južnije. Riječ je o nekoliko ulomaka grla amfora s ručkama koje tipološki pripadaju ranijim varijantama Lamboglie 2 (sl.7). Prema informacijama od lokalnih ribara s ove dvije lokacije u zadnjih 40tak godina ilegalno je izvađeno više desetaka amfora.

Pregledi podvelebitskog područja nastaviti će se i u 2014. i 2015. godini.



7. Sherd of an early variant of a Lamboglia 2 amphora, cape Malta
Ulomak ranije varijante amfora Lamboglia 2, rt Malta
(photo: J. Macura)

Bibliography / Literatura

- Empereur, J-Y., Picon, M., 1989 - Les régions de production d'amphores imperiales en Méditerranée orientale, Amphores romaines et histoire économique: dix ans de recherche, Actes du colloque de Sienne (22-24 mai 1986), Collection de l'École Française de Rome 114, 223-248.
- Keay, S. J. 1984 - Late Roman amphorae in the Western Mediterranean. A typology and economic study: the Catalan evidence. British Archaeological Reports International Series, Oxford.
- Panella, C. 1973 - Appunti su un gruppo di anfore della prima, media e tarda età Imperiale, Ostia III: Le terme del Nuotatore: scavo dell'ambiente V et di un saggio dell'area, Studi miscellanei 21, 460-633.
- Piéri, D. 2005 - Le commerce du vin oriental à l'époque Byzantine, Bibliothèque d'Archéologie et d'Histoire, Institut Français du Proche Orient, Beirut.
- Radić Rossi, I. 2004 - Antički brodolom u uvali Vlaškoj maloj (Ancient shipwreck in the Vlaška Mala Cove), in: Radić Rossi, I. (ed.), Skriveno blago Novalje, Novalja, 39-57.
- Reynolds, P. 2005 - Hispania in the late Roman Mediterranean: ceramics and trade, Hispania in Late Antiquity: Twenty-first century approaches, Leiden.

New Results from the Exploration of the Waters of Zadar County

Novi rezultati pretraživanja podmorja Zadarske županije

MLADEN PEŠIĆ - mpesic@icua.hr

Last year's successful exploration of the seafloor was followed up again this year with an underwater archaeological survey of Zadar County, supported by the Ministry of Culture (Pešić, Meštrov 2012). A number of underwater archaeological locations in the Zadar area and the islands of the Zadar archipelago were examined in the frame of the survey.

The archaeological research was conducted by the International Centre for Underwater Archaeology in Zadar (ICUA). Serving as research director was Mladen Pešić with deputy director Luka Bekić DSc. Also participating in the research effort were Anita Jelić, Marina Šimičić, Marko Meštrov, outside associate diver and photo-documentarian Jerko Macura and Petar Dobrović providing technical support during the survey. A course on underwater archaeology following the NAS (Nautical Archaeological Society) programme was also staged during the exploration, as was a two-week field school in underwater science organised by ICUA in collaboration with the RPM Nautical Foundation (USA), Transylvania University (USA) and the Centre for Conservation and Archaeology in Cetinje (Montenegro). Fifteen students and professors from the USA participated in the survey.



2. A diver alongside a stone block of the Roman pier at Sukošan
Ronilac uz kameni blok na antičkom molu kod Sukošana
(photo M. Pešić)

One of this year's key goals was to examine the underwater archaeological sites from the List of Protected Cultural Goods on the Register of Cultural Goods of the Republic of Croatia. Several locations were selected this year that have remains of Roman period dock installations. In the area along Cape Plitkača in Sukošan the remains of walls that likely belonged to a Roman villa rustica complex – for which the dock was constructed – are

Nakon uspješno obavljenih pretraživanja podmorja koja su obavljena prošle godine, uz potporu Ministarstva kulture i ove godine su provedena podvodna arheološka rekognosciranja Zadarske županije (Pešić, Meštrov 2012). U sklopu rekognosciranja proveden je pregled niza podvodnih arheoloških lokacija u okolici Zadra i na otocima zadarskog arhipelaga.



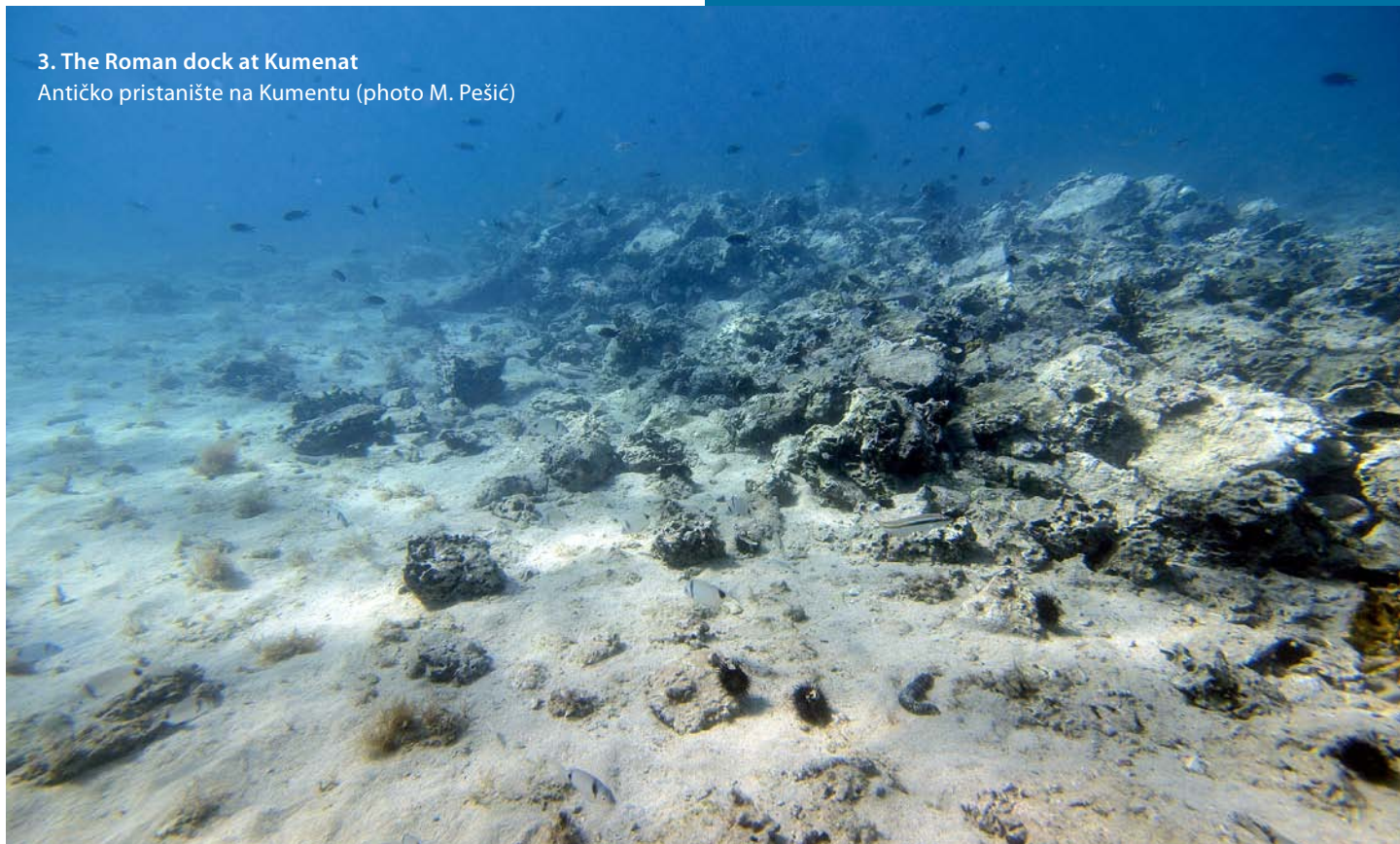
1. The base of a Roman jug found at the dock on Kumenat
Dno antičkog vrča nađenog uz pristanište na Kumentu
(photo M. Pešić)

Arheološka istraživanja provodio je Međunarodni centar za podvodnu arheologiju u Zadru (MCPA). Voditelj istraživanja bio je Mladen Pešić, zamjenik voditelja dr.sc.Luka Bekić a u istraživanju su sudjelovali Anita Jelić, Marina Šimičić, Marko Meštrov, vanjski suradnik ronilac fotograf-dokumentarist Jerko Macura te Petar Dobrović kao tehnička pomoć prilikom obavljanja rekognosciranja. Tijekom provođenja istraživanja održan je i tečaj podvodne arheologije po NAS programu (Nautical Archaeological Society) kao i dvotjedna terenska škola podvodnih znanosti u organizaciji MCPA u suradnji s RPM Nautical Foundation (USA), Sveučilištem Transylvania (USA) te Centrom za konzervaciju i arheologiju iz Cetinja (Crna Gora). Ovom prilikom u rekognosciranjima je sudjelovalo 15 studenata i profesora iz SAD-a.

Jedan od osnovnih ovogodišnjih ciljeva bio je pregled podvodnih arheoloških nalazišta koja se nalaze na Listi zaštićenih kulturnih dobara u Registru kulturnih dobara Republike Hrvatske. Za ovu je godinu odabrano nekoliko lokacija koji sadrže ostatke antičkih pristanišnih instalacija. Na predjelu uz rt Plitkača u Sukošanu su već na kopnu vidljivi ostatci zidova koji su vjerojatno pripadali antičkom kompleksu vile rustike, radi koje pristanište i izgrađeno. U plitkom moru može se raspoznati veliki kompleks podvodnih instalacija koje tvore zaštićenu luku sa

3. The Roman dock at Kumenat

Antičko pristanište na Kumentu (photo M. Pešić)



visible on land. A large complex of underwater installations are recognisable in the shallow waters forming a protected harbour with two piers. Some twenty large and smaller blocks were observed along an embankment constructed of smaller irregular stone that may have been part of the operational wharf in the Roman period. A part of the archaeological small finds we find on the seafloor can be attributed to North African provenance, prominent among which are sections of bowls and amphorae rimsherds. Along with these we also find fragments of amphorae of other provenance – one, for example, that belongs to the Late Roman II type (Karagiorgou 2001, 130). These finds indicate that the harbour may have been in use in the 3rd and 4th centuries.

A large Roman period dock was examined at the Kumenat position near Biograd na Moru, found at a depth of 2 to 5 metres. The entire dock structure is 70 metres in length and about 25 metres wide. The sides are constructed of large irregular blocks and stand slightly higher than the central plateau, while the central area has a fill of small stone. The entire area, in particular the northwest section around the dock, is very rich in archaeological material. Prominent among this material are fragments of tegulae, amphorae, highly fragmented vessels and ballast stones. Based on the analyses of the collected material, prominent among which are sherds of Forlimpopoli and Portorecanati type amphorae and a small thin-walled vessel with grey slip, the site can be dated to the 1st century.

In the waters facing the remains of a Roman villa rustica in Kožine are the remains of a small port. According to reports

dva mola. Uz nasip izgrađen od sitnijeg nepravilnog kamenja, uočeno je dvadesetak većih i manjih kamenih blokova koji su u antičko vrijeme možda bili dio operativne obale. Dio sitnih arheoloških nalaza koje nalazimo na morskom dnu se može pripisati sjeverno afričkoj provenijenciji, od kojih se ističu dijelovi zdjela i oboda amfora. Osim njih nalazimo i fragmente amfora drugih provenijencija, primjerice jedan koji pripada tipu Late Roman II (Karagiorgou 2001, 130). Ovi nalazi nam daju indicaciju da je luka mogla biti u funkciji tijekom III. i IV. stoljeća.



4. A Late Roman oil lamp from the waters of the islet of Galešnjak
Kasnoantička uljanica iz podmorje otočica Galešnjaka (photo M. Šimičić)

Na položaju Kumenat kod Biograda na moru pregledano je veliko antičko pristanište koje se nalazi na dubini od 2 - 5 metara dubine. Sama konstrukcija - pristanište - ima dimenzije 70 metara dužine i oko 25 metara širine. Bočni su dijelovi rađeni od većeg nepravilnog kamenja i nešto su uzdignutiji od središnjeg platoa, dok je središnji dio ispunjen sitnijim kamenjem. Čitavo ovo područje, osobito sjeverozapadni dio oko pristaništa je vrlo bogato arheološkim materijalom. Ističu se fragmenti tegula, amfora, sitnijih fragmentiranih posuda te balastnog kamenja. Prema analizama prikupljenog materijala, od kojih ističemo fragmente amfora tipa Forlimpopoli i Portorecanati, te posudicu tankih stijenki sa sivim premazom, nalazište se može datirati u 1. stoljeće.

U podmorju ispred ostataka antičke vile rustika u Kožinu nalaze se ostatci manje luke. Prema pričanjima lokalnog stanovništva tu su se 1960-ih i 1970-ih nalazile cijele amfore koje su oni kao djeca razbijali s ostima, jer su ih njihovi roditelji učili da na taj način vježbaju preciznost za lovljenje hobotnica. S obzirom na devastaciju koja se događala u tom dijelu,



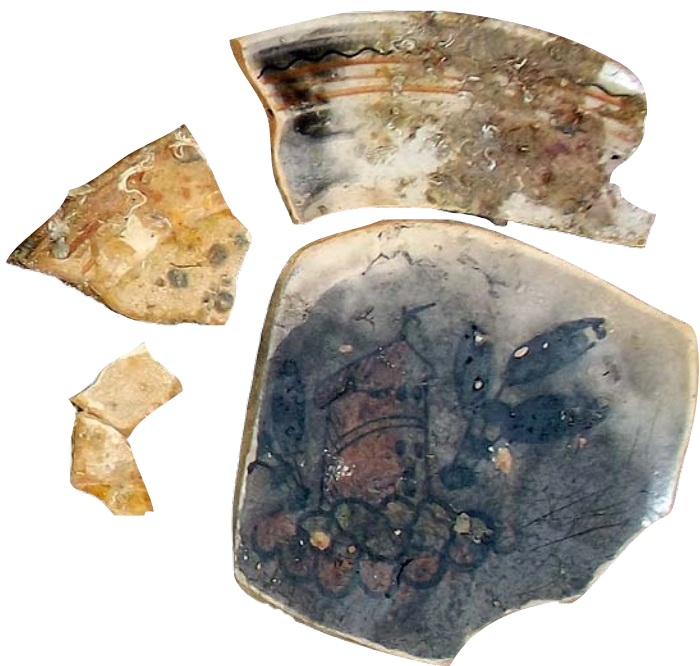
from local inhabitants there were intact amphorae here in the 1960s and 1970s that they broke with harpoons as children, as this was the method taught to them by their parents to hone their skills in hunting octopuses. Given the devastation that occurred in this area – and it was certainly no different at other Roman port archaeological locations – only fragments and

a small quantity of remains that here can now be found in shallow seas. Nevertheless, for us these fragments are approximately the period structures were present among the finds in the waters of Kožine are numerous

5. A ceramic tobacco pipe from the island of Ošljak
 Keramička lula s otoka Ošljaka
 (photo M. Šimičić)

of the archaeological site once existed. Nevertheless, even these fragments are sufficient to determine when these structures were in use. Prominent finds in the waters of Kožine are numerous

fragments of amphorae, dolia, tegulae, ballast stones, kitchenware and finer Roman ware. We can point to bowls of the Pompeian orlo bifido type manufactured in southern Italy and found at two rich shipwrecks in Croatia – Gušteranski and Glavat (Jurišić 2000, 29-30). The inaccessible shore necessitated the construction of a somewhat different structure. The example of a plateau at Dumboka Cove on the island of Iž – with a height of about 3 and a width of 2 to 3 metres – constituted a functional operational wharf in the Roman period onto which ships could be berthed and cargos loaded and unloaded. Amphorae of the Lamboglia 2 type that have fused into the structure of the embankment date it to the period from the 2nd century BCE to the 1st century CE.



6. A Post Medieval plate with a depiction of olive trees and tower from Ždrelac

Novovjekovni tanjur s prikazom maslina i kule sa Ždrelca
 (photo M. Šimičić)

ali zasigurno je bilo slično i na drugim arheološkim lokacijama antičkih luka, danas se u plitkom moru mogu naći tek fragmenti i manja količina arheoloških ostataka koji su tu nekad postojali. Ipak, za nas su i ti fragmenti dovoljni da bi se moglo približe definirati vrijeme kada su se takve konstrukcije upotrebljavale. Među nalazima u podmorju Kožina se ističu mnogobrojni fragmenti amfora, dolija, tegula, balastnog kamenja, ali i kuhinjskog i finog antičkog posuđa. Možemo istaknuti zdjele pompejanskog tipa „orlo bifido“ koje su se proizvodile u južnoj Italiji, a kod nas su nađene na dva bogata brodoloma – Gušteranski i Glavat (Jurišić 2000, 29-30). Nepristupačna obala uvjetovala je i izgradnju nešto drugačijih struktura. Primjer platoa u uvali Dumboka na Ižu, visine oko 3 i širine 2-3 metra, činio je funkcionalnu operativnu obalu u antičkom periodu na koju su se brodovi mogli vezati, te iskrcavati i ukrcavati teret. Amfore tipa Lamboglia 2 koje su srasle u strukturu nasipa datiraju ga u period 2. st. pr. Kr do 1. st. po. Kr.

Pregledan je i veći broj sidrišta na područjima koja su pružala sigurnu luku brodovima koji su tu tražili svoje utočište za lošeg vremena. Na južnom dijelu otočića Galešnjaka kod Turnja



7. A diver inspects the embankment and plateau with calcified Roman tegulae and bricks at Dumboka Cove on Iž
 Ronioci pregledava nasip i plato s kalcificiranim antičkim tegulama i opekama u uvali Dumboka na Ižu (photo L. Bekić)

nalazimo veći broj dna i ručki amfora od kojih prepoznajemo amfore Lamboglia 2, Forlimpopoli, Late Roman 1, ali i cjelovito očuvano kasnoantičku uljanicu okvirno može datirati u 4. - 5. stoljeće, što nam pokazuje kontinuitet putovanja Pašmanskim kanalom kroz čitavu antiku. Kod otočića Karantunića najveća količina nađenih fragmenata pripada amforama tipa Lamboglia 2, dok se manji broj može pripisati tipovima Forlimpopoli i Dressel 2-4. Ovi nalazi se mogu datirati u period oko 1. stoljeća,



8. Fragment of an amphora from the Roman port at Kožino

Fragment amfore iz antičke luke u Kožinu (photo J. Macura)

A large number of anchorages were examined in areas that offered a safe harbour to ships seeking havens during inclement weather. In the southern part of the islet of Galešnjak near Turanj we find a large number of amphorae bases and handles among which we recognise Lamboglia 2, Forlimpopoli and Late Roman 1 amphorae, as well as a wholly preserved Late Roman oil lamp that can approximately be dated to the 4th to 5th centuries, which tells us of the continuity of navigation along the Pašman channel throughout the entire Roman period. On



9. A fragment of Iž pottery from Dolinje Cove

Fragment iške keramike iz uvale Dolinje (photo M. Pešić)

kada je zasigurno promet ovim prostorom imao najveći intenzitet. Prema količini nalaza i njihovom vremenskom okviru postoji mogućnost da bi se ovdje moglo raditi o devastiranom brodolomu. Potencijalni brodolom pronađen je i u uvali Tanko na otoku Ravi. Na dubini od 29 metara otkriveno je nekoliko amfora tipa Lamboglia 2 od kojih je jedna gotovo cjelovita odnesena na restauraciju. Prema informacijama koje smo prikupili, sa ovog mjesta je tokom godina odnesena određena količina amfora istog tipa, tako da nam danas samo njihovi sporadični ostaci svjedoče o teretu koji je ovaj brod prenosio. Na hridima u blizini rta Osiljinac na sjeveru Iža postoje također podatci o



10. A Lamboglia 2 type amphora from Tanko Cove on the island of Rava
Amfora Lamboglia 2 iz uvale Tanko na otoku Ravi (photo J. Macura)

**11. An amphora from
a submarine rock off
Cape Osiljinac**

Amfora s podvodne hridi
kod rta Osiljinac
(photo J. Macura)

the islet of Karantunić most of the fragments found are from amphorae of the Lamboglia 2 type, while a smaller number can be attributed to the Forlimpopoli and Dressel 2-4 types. These finds can be dated to the period around the 1st century, when traffic in the area was certainly at its peak intensity. Based on the quantity of finds and their time frame, there is a possibility that this may be a devastated shipwreck. Another possible shipwreck was found in Tanko Cove on the island of Rava. Several amphorae of the Lamboglia 2 type were discovered at a depth of 29 metres one of which, almost intact, was sent for restoration. According to the information we collected, a quantity of amphorae of the same type were taken from this site over the years, so that today only sporadic remains bear witness to the cargo transported by this ship. There is also information concerning a devastated shipwreck with the same type of amphorae on the rocks near Cape Osiljinac on the north of Iž. One of these rocks was examined during this visit but – with the exception of sporadic sherds of these amphorae – no greater concentration was observed.

At some anchorages we can see the continuity of navigation and anchoring over a much greater span of time. At the island of Ošljak, the islets of Mrtovnjak and Ždrelac and V. Vodenjak Cove on the island of Iž the material found can be dated from the 1st century right up to the 19th century, which attests to their truly favourable positions as safe havens for maritime merchants and passengers

devastiranom brodolomu s istim tipom amfora. Ovom prilikom pregledana je jedna od tih hridi, ali osim sporadičnih fragmenata ovih amfora, njihova veća koncentracija nije zamijećena.

Na nekim sidrištima moguće je vidjeti kontinuitet plovidbe i sidrenja i kroz puno duži niz godina. Kod otoka Ošljaka, otočića Mrtovnjaka, Ždrelca i uvale V. Vodenjak na otoku Ižu pronađeni materijal može se datirati od 1. stoljeća pa sve do 19. stoljeća, što svjedoči o doista pogodnim pozicijama sa siguran odmor pomorskih trgovaca i putnika za lošeg vremena. S ovih lokacija možemo istaknuti dva nalaza novovjekovne lule i novovjekovnog loptastog vrča s tankim izljevom. Nalazišta na otoku Ižu, uvala Dumboka, uvala V. Vodenjak, uvala Dolinje do uvale Knež dala su nam i vrlo zanimljive nalaze iške keramike, tradicionalne keramike koja se kroz povijest proizvodila na otoku Ižu i s kojom su Ižani opskrbljivali otoke i primorske gradove čitavog Jadrana.

Novootkrivena nalazišta nadopunjuju nam već poznate podatke o intenzitetu pomorskog prometa na prostoru teritorija Zadarske županije, a govore nam i o promjenama pravaca plovidbe koji su se mijenjali tijekom povijesti. Pregledom već registriranih podvodnih lokacija, praćenjem promjena koje se događaju na njima, te njihovim nadzorom može se dobiti bolja slika o stanju njihove očuvanosti, te na taj način pokušati i djelovati na zaštiti sve malobrojnijih nalaza koji su nam ostali u podmorju.

**12. A
Post Medieval
ceramic jug from V.
Vodenjak Cove**

Novovjekovni keramički
vrč iz uvale V. Vode-
njak (photo M.
Šimičić)

in inclement weather. From these locations we can single out two finds – a Post Medieval tobacco pipe and a Post Medieval spherical jug with a thin spout. The sites on the island of Iž, from Dumboka Cove, V. Vodenjak Cove, Dolinje Cove to Knež Cove also yielded some very interesting finds of Iž pottery, traditional ceramics manufactured in the past on the island of Iž to supply the islands and coastal cities of the entire Adriatic seaboard.

The newly discovered sites supplement existing data on the intensity of maritime traffic in the territory of Zadar County, and are indicative of changes to the routes of navigation as they were altered over time. The examination of already registered underwater locations, observing changes that occur at these sites, and their monitoring, can provide a better picture of the state of their preservation, and in this way endeavour to work towards the protection of the increasingly rarer finds that remain in the sea.



13. A Lamboglia 2 amphora from Dumboka Cove on Iž
Amfora Lamboglia 2 iz uvale Dumboka, Iž (photo J. Macura)



14. A topographic map of the surveyed locations

Topografska karta sa lokacijama koje su reko-gnoscirane (author M. Pešić)

Bibliography / Literatura

Jurišić, M., 2000 - Ancient Shipwrecks of the Adriatic, Maritime transport during the first and second centuries AD, BAR International Series 828, Oxford.

Karagiorgou, O. 2001 - LR2: a Container for the Military annona on the Danubian Border?, in: S. Kingsley and M. Decker (eds.), Economy and Exchange in the East Mediterranean during Late Antiquity, Oxford, 129-166.

Pešić, M., Meštrov, M., 2012. - Survey of the seabed of Zadar county / Reko-gnosciranje podmorja Zadarske županije, Potopljena baština / Submerged Heritage 2, Zadar, 44-47.

Archaeological Survey of the Seabed in the Broader Rovinj and Pula Areas in 2013

Rekognosciranje šireg podmorja Rovinja i Pule 2013

LUKA BEKIĆ - lbekic@icua.hr

This year the International Centre for Underwater Archaeology resumed its survey of numerous positions on the seabed of the Istrian peninsula in search of archaeological sites. In spite of the limited financial resources available eighteen dives were undertaken to survey fifteen different locations.

Ove godine Međunarodni centar za podvodnu arheologiju ponovno je pregledavao brojne pozicije u podmorju istarskog poluotoka u potrazi za arheološkim nalazištima. Unatoč ograničenim sredstvima koja su bila na raspolaganju, pregledano je 15 različitih lokacija u 18 urona.

1. At the island of Polari we found a wall that encompasses a rounded area at a depth of 4 metres

Kod otoka Polari pronašli smo zid koji zatvara obli prostor na dubini od 4 metra (photo: L. Bekić)



2. The diving team during the survey of the Rovinj area - Luka Bekić, Marko Srećec, Neno Starčić and Marina Šimičić
Ronilački tim tijekom pretraživanja rovinjštine - Luka Bekić, Marko Srećec, Neno Starčić i Marina Šimičić (photo: L. Bekić)

Na rovinjskom području potraga se usredila na južnom dijelu akvatorija. Tu su pregledavane dubine između otoka Riviera, Veštar i Sestrica, i tom prilikom je pronađen cijeli donji dio amfore tipa Forlimpopoli. Na rtu Guštinja nisu pronađeni novi nalazi, ali je ispred malog kamenoloma prema dojavu pronađena zakopana povećana željezna cijev koja na jednoj strani ima zakovice. Moguće da je riječ o nekoj brodskoj opremi. Kod hrđi Guštinja pronađene su dvije manje koncentracije ulomaka amfora, ranijih tipova na zapadu otoka, i kasnijih tipova amfora na istoku otoka. Također je pronađeno i nalaza kod otoka Pisulja, gdje su na istoku otoka pronađeni i odbačeni veći obli balastni kamenovi, dok se na sjeveru uočavaju brojni obrađeni blokovi koji su očito isprani sa zgrada na otočiću. No svi ovi nalazi ipak ne ukazuju na brodolome.

Ponovno su pregledana i neke od prije poznate lokacije, tako je na otoku Veli Piruz pronađeno još ulomaka amfora koje su pripadale opljačkanom kasnoantičkom brodolomu, dok je kod otoka Polari pronađeno mnoštvo ostataka ranih amfora tipa Lamboglia 2, koje su izbačene s dva rimska mola koji se prepoznaju



3. One of the amphorae from Cape Rakovica

Jedna od amfora s rta Rakovica (photo: L. Bekić)

In the Rovinj area the survey was focused on the southern waters. The depths between the islands Riviera, Veštar and Sestrica were inspected, yielding the find of a complete lower section of a Forlimpopoli type amphora. No new finds were discovered off Cape Guštinja, but, following up on reports, a large iron pipe, riveted on one side, was found buried off a small stone quarry. This may have been part of a ship's equipment. At Guštinja Rock we discovered two smaller concentrations of



4. Numerous amphorae sherds at the ruins of the Roman period pier at Žunac Cove

Na ruševinama antičkog pristaništa u uvali Žunac nalaze se brojni ulomci amfora (photo: L. Bekić)

amphorae sherds – earlier types to the west of the islet, and later amphorae types to its east. Finds were also discovered off the island of Pisulj – found to the east of the island were large discarded round ballast stones, while many dressed blocks were observed to the north, evidently washed out from the edifices on the island. None of these finds, however, indicate a shipwreck. Some of the previously known locations were surveyed again – more amphorae sherds were discovered at Veli Piruz island from a looted late Roman shipwreck, while a large number of remains

u vidu gomila kamena. Ovdje je zapažena i jedna veća struktura u vidu suhozida koji zatvara prostor u obliku udice. Moguće je tu riječ o antičkom ribnjaku ili mandraču, poput strukture na Mučjim sikama.

Najvažniji nalaz jest novi antički brodolom kod otoka Velika Sestrica. Na zapadnom dijelu otoka mogu se prepoznati tragovi brodoloma broda koji je prevozio kamene poluproizvode, blokove dimenzija 0,7x0,5x0,25 ili 0,25x0,4x0,12 te 0,35x0,7x0,12 itd. Uz veći broj takvih blokova, pronađeni su i malobrojni ulomci tegula i sitnog posuđa te veći broj ulomaka amfora tipa Forlimpopoli. Usprkos činjenici kako je brodolom opljačkan tijekom posljednjih desetljeća, nadamo se kako će buduća istraživanja iznjedruti dovoljno podataka da ga bolje opišemo.



5. Numerous potsherds and glass fragments from the Roman to Post-Medieval period are found at the anchorage at Cape Seline

Na sidrištu kod rta Seline se pronalaze brojni ulomci keramike i stakla od antičkog do novovjekovnog doba (photo: L. Bekić)

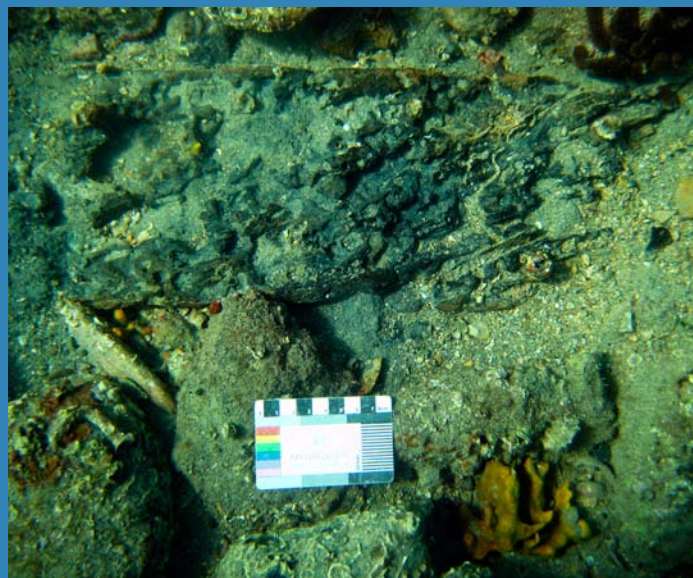
of early amphorae of the Lamboglia 2 type were found at Polari island, ejected from two Roman piers recognised as mounds of stone. Also observed here was a structure in the form of a dry stone wall enclosing an area in the form of a hook. This may have been a Roman fishpond or small port, similar to the structure at Mučje Sike.

The most significant find is a new Roman shipwreck off the island of Velika Sestrica. Traces of the wreck of a ship carrying a cargo of stone intermediate goods, blocks of dimensions ranging from 0.7x0.5x0.25 to 0.25x0.4x0.12 and 0.35x0.7x0.12 etc., are discernable to the west of the island. Found along with a large number of these blocks were a small number of tegulae sherds and small ware and a large quantity of sherds from amphorae of the Forlimpopoli type. In spite of the fact that the shipwreck has been looted during recent decades we hope that future research will yield sufficient data to better describe it.

Also continued was the survey of interesting positions in the Pula area. Here we also conducted dives at the long ago “researched” wreck of a late Roman vessel off Cape Rakovica. Some three hundred amphorae are alleged to have been taken from this site in the early 1970s to the Archaeological Museum of Istria in Pula, but the results of the research were never published. Today the remains of the bellies of amphorae, likely of the Lamboglia 2 or graeco-italic type, lacking typologically more revealing sections, can be found in sand at a depth of between 30 and 36 metres. Sections of pithoi were also allegedly found at this shipwreck, at the time transferred to a depth of 15 metres and left there.

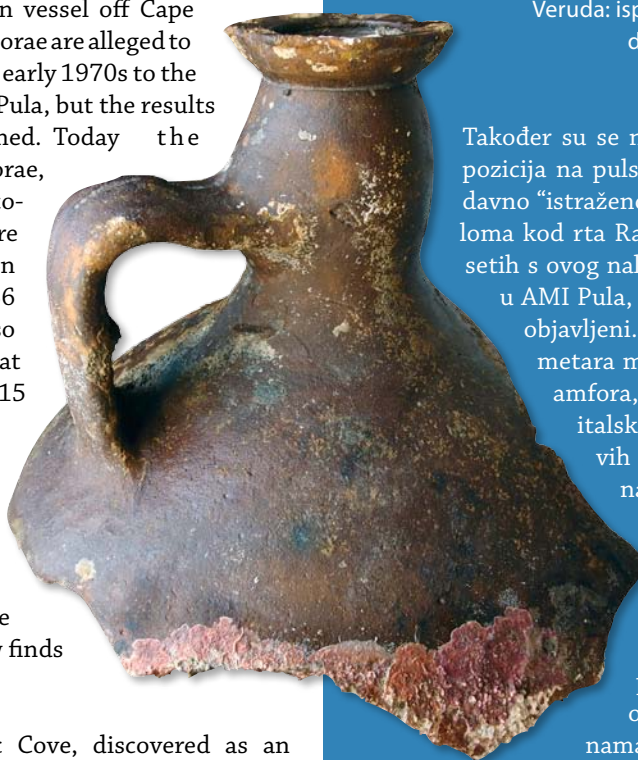
Besides the one at Rakovica, other potential roman shipwreck sites at island Fraškić and Crvene stijene were surveyed. They are also mentioned in the literature from the sixties of the 20th century. Very few finds remain at these sites to date.

Another interesting site is Žunac Cove, discovered as an underwater archaeological site a few years ago (Bekić 2012, 587). The cove was inspected on several occasions and we can say with relative certainty that there was once a late Roman pier on its northwest side of which only scattered stone blocks and a large quantity of pottery and amphorae sherds are presently preserved that can for the most part be dated to the 4th and 5th centuries. Based on typological characteristics it is evident that many of these finds originate from North African workshops. The use of the cove for military purposes – beginning with the construction of large ramparts and moles in the early Austrian period and their later lengthy use during the period of Yugoslavia, also for military purposes – has inflicted inestimable damage to this site, as a result of which it may never be possible to precisely identify the positions of the Roman period port structures. The remains we find on the seabed, however, do bear witness to the importance of this natural harbour in the late Roman period.



6. Veruda: the wooden structure of a ship is found under the ballast stones

Veruda: ispod balastnog kamena može se pronaći drvena struktura broda (photo: M. Pešić)



Također su se nastavila pregledavanja zanimljivijih pozicija na pulskom području. Ovdje smo ronili na davno “istraženom” brodolomu ranoantičkog brodoloma kod rta Rakovica. Navodno je ranih sedamdesetih s ovog nalazišta odneseno tristotinjak amfora u AMI Pula, ali rezultati istraživanja nisu nikada objavljeni. Danas se na dubini između 30 i 36 metara mogu u pijesku pronaći ostaci trbuha amfora, vjerojatno Lamboglia 2 ili grčko-italskog tipa, bez tipološki bolje određivih dijelova. Na ovom brodolomu su navodno pronađeni i dijelovi pitosa, koji su svojedobno preneseni na dubinu od 15 metara i tamo ostavljeni.

Osim na Rakovici, pregledani su i potencijalni antički brodolomi na otoku Fraškiću i Crvenim stijena. I oni se spominju u literaturi još od šezdesetih godina 20-tog stoljeća. Na ovim mjestima do danas je ostalo vrlo malo arheoloških ostataka.

7. Unusual amphora from Crvene stijene Neobična amfora sa Crvenih stijena (photo: L. Bekić)

Drugo zanimljivo nalazište je uvala Žunac, koja je kao podvodno arheološko nalazište otkriveno prije nekoliko godina (Bekić 2012, 587). U nekoliko navrata pregledavan je prostor ove uvale i sa razmjernom sigurnošću možemo konstatirati kako se na sjeverozapadnoj strani nekada nalazilo kasnoantičko pristanište od kojeg su danas sačuvani samo razbacani kameni blokovi te mnoštvo keramike i dijelova amfora, koje se uglavnom mogu datirati u 4. i 5.st. Na osnovu tipoloških karakteristika očito je kako mnoštvo ovih nalaza potječe iz sjevernoafričkih radionica. Korištenje uvale u vojne svrhe, počevši s gradnjom velikih bedema i molova u doba stare Austrije, te kasnije dugotrajno korištenje u doba Jugoslavije u iste svrhe, nanijelo je ovom nalazištu neprocjenjivu štetu, zbog koje se možda nikada neće moći sa sigurnošću ubicirati lučke strukture iz antičkog



8. The shipwreck at Veruda is discernable as a large mound of ballast stones

Brodolom kod Verude prepoznaje se kao velika gomila balastnog kamena (photo: L. Bekić)

The area of Cape Seline (Stoka, Soline) near Pula was surveyed again – for years remains from the Roman and, in particular, early Post-Medieval periods have been found here. These include numerous amphorae sherds and their plugs, Renaissance glazed pottery, glass bottles and cups and late Post-Medieval ceramic smoking pipes. This is evidently a site at which ships anchored for many centuries to make the best of its favourable position protected from the perilous bura (bora) and jugo (scirocco) winds.

We succeeded in locating an excellent find off the island of Veruda – the remains of a previously unknown ship discernable among a large quantity of rounded ballast stones on the seabed. A careful inspection of the seabed revealed the partially preserved wooden structure of a vessel under the ballast stones, covered by a thin layer of sand. The ship was certainly in excess

doba. Ipak, ostaci koje pronalazimo na dnu svjedoče nam o važnosti ove prirodne luke u kasnoj antici.

Ponovno je pregledavano područje rta Seline (Stoka, Soline) kod Pule gdje se godinama pronalaze ostaci iz doba antike i posebice ranog novog vijeka. To su brojni ulomci amfora i njihovih čepova, renesansne cakljene keramike, staklenih boca i čaša te kasnonovovjekovne keramičke lule. Očito je ovo prostor na koje su se brodovi dugi niz stoljeća sidrili i tako koristili povoljan položaj zaštićen od opasne bure i juga.

Kod otoka Veruda, uspjeli smo pronaći odličan nalaz - ostatke nekog dosada nepoznatog broda, koji se nazire u većoj količini oblog balastnog kamena na dnu. Pomnim pregledom terena, ustanovili smo kako je ispod balastnog kamena djelomično sačuvana drvena struktura broda, usprkos tankom sloju



9. Diving team (Kamerla, Novak, Bekić) surveys Pula archipelago
 Ronilačka ekipa (Kamerla, Novak, Bekić) pretražuje pulski arhipelag
 (photo: L. Bekić)

of 6x8 metres in size – the area covered by the mound of stone ballast. No conclusions can be made yet regarding its dating. A sample of the wooden structure has been sent for AMS C14 analysis, results point to the second half of the 16th century. Small finds recovered seem to support this date. It appears that its cargo consisted of waste bronze and copper as various bronze pieces such as a squashed section of a kettle, wound copper strips, half-melted and melted bronze artefacts were found among the ballast stones. We hope that this interesting shipwreck remains hidden from looters until proper research can be undertaken to give us a full picture of the site.

Weather conditions did not allow us to continue with the survey of the eastern shores of Istria, as the interesting positions on this side are often subject to southerly and northerly winds. Nevertheless, a renewed inspection was conducted of the Roman period pier at Vinjole Cove and we can now say for sure that this massive (about 50 x 10 metre) structure dates from the early Roman period. Numerous sherds of early Imperial amphorae and tegulae were found as well as large stone blocks that may indicate that it was used to service a nearby stone quarry. Traces of the berthing of Post-Medieval ships have been found along this pier with small finds dated to the 17th to 19th century period. An anchorage at Duga Uvala was inspected where sherds of tegulae, Byzantine amphorae and Post-Medieval pottery were found. The northern shore here offered a safe haven to ships from strong gusts of the bura wind.

Surveys of the seabed off the Istrian peninsula continue to demonstrate how closely the sea keeps its secrets and how we continue to discover exciting finds at relatively accessible places – as long as we are dedicated to searching them out.

pijeska koji ju prekriva. Dimenzije broda bile su zasigurno veće od 6x8 metara, koliko iznosi hrpa kamenog balasta. O dataciji broda zasad ne možemo ništa reći. Na analizu AMS C14 je poslat komadić drvene strukture, a rezultat ukazuje na drugu polovinu 16.st. Prikupljeni pokretni nalazi, čini se, podržavaju tu dataciju. Čini se kako je njegov teret bila otpadna bronca i bakar, jer su između balastnog kamena pronađeni razni brončani komadi poput spljoštenog dijela kotla, namotanih bakrenih traka, polurastaljenih i rastaljenih brončanih predmeta. Nadamo se kako će ovaj zanimljivi brodolom i nadalje ostati skriven od devastatora do provođenja pravih istraživanja koje bi nam dale njegovu konačnu sliku.

Zbog vremenskih uvjeta nismo bili u mogućnosti nastaviti s rekognosciranjem istočne obale Istre, jer su zanimljive pozicije na ovoj strani često ugrožene bilo južnim, bilo sjevernim vjetrovima. Ipak, obavljen je ponovni pregled antičkog pristaništa u uvali Vinjole, i sada možemo sa sigurnošću reći kako ovaj masivni (oko 50 x 10 metara) objekt datira u ranoantičko razdoblje. Na njemu su pronađeni brojni ulomci ranocarskih tipova amfora, tegula ali i veliki kameni blokovi, koji možda ukazuju kako je korišten za potrebe nekog obližnjeg kamenoloma. Uz ovo pristanište pronađeni su i tragovi pristajanja novovjekovnih brodova, a pokretni nalazi mogu se datirati od 17. do 19.st. Pregledano je i sidrište u Dugoj uvali, gdje su pronađeni ulomci tegula, bizantskih amfora te novovjekovne keramike. Sjeverna obala uvale pružala je sigurnu zaštitu brodovima tijekom udara jake bure.

Pregledi podmorja istarskog poluotoka uvijek iznova nam pokazuju kako more neobično ljubomorno čuva svoje tajne, te kako se i na razmjerno pristupačnim mjestima i danas mogu pronaći uzbudljivi nalazi. Samo ako ih se uistinu traži.



10. Large stone blocks at the Roman period quay at Vinjole
 Veliki kameni blokovi na antičkoj operativnoj obali u Vinjolama
 (photo: L. Bekić)

Bibliography / Literatura.

- Bekić, L. 2011 - Podvodna arheološka rekognosciranja podmorja Istre / Underwater Archaeological Reconnaissance of Istrian Maritime Waters, Potopljena baština / Submerged Heritage 1, Zadar, 35-38.
- Bekić, L. 2012a - Once Again on the Coastal Surveys of Istria / Još jednom o rekognosciranjima istarskog priobalja, Potopljena baština / Submerged Heritage 2, Zadar, 21-23.
- Bekić, L. 2012b - Najnovija podvodna rekognosciranja podmorja Istre, Histria Antiqua 21, Pula, 581-597.
- Vrsalović, D. 2011 - Arheološka istraživanja u podmorju istočnog Jadrana, Split, 2011.
- Bekić, L. in print A Istarsko podmorje, Rovinj, Pula, Bale, Ližnjan, Kavran, Umag, Hrvatski arheološki godišnjak 7/2010, Zagreb.
- Bekić, L. in print B Istarsko podmorje, Rovinj, Pula, Ližnjan, Kavran, Hrvatski arheološki godišnjak 8/2011, Zagreb

Illyrian Coastal Exploration Program Underwater Field School

Podvodna terenska škola Programa istraživanja ilirske obale

DEREK SMITH - benthos@uw.edu | PETER CAMPBELL - peter.campbell@soton.ac.uk
JEFF ROYAL - jroyal@rpmnautical.org | CHRIS BEGLEY - cbegley@transy.edu
DEREK IRWIN - derekirwins@gmail.com | PETRA ZDRAVKOVIĆ - petra.zdravkovic@yahoo.com
HOWARD PHOENIX - hphoenix@rpmnautical.org

The Illyrian Coastal Exploration Program (ICEP) is a collaborative research group founded by Dr. Jeff Royal to integrate research on ancient Illyria spanning modern day cultural and



1. ICUA staff Dr. Luka Bekić and Mladen Pešić leading students Damian Byers, Jaaziel Garcia Hernandez, Dave Conklin, Cameron Hutchins, Annie Wright, Effie Ford, and Nick Bartos
Osoblje MCPA dr. Luka Bekić i Mladen Pešić sa studentima Damianom Byersom, Jaazielom Garciom Hernandezom, Daveom Conklinom, Cameronom Hutchinsom, Annie Wright, Effie Ford i Nickom Bartosom (photo: P. Campbell)

political boundaries. Part of its research program consists of an interdisciplinary underwater sciences field school. The 2013 ICEP field school was offered by Transylvania University and partnered with the International Centre for Underwater Archaeology in Zadar (ICUA), Croatia, and the Regional Center for Underwater Demining (RCUD) in Bijela, Montenegro.

Partnering with these leading organizations, the main goal of the field school was to aid ongoing research while providing hands-on training for students through a combination of morning dives and afternoon lectures. Truly an international project, staff and students hail from Canada, Croatia, Denmark, Ireland, Mexico, Montenegro, Serbia, and the United States. The ICEP field school was directed by Derek Smith and Peter Campbell with staff including Dr. Jeff Royal, Dr. Chris Begley, Dr. Derek Irwin, Petra Zdravković, Dr. Kurt Knoerl, Howard Phoenix,

Program istraživanja ilirske obale (Illyrian Coastal Exploration Program, ICEP) suradnička je istraživačka skupina koju je dr. Jeff Royal osnovao radi sjedinjavanja istraživanja antičke Ilirije preko današnjih kulturoloških i političkih granica. Dio istraživačkog programa čini interdisciplinarna terenska škola podvodnih znanosti. Terensku nastavu 2013. ponudilo je Sveučilište Transylvania u suradnji s Međunarodnim centrom za podvodnu arheologiju u Zadru (MCPA), Hrvatska, i Regionalnim centrom za podvodno razminiranje (RCUD) u Bijeloj, Crna Gora.

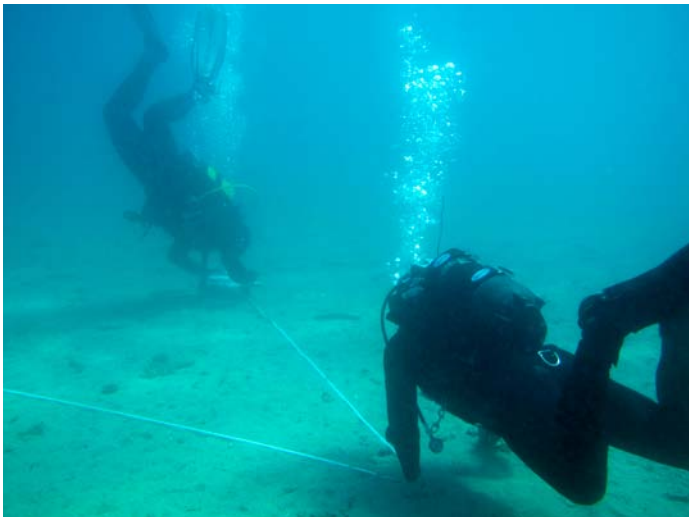
U suradnji s tim vodećim ustanovama, glavni cilj terenske škole bila je pomoći istraživanjima u tijeku, uz nudenje praktičnog iskustva studentima kombinacijom prijepodnevnog ronjenja i poslijepodnevni predavanja. Riječ je o pravom međunarodnom projektu, s osobljem i studentima iz Crne Gore, Dan-



2. Derek gives the students a lecture on Adriatic coastal ecology at the ICUA

Derek u Zadru predaje studentima o jadranskoj obalnoj ekologiji (photo: P. Campbell)

ske, Hrvatske, Irske, Kanade, Meksika, Sjedinjenih Američkih Država i Srbije. Terenskom školom ICEP-a rukovodili su Derek Smith i Peter Campbell, s nastavnim osobljem koje je uključivalo dr. Jeffa Royaala, dr. Chrisa Begleyja, dr. Dereka Irwina,



3. Students practice trilateration as part of the NAS Intro course

Studenti iskušavaju trilateraciju kao dio NAS-ova uvodnog predavanja (photo: M. Pešić)

Nick Bartos, and Lee Pape. The ICEP team was hosted by ICUA's director Dr. Luka Bekić with archaeologists Mladen Pešić and Marina Šimičić and RCUD's director Veselin-Vesko Mijajlović with a dive staff led by Bogdan Spaić and Danilo Mijajlović.

The first week was spent at the ICUA helping with the Zadar County Survey. The ICUA has compiled a database of reported shipwreck sites based on information from divers, fisherman, and previous archaeologists. The Zadar County Survey is systematically ground-truthing these reports to verify whether

Petru Zdravković, dr. Kurta Knoerla, Howarda Phoenixa, Nicka Bartosa i Lee Pape. Domaćini ICEP-ovom timu bili su ravnatelj MCPA dr. Luka Bekić s arheolozima Mladenom Pešićem i Marinom Šimičić te direktor RCUD-a Veselin-Vesko Mijajlović s ronilačkim osobljem predvođenim Bogdanom Spaićem i Danilom Mijajlovićem.

Prvi je tjedan proveden pomažući MCPA-u u istraživanju Zadarske županije. MCPA je na temelju informacija dobivenih od ronilaca, ribara i arheologa sastavio bazu podataka o poznatim mjestima brodoloma. Istraživanje u Zadarskoj županiji trebalo je sistematski na terenu provjeriti ta izvješća kako bi se potvrdila prisutnost brodoloma. Terenska škola pomogla je u provjeri nekolicine nalazišta, a studentima je ponudila iskustvo u prepoznavanju i opisivanju nalaza, baš kao i izrade karte nalazišta. Pritom su pronađeni predmeti iz razdoblja od rimskog doba do srednjeg vijeka. Osim istraživanja, studenti su imali priliku slušati uvodna predavanja o obalnoj i podvodnoj arheologiji Nautičkog arheološkog društva (Nautical Archaeology Society, NAS), uz pregled konzerviranja predmeta koje je ponudilo konzervatorsko osoblje MCPA.

Drugi je tjedan proveden s RCUD-om istražujući različito crnogorsko podmorsko kulturno naslijeđe. Centar je smješten u prekrasnom Kotorskom zaljevu, koji sadrži nevjerojatno kulturno i prirodno podvodno bogatstvo. Studenti su istraživali i opisali mnogobrojne vrste podvodnih nalazišta, među njima željezni ratni brod, sustav podmorskih špilja i luku antičkog Risana. Nastavnici RCUD-a predavali su o povijesti zaljeva i potopljenom oružju.



4. Mladen discusses an amphora handle with Cameron, Damian, and Lee
Mladen s Cameronom, Damianom i Lee razgovara o drški amfore (photo: P. Campbell)



5. ICUA conservator Mladen Mustaček gives students an overview on the conservation of wet finds (iron)

Konzervator MCPA Mladen Mustaček studentima govori o očuvanju mokrih željeznih nalaza (photo: L. Pape)

wrecks are present. The field school helped to verify several sites and provide students with experience identifying and recording artifacts, as well as mapping sites. Artifacts from the Roman through Medieval periods were found. Besides survey, the students took the Nautical Archaeology Society's (NAS) Introduction to Foreshore and Underwater Archaeology course and received an overview of artifact conservation from the ICUA conservation staff.

The second week was spent with the RCUD exploring Montenegro's diverse submerged cultural heritage. The Center is situated in beautiful Kotor Bay, which contains incredible cultural and natural underwater resources. Students surveyed and recorded a wide range of underwater site types, including an iron warship, a submerged cave system, and the harbor of ancient Risan. RCUD staff lectured on the bay's history and underwater ordnance.

The field school culminated in the students organizing the recording of a known shipwreck, a Byzantine bulk marble carrier that sank in Maljevik Bay, Montenegro. First recorded and documented by the Montenegrin Maritime Archaeological Rescue Project (MMARP), the shallow site is excellent for training purposes. Students were tasked with carrying out their own research design, surveying the bay to locate the site, and fully recording it with hand measurements and 3D photogrammetry, as well as documenting the ecology of the site.

The first year of the ICEP field school was highly successful. Subsequent years will have field schools focused in each country for longer durations and on specific sites. As RPM Nautical Foundation continues to extend its coastal surveys along the Adriatic, the field schools will document new site finds in great details, adding to scholarly pursuits while training the next generation of underwater researchers. The ICEP staff looks forward to next year's field school and working again with the excellent staff at ICUA and RCUD.

Terenska škola vrhunac je doživjela studentskim organiziranjem istraživanja poznatog mjesta brodoloma bizantskog teretnog broda za prijevoz mramora potonulog u uvali Maljevik, Crna Gora. Prvi put opisano i dokumentirano od strane Crnogorskog projekta za pomorsko arheološko spašavanje (Montenegrin Maritime Archaeological Rescue Project, MMARP), nalazište u plićaku odlično je za učenje. Studenti su sami morali osmisлити istraživanje, pregledati uvalu kako bi pronašli mjesto brodoloma te ga u potpunosti opisati rabeći ručne izmjere i 3D fotogrametriju, uz dokumentiranje ekologije nalazišta.

Prva godina ICEP-ove terenske škole bila je iznimno uspješna. Idućih godina terenske ćemo škole u dužem trajanju i na karakterističnim nalazištima usmjeriti na svaku zemlju. Kako Nautička zaklada RPM proširuje obalna istraživanja u Jadranu, terenske škole nova će nalazišta dokumentirati mnogo detaljnije, nudeći i akademske izazove tijekom obučavanja sljedećeg naraštaja podvodnih istraživača. Osoblje ICEP-a s veseljem očekuje terensku školu iduće godine i ponovnu suradnju s izvanrednim osobljem MCPA i RCUD-a.



6. RCUD staff and the dive team heading to the ancient city of Risan in Kotor Bay

Osoblje RCUD-a i ronilačko osoblje odlaze u gradić Risan u Kotorskom zaljevu (photo: C. Hutchins)

Student Workshop on 3D Data Capture and Processing in Underwater Archaeology in Portorož, Slovenia

Delavnica za študente

“Zajem in obdelava 3D podatkov v podvodni arheologiji”, Portorož, Slovenija

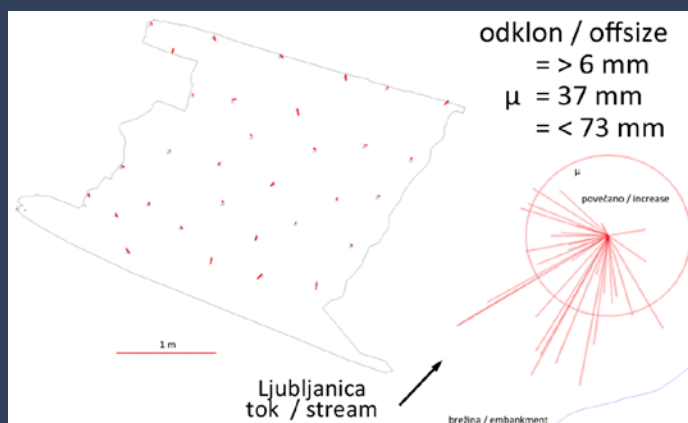
MIRAN ERIČ - miran.eric@guest.arnes.si | FRANC SOLINA - franc.solina@fri.uni-lj.s

In early July, a student workshop on 3D Data Capture and Processing in Underwater Archaeology took place in Portorož, organised by the Institute for the Protection of Cultural Heritage of Slovenia (Miran Erič) and the University of Ljubljana's Faculties of Computer and Information Science (Franc Solina) and Maritime Studies and Transport (Marko Perkovič). Sixteen students and underwater archaeologists attended this international workshop from the Department of Archaeology, the Faculty of Arts, the Computer Vision Laboratory at the Faculty of Computer and Information Science, the Archaeology Department at the University of Zadar and the Archaeological Museum of Zadar.

The workshop programme was divided into morning field work at the site of sunken wooden cargo ships (Maona) in front of the Portorož salt warehouses, and afternoon lectures and workshops on archaeological methods and terminology, underwater archaeology, 3D data capture, photography, photogrammetry and 3D data processing, which all took place at the Faculty of Maritime Studies and Transport.

The workshop offered lectures and an introduction to various possibilities in documenting – over five days the authors presented the importance of documenting underwater heritage, methodology, techniques and the development of 3D tools and software, while Darja Grosman from the Department of Archaeology, Faculty of Arts gave a lecture on archaeological methodology, importance, remote data collection and prospects, and the difference between 2D > 3D > 4D.

Marko Perkovič from the Faculty for Maritime Studies and Transport presented the Faculty's



1. The comparative analysis of 3D model and surveys conducted with tacheometer

Primerjalno analizo med 3D modelom in meritvami s tahimetrom



V začetku julija je bila v Portorožu organizirana delavnica za študente “Zajem in obdelava 3D podatkov v podvodni arheologiji” v organizaciji Zavoda za varstvo kulturne dediščine Slovenije

(Miran Erič), Fakultete za računalništvo in informatiko UL (Franc Solina) ter Fakultete za pomorstvo in promet UL (Marko Perkovič). Mednarodne delavnice se je udeležilo 16 študentk in študentov ter podvodnih arheologov iz Oddelka za arheologijo Filozofske fakultete, Laboratorija za računalniški vid Fakultete za računalništvo in informatiko, Odjela za arheologijo Sveučilišta u Zadru ter Arheološkega muzeja iz Zadra.

Program delavnice je bil razdeljen na dopoldansko terensko delo na najdišču potopljenih lesenih tovornih ladij (maon) pred skladišči soli v Portorožu ter na popoldanska predavanja in delavnice o arheološki

2. a. 3D model constructed by photogrammetric processing, b. 3D model taken by Artec MHT scanner (photo and 3D models: R. Kovačič, processing with Autodesk 123D, 3D view with Meshlab).

a. 3D model narejen s fotogrametričnim procesiranjem, b. 3D model posnet s snemalnikom Artec MHT (photo in 3D modeli: R. Kovačič, procesiranje z Autodesk 123D, 3D ogled z Meshlab).



3. Udeleženci delavnice

The workshop participants (photo: M. Perkovič)

nautical simulator and its importance for the protection of underwater cultural heritage. Rok Kovačič, Gregor Berginc and Žiga Stopinšek prepared seminars involving practical work: digital photography and cameras, the specific characteristics of underwater photography; lectures, workshops and exercises; programming tools for photogrammetry; lecture, workshops and exercises; 3D scanning, scanners, programming tools and prospects; lecture, workshop and exercises. Smiljan Glušević, the director of the Archaeological Museum of Zadar, presented insights into the contents of documenting and gave a lecture on the Apoxyomenos – from discovery to exhibition. Sebastijan Govorčin, a student at the University of Zadar, gave a lecture on shipbuilding terminology and on terminology pertaining to parts of a ship's structure.

One of the reasons for the good atmosphere and the high point of the introduction to the cultural heritage of Slovenian territorial waters was a meeting with the oldest living shipbuilder on the Slovenian coast, Mr Davide Filipas, who was presented at with the Shipbuilding Department of the Sergej Mašera Maritime Museum in Piran by curator Uroš Hribar. The Maritime Museum was presented by its director Franco Juri and its curator Snježana Karinja. The participants had the special honour of meeting Elica Boltin Tome, a pioneer in Slovenian coastal underwater site research, now retired. Curator Doris Delgiusto took us on a guided tour of the exhibition at the Piran Museum of Underwater Activities.

REASONS FOR HOLDING THE WORKSHOP

The development of hardware and programming solutions, the trend towards public access to common knowledge (a community that develops open-source systems) and the flexibility of the research community in the field of heritage research have in the past ten years changed the methodology of on-site heritage documentation. In just three steps, documenting has completely changed from first being done completely manually and

metodologiji in terminologiji, podvodni arheologiji, zajemu 3D podatkov, fotografiji, fotogrametriji in obdelavi 3D podatkov, ki so potekale v prostorih Fakultete za pomorstvo in promet.

Delavnica je ponudila predavanja in seznanjanje z različnimi možnostmi pri dokumentiranju, kjer sta avtorja v 5 dneh predstavila Pomen dokumentiranja podvodne dediščine, metodologija in tehnike ter razvoj 3D orodij in programske opreme, Darja Grosman iz oddelka za arheologijo Filozofske fakultete Arheo-



4. Curator Doris Delgiusto led the participants through the exhibitions at the Sergej Mašera Maritime Museum in Piran

Kustosinja Doris Delgiusto je udeležence vodila po razstavah Pomorskeg muzeja Sergej Mašera v Piranu (photo: F. Solina).

loško metodologijo, pomen, daljinsko zajemanje podatkov in perspektive ter razliko med 2D > 3D > 4D.

Marko Perkovič iz Fakultete za pomorstvo in promet je predstavil in demonstriral delovanje Navtičnega simulatorja FPP in njegov pomen za varstvo podvodne kulturne dediščine, Rok Kovačič, Gregor Berginc in Žiga Stopinšek pa so pripravili seminarje s praktičnim delom: Digitalna fotografija in fotoaparati, Posebnosti podvodne fotografije; predavanje, delavnica in vaje; Programska orodja za fotogrametrijo; predavanje, delavnica in



5. Davide Filipas, the legendary oldest living shipbuilder on the Slovenian coast

Legendarni, najstarejši še živeči ladjedelec na slovenski obali Davide Filipas (photo: F. Solina)

producing doubtful results in terms of accuracy – it was not in fact possible to detect and assess errors – to the digital recording of sites, and the final shift to entirely automated hardware and software documenting of sites, and will provide high-quality and scientifically verifiable documentation in the future.

An example of the progress made is the comparative analysis of a 3D model of the Roman ship from Sinja Gorica (Erič, Gaspari 2009; Erič et al. 2013) with simultaneously conducted geodetic surveys. These should be quite precise since the depth where the ship is located is only 3 m. Mistakes were detected in surveying conducted with a tacheometer (Figure 1), which pointed to the fact that they were connected to the flow of the Ljubljana River. More important is the bitter realisation that to date faith in geodetic surveys was complete and the analogue documentation was drawn up in accordance with these surveys, which cannot be verified, and therefore the mistakes will remain unknown. Underwater heritage sites in deep waters are mostly shipwrecks and other sunken objects (aeroplanes, very rarely anything else), while in shallow coastal waters, due to geological changes such as erosion and tectonic shift, we encounter submerged architecture and other infrastructure. The increasingly better availability of 3D data collection devices and the quality of free 3D photogrammetric modelling software has completely changed the methodology of documenting underwater heritage.

Currently, new technologies for 3D data capturing and open-source solutions for the processing and modelling of such data are key to the development underwater cultural heritage

vaje; 3D snemanje, snemalniki, programska orodja in perspektive; predavanje, delavnica in vaje.

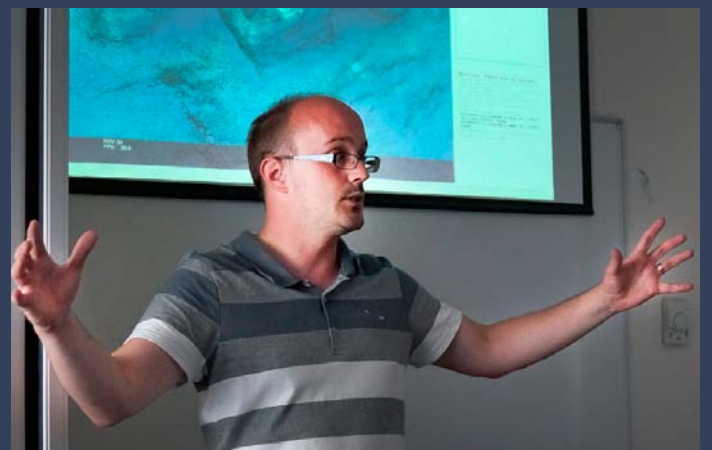
Vpogled v vsebino dokumentiranja sta predstavila direktor Arheološkega muzeja iz Zadra Smiljan Gluščević, ki je predstavil Apoksiomen. Od odkritja do razstave ter študent Sveučilišta iz Zadra Sebastijan Govorčin, ki je spregovoril o Terminologiji v ladjedelništvu in delih ladijske konstrukcije.

K dobremu počutju in seznanitvi s kulturno dediščino slovenskega teritorialnega morja pa so zaznamovala tudi srečanja z najstarejšim živečim ladjedelcem na slovenski obali g. Davideom Filipasom, ki ga je hkrati z Oddelkom za ladjedelništvo Pomorskega muzeja "Sergej Mašera" iz Pirana predstavil kustos Uroš Hribar. Pomorski muzej so še posebej predstavili direktor muzeja Franco Juri, kustosinja Snježana Karinja, udeleženci delavnice pa so imeli posebno čast srečati tudi pionirko raziskav podvodnih najdišč v priobalnem morju Elico Boltin Tome, danes upokojenko. Po razstavi v Muzeju podvodnih dejavnosti Piran nas je popeljala kustosinja Doris Delgiusto.

RAZLOGI ZA PRIPRAVO DELAVNICE

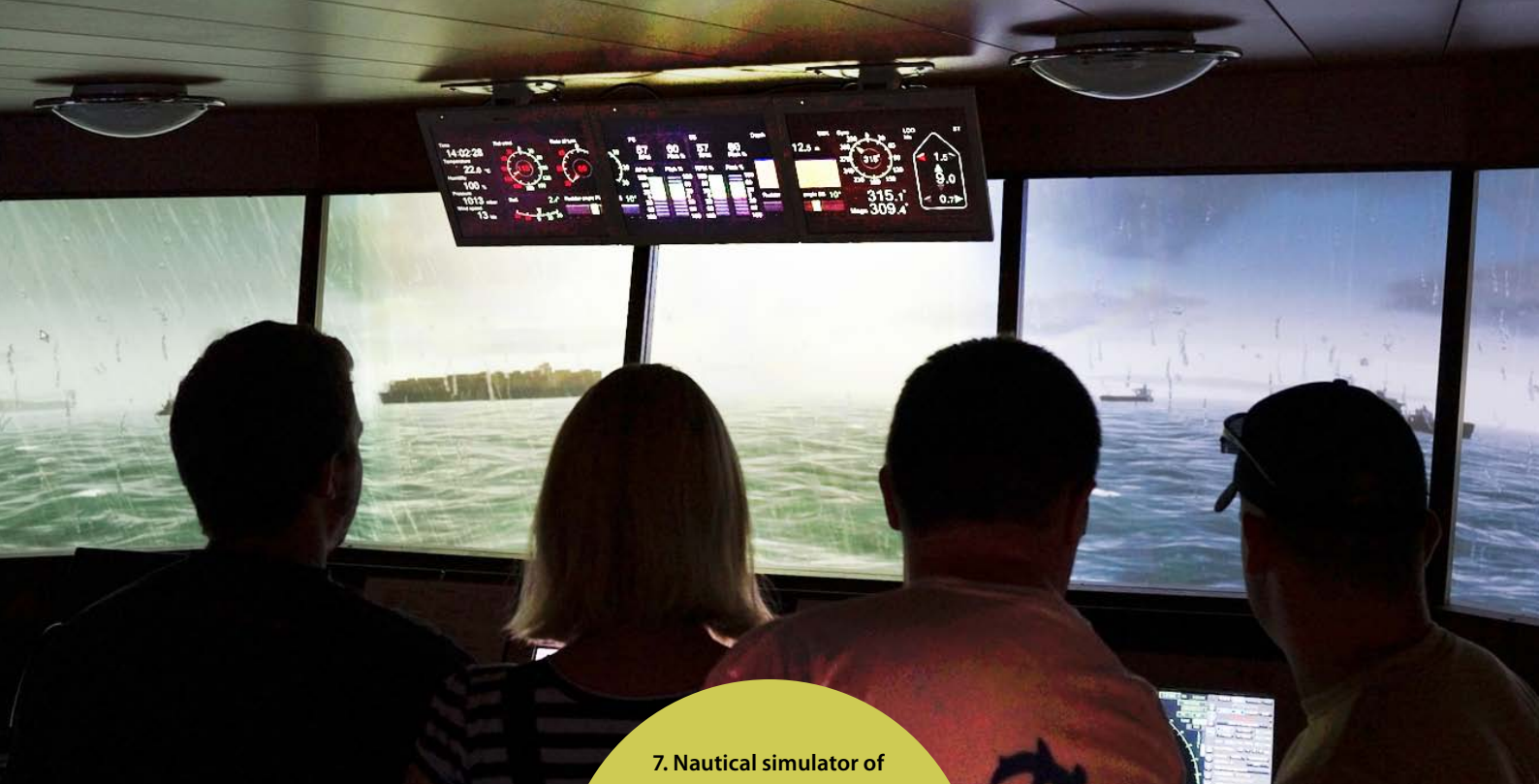
Razvoj strojne opreme in programskih rešitev, trend javne dostopnosti do skupnega znanja (skupnost, ki razvija odprtokodne sisteme) in fleksibilnost raziskovalne skupnosti na področju raziskovanja dediščine je v 10 letih spremenil metodologije dokumentiranja dediščine in situ. V treh korakih se je dokumentiranje iz povsem ročnega in v smislu natančnosti - napak pravzaprav niti ni bilo mogoče prepoznati in oceniti - negotovega rezultata preko digitalnega snemanja najdišč prelevilo v povsem avtomatizirano strojno in programsko dokumentiranje najdišč, ki bo v bodoče zagotavljalo visokokvalitetno ter znanstveno preverljivo dokumentacijo.

Kot primer napredka si velja ogledati primerjalno analizo 3D modela rimske ladje iz Sinje Gorice (Erič, Gaspari 2009; Erič et al. 2013) z geodetskimi meritvami, ki so bile opravljene sočasno. Te bi morale biti dokaj precizne saj je globina na kateri se nahaja ladja zgolj 3 m. Ugotovljene so bile napake v meritvah s tahimetrom (Slika 1), ki so pokazale na dejstvo, da so bile povezane s tokom Ljubljane. Pomembnejše je grenko spoznanje, da je bilo doslej zaupanje v geodetske meritve popolno in je bila risana analogna dokumentacija vezana na meritve, ki jih ni mogoče preverjati, prav tako pa ostaja neznana tudi napaka. Podvodna najdišča dediščine so v globljih vodah v veliki večini brodolomi in drugi potopljeni objekti (letala, zelo redko še kaj drugega), v plitvih priobalnih delih pa zaradi geoloških sprememb kot sta



6. Lecturer Gregor Berginc

Predavatelj Gregor Berginc (photo: F. Solina)



7. Nautical simulator of the Faculty for Maritime Studies and Transport, University of Ljubljana, presented by Marko Perkovič MSc

Navtični simulator Fakultete za pomorstvo in promet Univerze v Ljubljani vodi mag. Marko Perkovič (photo: F. Solina)

documentation. White light scanners (Stopinšek 2012), due to their technical limits (energy source, connection to computer, etc.) are not the best solution for documenting underwater heritage, but they can be useful under some conditions. Photogrammetry has completely changed due to the development of digital photography and, consequently, capturing image data. The devices are smaller, and the quality of the image is better. Because of the data processing difficulty and delays in documenting underwater heritage, photogrammetry was almost useless. However, in recent years, the research of photogrammetric procedures and computer processing of many images has seen rapid progress. Nowadays, due to the availability of open-source programmes and free access to programming tools – programming tools of the former generation were extremely expensive and therefore unavailable to a wider circle of researchers – the possibilities for accurate data capturing and quick on-site execution are great.

Comparative tests were conducted 3D point accuracy for the results obtained by a white light scanner and the photogrammetrically processed 3D model (Figure 2). The comparison showed that, in the majority of instances, 3D models obtained by photography and processed by photogrammetric software produced better results. The structured-light 3D scanner (< 0.1 mm) is more precise when it comes to the morphological features of an object's surface. In the case of capturing greater surfaces, where it is necessary to have several consecutive scanning cycles, the rate of error inevitably increases (Stopinšek 2012).

3D modelling software has to combine two elements: (1) groups of images for site analysis and (2) groups of images for depicting a 3D model.

The study procedures may be performed automatically or semi-automatically: (1) segmentation analysis, (2) 2D metric and volume metric analysis of 3D models, (3) orthographic analysis and conversion of 3D models into 2D basic plans, (4)

erozija in tektonski premiki, tudi potopljena arhitektura in druga infrastruktura. Čedalje boljše dostopnost do naprav za 3D zajemanje podatkov in kvaliteta prostodostopnih programov za 3D modeliranje s pomočjo fotogrametrije povsem spreminja metodologije dokumentiranja podvodne dediščine.

Ta hip so za razvoj dokumentiranja podvodne kulturne dediščine najpomembnejše nove tehnologije za zajem 3D podatkov in odprtokodne rešitve za predelavo in modeliranje takih podatkov. Snemalniki na belo svetlobo (Stopinšek 2012) zaradi tehničnih omejitev (vir energije, povezave z računalnikom itd.) niso najboljša rešitev za dokumentiranje podvodne dediščine, so pa pogojno uporabni. Fotogrametrija se je zaradi razvoja digitalne fotografije in s tem zajemanje slikovnih podatkov popolnoma spremenila. Aparati so manjši, kakovost slike pa boljše. Fotogrametrija je bila zaradi zahtevnosti in zamudnosti pri obdelavi podatkov pri dokumentiranju podvodne dediščine skorajda neuporabna. V zadnjih letih pa so raziskave fotogrametričnih postopkov in računalniške obdelave množice slik zelo napredovale. Zaradi dostopnosti do odprtokodnih programov in prostega dostopa do programskih orodij - programska orodja prejšnje generacije so bila izjemno draga in zato nedostopna širšemu krogu raziskovalcev - so danes možnosti za natančno zajemanje podatkov in hitro izvedbo na terenu povsem odprte.

Izvedeni so 3D natančnost bili primerjalni testi med rezultati snemalnika na belo svetlobo in fotogrametrično procesiranim 3D modelom (Slika 2). Primerjava je pokazala, da so v večini primerov 3D modeli dobljeni s fotografijo in procesirani s fotogrametrično programsko opremo boljše rezultirani. 3D snemalnik na strukturirano svetlobo (< 0,1 mm) je bolj natančen pri morfoloških zaznavah površine predmeta. V primeru zajema večjih površin, kjer je potrebno sestavljati več zaporednih snemalnih ciklusov se začne napaka nenadzorovano večati (Stopinšek 2012).

Programska oprema za 3D modeliranje mora združiti dva

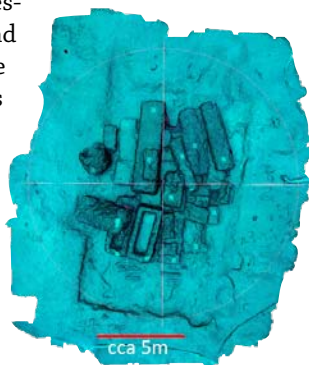


8. Lectures, demonstrations and exercises were held in the afternoon at the lecture hall of the University of Ljubljana's Faculty of Maritime Studies and Transport

Predavanja, demonstracije in vaje so se v popoldanskem času odvijale v predavalnicah Fakultete za pomorstvo in promet Univerze v Ljubljani (photo: F. Solina)

registration of the site in GIS, and (5) automatic classification by using open databases.

There are readily available advantages of using modern technology and surveying accessories, which are more and more affordable, while open-source software is literally improving on a daily basis. In the research of underwater heritage, the safety of divers comes first. For the sake of comparison, we can use the case of documenting the Roman vessel in Sinja



Gorica at a depth of 3 m (Erič 2012). The drafting of manual documentation, covering 2D layout, 2-3 cross sections and 2-3 longitudinal sections, sketch and orthographic projection, would require 25 to 30 hours of diving. By using photographic sequences – with each sequence covering over 900 photographs – we needed a mere 3 to 4 hours of diving to conduct 3D photogrammetric modelling of the 3 phases of research of the layers of the vessel with the help of PHOV Mementify software.

It is easy to understand and recognise from this that, with the latest 3D data capturing technologies, the availability of open-source programming tools and development of tools for the segmentation and processing of 3D data captured in underwater heritage research, we can obtain a previously unachievable accuracy of primary documentation, improve the safety of underwater work by reducing the time spent under

elementa: (1) skupino posnetkov za analizo najdišča in (2) skupino posnetkov za upodobitev 3D modela.

Postopki proučevanja so lahko izvedeni avtomatsko ali polavtomatsko: (1) segmentacijska analiza, (2) 2D merska ter volumetrična analiza 3D modelov, (3) ortofotografska analiza in pretvorba 3D modela v 2D temeljne načrte, (4) vpenjanje najdišča v GIS, in (5) samodejno klasificiranje z uporabo odprtih podatkovnih zbirk.

Prednosti pri uporabi sodobne tehnologije in merilnih pripomočkov, ki dobivajo vse bolj dostopne cene in dobesedno vsakodnevno izboljševanju odprtokodne programske opreme so na dlani. Varnost potapljačev je na prvem mestu pri raziskavah podvodne dediščine.

Za primerjavo je mogoče uporabiti dokumentiranje rimske tovorne ladje v Sinji Gorici na globini 3 m (Erič 2012). Za izdelavo ročne dokumentacije, ki bi obsegala 2D tloris, 2 - 3 prečne preseke in 2 -3 vzdolžne preseke, naris in ortografski tloris bi potrebovali 25 do 30 potapljaških ur. S pomočjo fotografskih nizov - vsak niz je obsegal preko 900 fotografij - za fotogrametrična 3D modeliranja 3 faz odkrivanja ladje po plasteh s pomočjo programske opreme PHOV Mementify smo potrebovali zgolj 3 - 4 potapljaške ure.

Iz naštetega je mogoče razumeti in prepoznati, da gre pri uporabi najnovejših tehnologij 3D zajemanja podatkov, dostopnosti prostokodnih programskih orodij in razvoj novih orodij za segmentacijo in obdelavo 3D zajetih podatkov pri raziskavah podvodne dediščine, za še nedosežene pridobitve pri natančnosti primarne dokumentacije, povečevanje varnosti pri podvodnem delu s skrajševanjem časa pod vodo in s tem povezan precej nižji strošek raziskav. Tako postajajo razmerja med kvaliteto podatkov in ceno za rezultate povsem neprimerljiva s tovrstnimi razmerji v preteklosti.

9. A Roman period shipwreck with a cargo of sarcophagi at Sutivan on the island of Brač: a 3D model of the wreck

Antični brodolom s tovorom sarkofagov, Sutivan, Brač: 3D model brodoloma (photo: R. Kovačič, 3D model: G. Berginc, PHOV Mementify, Meshlab)



10. Manual data capture exercise at an archaeological site

Vaje iz ročnega zajema podatkov na arheološkem najdišču (photo: GoPro)

water and thus significantly reduce the costs of research. Therefore, the ratio between the quality and price of data has become entirely incomparable with this ratio in the past.

The pedagogical objectives of the student workshop on 3D Data Capture and Processing in Underwater Archaeology can be divided into short-term and long-term objectives.

SHORT-TERM OBJECTIVES:

(1) systematic observation of underwater cultural heritage, (2) documenting underwater heritage prior to the technological and computer development of surveying equipment and programming tools and the transition to the use of the latest tools, (4) awareness of the need for three important advantages when it comes to underwater heritage research; (a) the precision of documentation due to better interpretation possibilities, (b) increased safety due to the reduced time needed for documenting, and (c) the implementation of a better ratio between the lower price of underwater work and the higher quality of results, (5) self-evaluation, planning, performance of learning processes and continuous professional education and training, and (6) independent on-site research.

LONG-TERM OBJECTIVES:

(1) interdisciplinary participation in the field of underwater heritage research, (2) broadening the present multidisciplinary research of heritage, enabling inductive and deductive conclusions and understanding of underwater heritage, (3) evaluation and integration in international underwater heritage research, (4) the dissemination of research results to the professional and wider non-professional community, (5) improving the relations and understanding the importance of underwater heritage for the history of mankind, and (6) applying to tenders and acquiring funds for scientific and development research activities.

Pedagoške cilje Delavnice za študente "Zajem in obdelava 3D podatkov v podvodni arheologiji" lahko razdelimo na kratkoročne in dolgoročne.

KRATKOROČNI:

1. Sistematično opazovanje podvodne kulturne dediščine, 2. Dokumentiranje podvodne dediščine pred tehnološko -računalniškim razvojem merilne opreme in programskih orodij s prehodom na uporabo najnovejših orodij, 4. zavest o potrebi po treh pomembnih prednostih pri raziskavi podvodne dediščine; (a.) natančnost dokumentacije zaradi boljših možnosti interpretacije, (b.) povečana varnost zaradi skrajšanega časa za dokumentiranje in (c.) implementacija izboljšane razmerja med nižjo ceno podvodnega dela in višji kvaliteti rezultatov, 5. ocena lastnega dela, načrtovanje, izvedba učnih procesov in stalno strokovno izpopolnjevanje, ter 6. samostojno raziskovalno delo na terenu.



11. The participants prepare for underwater work - dive leader R. Kovačič gives instructions

Priprava udeležencev na podvodno delo in napotki vodje potopov R. Kovačiča (photo: Ž. Stopinšek)

DOLGOROČNI:

1. Interdisciplinarno sodelovanje na področjih raziskovanja podvodne dediščine, 2. širjenje zastavljene multidisciplinarne raziskave dediščine, ki omogočajo induktivna in deduktivna sklepanja in razumevanja podvodne dediščine, 3. evalvacija in vključevanje v mednarodne raziskave podvodne dediščine, 4. diseminacija raziskovalnih rezultatov strokovni in širši laični javnosti, 5. poglobljanje odnosa in razumevanje pomena podvodne dediščine za skupno zgodovino človeštva in 6. aktivnosti prijavljanja na razpise in pridobivanja sredstev za znanstveno-raziskovalne in razvojno-raziskovalne naloge.

Bibliography / Literatura

- Erič, M. 2012 - Documenting a Roman Vessel at Sinja Gorica / Dokumentiranje rimskega plovila iz Sinje gorice, Submerged Heritage / Potopljena baština 2, Zadar, 58 - 65.
- Erič, M., Gaspari, A. 2009 - Sinja Gorica: poročilo o arheološkem podvodnem pregledu struge reke Ljubljanice na območju zavarovanja desne brežine ob Sinjegoriških ribnikih, Poročila skupine za podvodno arheologijo 28, ZVKDS.
- Erič, M., Kovačič, R., Berginc, G., Pugelj, M., Stopinšek, Ž., Solina, F. 2013 - The Impact of the Latest 3D Technologies on the Documentation of Underwater Heritage Sites, Proceedings of the 2013 Digital Heritage International Congress (DigitalHeritage), Vol. 2., 28. Oct. - 01. Nov. 2013 Marseilles, France, 281-288.
- Stopinšek, Ž. 2012 - Applicability of 3D scanners in cultural heritage, Faculty of Computer and Information Science, University of Ljubljana, Dipl. thesis, 2012.

Albanian Center for Marine Research Underwater Sciences Field School

Terenska škola za podvodne znanosti Albanskog centra za istraživanje mora

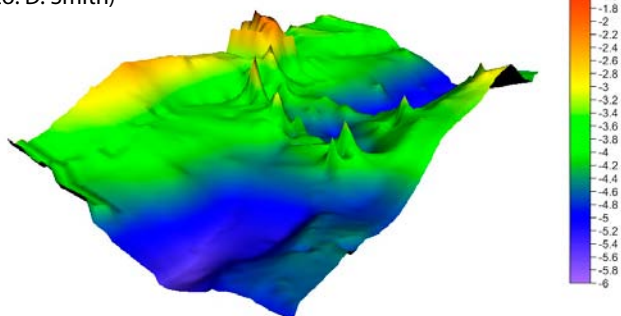
PETER CAMPBELL - peter@albaniamarinecenter.org | DEREK SMITH - derek@albaniamarinecenter.org
AURON TARE - auron@albaniamarinecenter.org | CHRIS BEGLEY - cbegley@transy.edu
DEREK IRWIN - derekirwins@gmail.com | PETRA ZDRAVKOVIĆ - petra.zdravkovic@yahoo.com
HOWARD PHOENIX - hphoenix@rpmnautical.org

Albania lies at a crossroads for ancient shipping in the Adriatic Sea. This rich underwater cultural heritage has been inadvertently preserved and protected by Albania's former communist government who outlawed diving along its coast. In 2007, RPM Nautical Foundation (RPMNF) partnered with Auron Tare (MP) and Dr. Adrian Anastasi (Albanian Institute of Archaeology) to survey the coast. This collaborative project culminated in the founding of the Albanian Center for Marine Research (ACMR) in 2010 by Tare, RPMNF founder George Robb, and esteemed Albanian archaeologist Dr. Neritan Ceka. During its short life, the Center has established itself as the primary marine research organization in Albania by conducting collaborative research with numerous international organizations.

Part of the Center's mission is professional training in conjunction with ongoing research. For the last two years, the ACMR has hosted underwater sciences field schools and scientific diving training to teach underwater archaeology and coastal ecology. Directed by Peter Campbell and Derek Smith, the international staff includes Executive Director Auron Tare, RPMNF Director Dr. Jeff Royal, Dr. Chris Begley, Dr. Derek Irwin, Petra Zdravković, Howard Phoenix, Lee Pape, and Nick Bartos. Students from all over the world attend the courses, including Albania, Canada, Israel, Italy, Mexico, Portugal, and United States.

2. Bathymetry data of the Butrint aqueduct and bridge

Batimetrijski podaci butrintskog akvedukta i mosta
(photo: D. Smith)



1. Students practice safety and diver recovery skills as part of their scientific diver training

Kao dio tečaja znanstvenog ronjenja, studenti vježbaju sigurnosne postupke i spašavanje ronilaca (photo: M. Blades)

Albanija se nalazi na raskrižju antičkih trgovačkih pomorskih putova u Jadranskom moru. To bogato podmorsko kulturno naslijeđe nenamjerno je očuvala i zaštitila prijašnja albanska komunistička vlast jer je zabranila ronjenje uzduž svoje obale. Godine 2007. Nautička zaklada RPM (RPMNF) udružila se s Auronom Tareom (MP) i dr. Adrianom Anastasijem (Albanski arheološki institut) kako bi istražili albansku obalu. Taj je zajednički projekt vrhunac doživio osnivanjem Albanskog centra za istraživanje mora (Albanian Center for Marine Research, ACMR) 2010., u čemu su sudjelovali Tare, osnivač RPMNF-a George Robb i ugledni albanski arheolog dr. Neritan Ceka. Tijekom svojeg kratkog postojanja Centar se iskazao kao vodeća albanska ustanova za istraživanje mora, koja u radu surađuje s brojnim međunarodnim organizacijama.

Dio zadaće Centra profesionalna je obuka povezana s tekućim istraživanjima. U posljednje dvije godine ACMR je bio domaćinom terenske škole za podvodne znanosti i tečaja znanstvenog ronjenja u područjima podvodne arheologije i obalne ekologije. Pod vodstvom Petera Campbella i Dereka Smitha, međunarodno nastavno osoblje obuhvaća izvršnog direktora Aurona Tarea, direktora RPMNF-a dr. Jeffa Royala, dr. Chrisa Begleyja, dr. Dereka Irwina, Petru Zdravković, Howarda Phoenixa, Lee Pape i Nicka Bartosa. Program pohađaju studenti iz cijelog svijeta, uključujući Albaniju, Italiju, Izrael, Kanadu, Meksiko, Portugal i Sjedinjene Američke Države.

Akreditirani kroz Sveučilište Transylvania (SAD) i u suradnji s RPMNF-om kroz inicijativu ICEP-a, taj sveučilišni program studentima osnove podmorske arheologije i obalne ekologije nudi kroz praktične vježbe na različitim nalazištima. Proučavani brodolomi u rasponu su od grčkih brodova iz 4. stoljeća pr. Kr. blizu Butrinta, sjevernoafričkog broda iz 4. stoljeća po. Kr. i broda iz Drugoga svjetskog rata Probitas. Druga nalazišta obuhvaćaju izvor Plavo oko i potopljene ruševine u Butrintskom jezeru. Kao dio projekta razvođa, sveobuhvatan ekološki nadzor obavljen je na pet topovnjača iz razdoblja hladnog rata u Ksamilskom zaljevu. Financirano od strane Zaklade Waitt, istraživanje skuplja temeljne podatke o obalnoj ekologiji Albanije te pokazuje

Accredited through Transylvania University (United States) and in collaboration with RPMNF through the ICEP initiative, this university course exposes students to the basics of maritime archaeology and coastal ecology through practical exercises on a wide range of site types. Shipwrecks studied range from the 4th century BC Greek shipwrecks near Butrint, a 4th century AD North African shipwreck, and the World War II ship SS Probitas. Other sites include the Blue Eye spring and submerged ruins in Lake Butrint. Extensive ecological monitoring has been conducted on five Cold War-era gunboats in Ksamil Bay as part of a watershed project. Funded by the Waitt Foundation, the research is gathering baseline data on Albania's coastal ecology and demonstrating how ecology and archaeology work hand-in-hand to answer the same questions through mutually beneficial scientific methods. Hands-on experience conducting diver surveys, remote sensing, ecological surveys, photography, artifact recording, and underwater excavation prepare the students for professional work. Practical experience is coupled with classroom lectures discussing ethics, theory, ecology, ship construction, and experimental archaeology.

The primary focus of the 2013 field school was the Roman aqueduct and bridge at the UNESCO World Heritage Site of Butrint. Terrestrial excavations at Butrint and the Vrina Plain directed by Richard Hodges have led to incredible discoveries over two decades, but underwater ruins in the lake remain understudied. Remote sensing and diver surveys identified monumental architecture such as massive granite piles and brick arches. Recording has just begun, offering insight into how the city linked to the surrounding region.

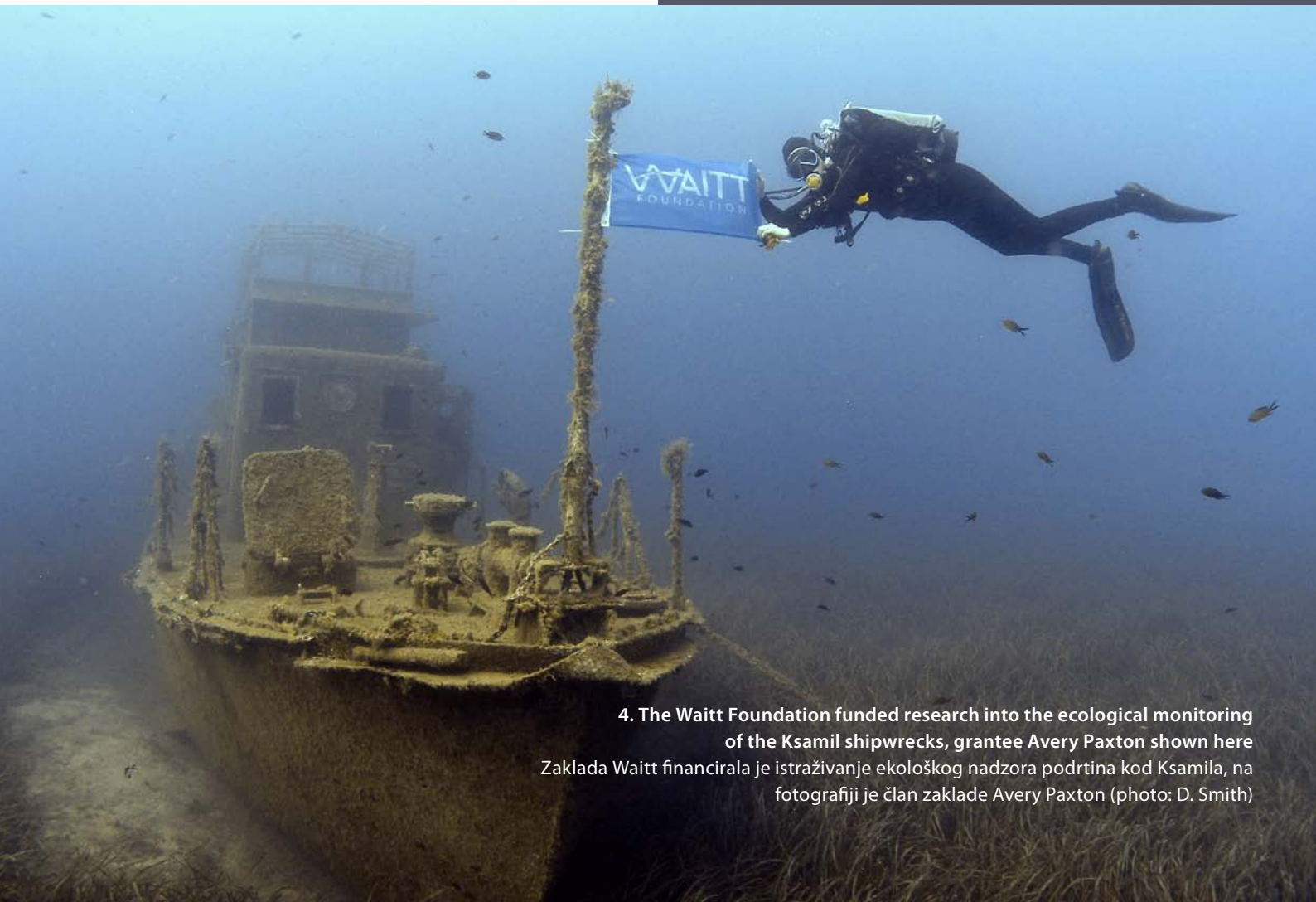
Two years of field schools have been an unequivocal success. To date 75% of former students have entered graduate programs



3. Roman bridge foundation piling in Lake Butrint, now acting as a biology colony

Ostaci temelja rimskog mosta u Butrintskom jezeru, danas biološka kolonija (photo: D. Smith)

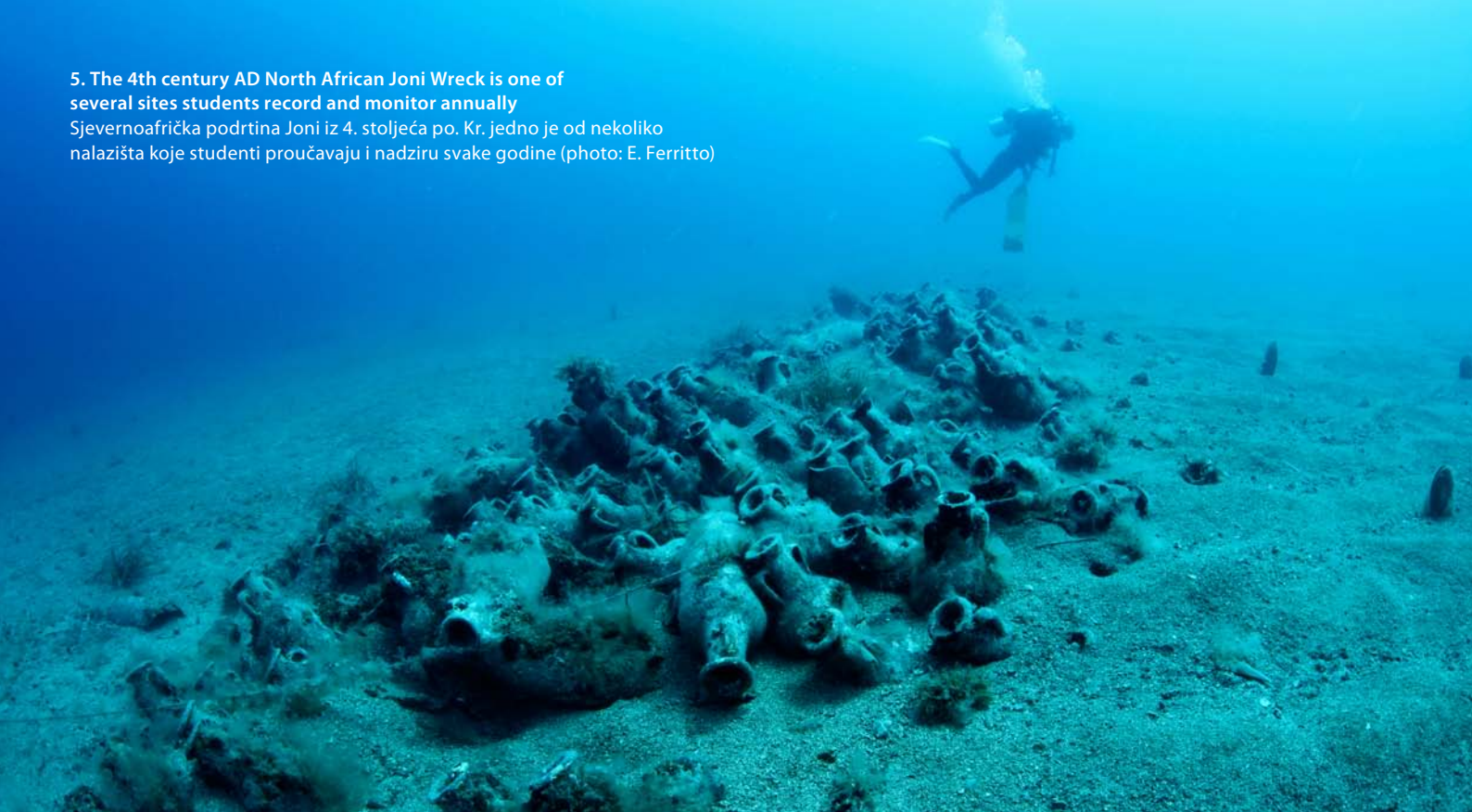
kako ekologija i arheologija surađuju na rješavanju zajedničkih pitanja, rabeći zajednički korisne znanstvene metode. Praktično iskustvo u ronjenju, daljinskom nadzoru, ekološkim istraživanjima, snimanju, opisivanju predmeta i podvodnim iskopavanjima studente priprema za profesionalni rad. Praktičan se rad nadopunjuje predavanjima u kojima se govori o etici, teoriji,



4. The Waitt Foundation funded research into the ecological monitoring of the Ksamil shipwrecks, grantee Avery Paxton shown here

Zaklada Waitt financirala je istraživanje ekološkog nadzora podrtina kod Ksamila, na fotografiji je član zaklade Avery Paxton (photo: D. Smith)

5. The 4th century AD North African Joni Wreck is one of several sites students record and monitor annually
Sjevernoafrička podrtina Joni iz 4. stoljeća po. Kr. jedno je od nekoliko nalazišta koje studenti proučavaju i nadziru svake godine (photo: E. Ferritto)



and 58% have been hired for subsequent projects, which is all the more impressive considering several remain undergraduates and have yet to apply for graduate school or employment. Data gathered during the field schools is being used for publications on fishermen's finds, Adriatic ecology, and the archaeology of Lake Butrint.



6. Corinthian amphora at the 4th century BC Butrint wreck site
Korintska amfora na mjestu brodoloma iz 4. stoljeća pr. Kr. kraj Butrinta (photo: K. Martinsen)



7. Students watching Peter Campbell demonstrating artifact recording
Studenti prate kako Peter Campbell opisuje nalaze (photo: E. Ferritto)

ekologiji, brodogradnji i ekperimentalnoj arheologiji.

Glavni cilj terenske škole 2013. bili su rimski akvedukt i most u Butrintu, UNESCO-ovu mjestu svjetske baštine. Kopnena iskopavanja u Butrintu i na ravnici Vrîna, pod vodstvom Richarda Hodgesa, tijekom dvaju desetljeća dovela su do nevjerojatnih otkrića, ali ruševine potopljene u jezeru nisu dovoljno dobro istražene. Daljinskim opažanjima i ronilačkim istraživanjima prepoznata su monumentalna arhitektonska djela poput masivnih granitnih stupova i lukova od opeke. Opisivanje je tek započelo, nudeći uvid u to kako je grad bio povezan s okolnim područjima.

Dvije godine terenske škole nedvojbeno su se pokazale uspješnim. Do danas je 75% prijašnjih studenata ušlo u poslijediplomske programe, a 58% je uključeno u nove projekte, što je iznimno dojmljivo znamo li da su nekolicina još dodiplomci pa se tek moraju uključiti u neki poslijediplomski program ili zaposliti. Podaci skupljeni za terensku školu iskorišteni su u člancima o ribarskim nalazima, jadranskoj ekologiji i arheologiji Butrintskog jezera.

The Conservation and Restoration of Three Amphorae from the Pakoštane - Janice and Rovinj - Veštar Sites

Konzerviranje i restauriranje triju amfora s lokaliteta Pakoštane - Janice i Rovinj - Veštar

MLADEN MUSTAČEK - mmustacek@icua.hr | MARTINA ČURKOVIĆ - mcurkovic@icua.hr
IVO MARTINOVIĆ - imartinovic@icua.hr

Conservation-restoration treatment was conducted at the Conservation and restoration department of the International Centre for Underwater Archaeology in Zadar on three fragmented Roman amphorae. The first two amphorae were found during underwater archaeological research of the waters of Janice Cove at Pakoštane in May and June of 2011 (Figure 1). The two amphorae from the Janice site are of the Forlimpopoli

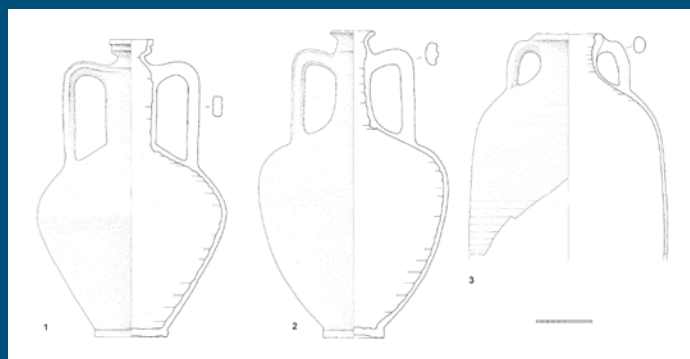


1. Amphora No. 2 in situ at the Pakoštane - Janice site
Amfora br. 2 in situ na nalazištu Pakoštane - Janice
(photo: L. Bekić)

type and likely originate from various workshops, given that one amphora is of yellowish colour and softer fabric, characteristic of the Italic workshops in Forlimpopoli (Figure 2-2), while the other is of reddish colour and harder fabric, and is similar to the amphorae of the local workshop of Sextus Metilius Maximus in Crikvenica (Figure 2-1). The third amphora was found during underwater archaeological research of the Rovinj - Veštar site in 2011 (Figure 2-3). The amphora from the Rovinj - Veštar site is of currently unknown analogy and is similar to some types of late Roman amphorae, although found in an archaeologically well documented context, that stratigraphically belongs to the early 1st century (Bekić, Pešić IN PRINT) (Figure 3).

Upon receipt at the restoration workshop the condition of the fragmented amphorae as found was documented whereupon delicate cleaning with brushes was used to remove the smaller encrustations that might have hampered the desalination procedure. After preliminary cleaning the fragmented amphorae were placed in a vat with tap water in a desalination process that lasted ten months. During the desalination procedure water in the vat was changed on a monthly basis and analyses of samples were conducted using potentiometric titration to monitor the

U Odjelu konzerviranja i restauriranja Međunarodnog centra za podvodnu arheologiju u Zadru provedeni su konzervatorsko-restauratorski radovi na tri fragmentirane antičke amfore. Prve dvije amfore pronađene su prilikom podvodnog arheološkog istraživanja podmorja uvale na položaju Janice u Pakoštanima tijekom svibnja i lipnja 2011. godine (Slika 1). Dvije amfore s lokaliteta Janice odgovaraju tipu Forlimpopoli i vjerojatno potječu iz različitih radionica budući da je jedna amfora žućkaste boje i mekše fakture, koje su karakteristike italjskih radionica u Forlimpopoliu (Slika 2-2), a druga crvenkaste boje i tvrđe fakture, te nalikuje amforama lokalne radionice Seksta Metilija Maksima u Crikvenici (Slika 2-1). Treća amfora pronađena je prilikom podvodnog arheološkog istraživanja lokaliteta Rovinj - Veštar tijekom 2011. godine (Slika 2-3). Amfora s lokaliteta Rovinj - Veštar zasad je nepoznate analogije i nalikuje nekim tipovima kasnoantičkih amfora, iako je pronađena u arheološki dobro dokumentiranom kontekstu, koji stratigrafski pripada ranom 1.st. (Bekić, Pešić IN PRINT), (Slika 3).



2. Drawings of amphorae Nos. 1, 2 and 3
Crteži amfora br.1, 2 i 3 (drawing: L. Bekić)

Po zaprimanju u restauratorsku radionicu dokumentirano je zatečeno stanje fragmentiranih amfora nakon čega su delikatnim čišćenjem četkicama uklonjene manje naslage koje su eventualno mogle smetati u provođenju postupka desalinizacije. Nakon preliminarnog čišćenja fragmentirane amfore su postavljene u kadu s vodovodnom vodom u postupak desalinizacije koji je trajao 10 mjeseci. Tijekom postupka desalinizacije u kadi su mjesečno vršene izmjene vode, te su provedene analize uzoraka potenciometrijskom titracijom radi praćenja količine klorida u otopini. Nakon provedenog zadnjeg mjerenja količina klorida u otopini bila je 60,77 mg/L čime je proces desalinizacije bio završen. Nakon provedene desalinizacije i sušenja, pripadajući keramički ulomci amfora djelomično su impregnirani potapanjem u 5 % akrilnu disperziju Dispersion K9 (Kremer) radi sprečavanja osipanja površinskog sloja nakon čega su fragmenti



3. In-situ fragments of amphora No. 3 from the Rovinj - Veštar site

In-situ fragmenti amfore br. 3 s lokaliteta Rovinj - Veštar (photo: M. Pešić)

concentration of chloride in the solution. The final measurement taken had the concentration of chloride in the solution at 60.77 mg/L, which completed the desalination process. After desalination and drying, the ceramic fragments were partially impregnated by immersing them in a 5% solution of acrylic Dispersion K9 (Kremer) to prevent crumbling of the surface layer, whereupon the fragments underwent preliminary joining into larger sections (Figure 4).

The Conservation and Restoration of Amphora No. 1

The Forlimpopoli type amphora from the Janice site was received in thirty-seven fragments and is of reddish colour and of harder fabric. The level of preservation of the ceramic fragments is good as they do not fracture, and crumbling during handling is minimal. Joining and bonding yielded about 60% of the original amphora, with a smaller shoulder section and a large part of the belly missing that will be entirely reconstructed in the restoration process (Figure 5). Prior to the reconstruction of the missing sections the surface layer of the ceramic was consolidated by the application of a thin layer of a 5% solution of PVA resin Mowilith 50 (Kremer) dissolved in acetone to prevent crumbling of the surface layer. To protect the original surface from excess plaster and possible damage during the work, a thicker layer of liquid latex (Figure 6) was applied to the inner and outer surface of the ceramic.

The missing sections of the amphora were filled with alabaster gypsum by taking an impression of the interior of the amphora with plasteline and clay that was then transferred to the missing section. Plaster was then applied on the impression over the missing area. After the plaster hardened the fills were hand-shaped

preliminarno spojeni u veće cjeline (Slika 4).

Konzerviranje i restauriranje amfore br.1

Amfora s lokaliteta Janice tipa Forlimpopoli zaprimljena je u 37 fragmenata i crvenkaste je boje i tvrde fakture. Očuvanost keramičkih fragmenata je dobra budući da se ne lome i prilikom rukovanja neznatno se osipaju. Nakon spajanja i lijepljenja fragmenata dobiveno je oko 60 % originalne cjeline amfore kojoj nedostaje manji dio ramena i veći dio trbuha koji će se u postupku restauriranja u cijelosti rekonstruirati (Slika 5). Prije rekonstruiranja nedostajućih dijelova, površinski sloj keramike konsolidiran je nanošenjem tankog sloja 5% otopine PVA smole Mowilith 50 (Kremer) otopljene u acetonu čime je spriječeno osipanje površinskog sloja. Kako bi originalnu površinu zaštitili od prelijevanja gipsa i eventualnih oštećenja tijekom obrade, na unutrašnju i vanjsku površinu keramike nanesen je deblji sloj tekućeg latexa (Slika 6).

Nedostajući dijelovi amfore izrađeni su od alabaster gipsa na način da se pomoću plastelina i gline uzimao otisak unutrašnjeg dijela amfore koji se zatim prenosio na dio koji nedostaje, nakon čega se na otisak nanosio gips. Nakon stvrdnjavanja gipsa ispune su ručno oblikovane pomoću raznog alata za modeliranje kako bi odgovarale originalnoj formi amfore. Ovom tehnikom najprije su rekonstruirani nedostajući dijelovi ramena a zatim i trbuha amfore. Prije rekonstruiranja posljednje ispune dok je unutrašnjost amfore još uvijek bila dostupna, s unutrašnjih površina amfore uklonjen je prethodno nanesen zaštitni sloj latexa, nakon čega su se preostale nečistoće i ostaci gipsa uklonili ispuhivanjem i pomoću četkica.

Nakon nadomještanja i oblikovanja svih nedostajućih dijelova amfore, zaštitni sloj latexa uklonjen je i sa vanjske površine originala. Pažljivim nanošenjem alabaster gipsa zapunjene su i sve vidljive pukotine između slijepljenih fragmenata čime je dodatno ojačana fragmentirana struktura amfore. Radi postizanja



4. The sorting and preliminary joining of the ceramic fragments

Razvrstavanje i preliminarno spajanje keramičkih fragmenata (photo: L. Bekić)

using various modelling tools to achieve the original form of the amphora. This technique was used to first reconstruct the missing sections of the shoulder and then the belly of the amphora. Prior to reconstruction of the last filler, while the interior of the amphora was still accessible, the previously applied layer of latex was removed from the surface of the amphora, after which the remaining impurities and remnants of plaster were removed by air blower and brushes.

After the filling and shaping of all missing section of the amphora, the protective layer of latex was also removed from the outer surface of the original. Careful application of alabaster gypsum was used to fill all visible cracks between the bonded fragments, which further strengthened the fragmented structure of the amphora. The white plaster areas were toned with the aim of achieving better visual consistency between the original and replaced sections. The toning procedure used acrylic paints carefully applied on the plaster surfaces with brushes to avoid the application of paint on the original amphora surface. The replaced plaster sections were toned in a lighter nuance from that of the original in order to clearly differentiate them from the replaced sections.

The Conservation and Restoration of Amphora No. 2

Following preliminary sorting, bonding and impregnation the amphora was transferred to the conservation and restoration department of the International Centre for Underwater Archaeology (Figure 7). Although the amphora had already been consolidated in a solution of acrylic Dispersion K9 (Kremer), the ceramic was still crumbling and was of unsatisfactory firmness, which resulted in the separation and fracturing of the bonded ceramic fragments. The outer surface of the amphora fragments is worn, in particular at the joints of the fragments, and crumbles at the touch. The shoulder area and the base of the amphora exhibit surface flaking, exacerbated by the preliminary bonding with adhesive tape prior to the complete consolidation of the ceramic. The fractures present likely occurred as a result of the shrinkage of the ceramic or the crystallisation of the remain-



6. Protecting the original surface with the application of liquid latex

Zaštićivanje originalnih površina nanošenjem tekućeg latexa
(photo: M. Ćurković)

ing soluble salts whilst drying in the air. The mechanical action of the sea or marine organisms is visible on the surface of the ceramic as cuts, pitting and specific incisions on the surface. In the neck and shoulder area there is a partially preserved coating of lighter engobe. The surface of the pottery is light yellow to



5. Amphora No. 1 following the preliminary joining of fragments

Amfora br.1 nakon preliminarnog spajanja fragmenata
(photo: M. Ćurković)

bolje vizualne ujednačenosti između originala i nadomještenih dijelova proveden je postupak toniranja bijelih gipsanih površina. U postupku toniranja koristile su se akrilne boje koje su se pomoću kista pažljivo nanosile na gipsane površine kako bi se izbjeglo nanašanje boje na originalnu površinu amfore. Nadomješteni gipsani dijelovi tonirani su u svjetlijem tonu od originala kako bi se originalni fragmenti amfore jasno mogli razlikovati od onih nadomještenih.

Konzerviranje i restauriranje amfore br.2

Nakon preliminarnog sortiranja, lijepljenja i impregniranja amfora je prosljeđena u Odjel konzerviranja i restauriranja Međunarodnog centra za podvodnu arheologiju (Slika 7). Iako je amfora već prethodno bila konsolidirana otopinom akrilne disperzije Dispersion K9 (Kremer), crijep se još uvijek osipao i bio nezadovoljavajuće čvrstoće, što je rezultiralo razdvajanjem i lomljenjem lijepljenih fragmenata keramike. Vanjska površina ulomaka amfore je izlizana, posebice uz sljubnice fragmenata, te se osipa na dodir. Na području ramena i dna amfore došlo je do listanja površine, koje je potpomognuto preliminarnim lijepljenjem ljepljivim trakama prije izvršene potpune konsolidacije crijepa. Prisutni su i lomovi nastali vjerojatno zbog utezanja keramike ili kristalizacije preostalih topivih soli tijekom sušenja na zraku. Vidljivo je mehaničko djelovanje mora ili morskih organizama na površinu keramike u vidu rezova, rupica i specifičnih ureza na površini. Na području vrata i ramena djelomično je očuvan premaz svijetlije engobe. Površina keramike je svijetle žuto - smeđe, dok je u presijeku sive boje. Na području oboda, vrata te ručki prisutni su tragovi smole kojom je bila premazana

brown, and grey at the core. In the rim, neck and handle areas there are traces of the resin the interior was coated with. The interior was entirely coated with a thick layer of resin, now incoherent and crumbling profusely at the touch. There are some calcite encrustations of marine organisms evenly dispersed across the outer surface, which shall not be removed as they do not impair the overall aesthetic impression and the artefact's conservation condition, while their removal could result in damage to the artefact.

The bonded fragments were carefully separated using acetone and cleansed of the remains of adhesive and were, along with the remaining fragments, consolidated by multiple immersions in a 4% solution of AcrilME (CTS) acrylic dispersion in distilled water. After the consolidation procedure the surface continued to exhibit exfoliation in places. The surface layer of ceramic flaking off in the form of a crust was fixed by the micro-injection of MECOSAN L-TR ceramic adhesive into the fissures. These surface areas were additionally protected with a coating of a 7% solution of Mowilith 50 PVA resin (Kremer) in acetone. The fragments were mounted from bottom to top, preliminarily joined with adhesive tape and then permanently bonded with Mecosan L-TR adhesive (Figure 8). The mounting of the artefact was only possible with the instalment of an internal structure



8. Bonding the fragments of amphora No. 2 with the aid of an internal structure

Spajanje fragmenata amfore br.2 uz pomoć postavljanja unutrašnje konstrukcije (photo: M. Čurković)



7. The condition of amphora No. 2 as found
Zatečeno stanje amfore br.2 (photo: M. Čurković)

unutrašnjost. Unutrašnjost je u potpunosti prekrivena debelim slojem smole koja je nekoherentna i snažno se osipa na dodir. Na vanjskoj površini ravnomjerno je raspoređeno ponešto kalcitnih naslaga morskih organizama, koje neće biti uklanjane jer ne narušavaju ukupan estetski dojam i konzervacijsko stanje predmeta, dok bi njihovo uklanjanje moglo uzrokovati štetu na predmetu.

Slijepljeni fragmenti pažljivo su uz pomoć acetona razdvojeni i očišćeni od ostataka ljepljiva, te su zajedno s preostalim fragmentima konsolidirani višestrukim potapanjem u 4% otopinu akrilne disperzije AcrilME (CTS) u destiliranoj vodi. Nakon postupka konsolidiranja, površina se mjestimično i dalje listala. Površinski sloj keramike koji se odvajao u obliku kora fiksiran je mikroinjektiranjem ljepljiva za keramiku MECOSAN L-TR u pukotine. Takvi dijelovi površine su dodatno zaštićeni premazivanjem 7% otopinom PVA smole Mowilith 50 (Kremer) u acetonu. Fragmenti su montirani od dna prema vrhu, preliminarno povezani ljepljivim trakama, te zatim trajno spajani Mecosan L-TR ljepljivom (Slika 8). Montiranje predmeta bilo je moguće samo uz postavljanje unutrašnje konstrukcije koja je pridržavala teške fragmente na svome mjestu dok se ljepljivo u potpunosti nije osušilo, te je zatim uklonjena kroz šupljine na mjestima gdje su nedostajali fragmenti. Zbog male dodirne površine među fragmentima spojevi su s unutrašnje strane dodatno ojačani trakicama staklene tkanine natopljenima Mecosan L-TR ljepljivom. Nedostajući dijelovi nadopunjeni su alabaster gipsom (Kremer) toniranim prirodnim zemljanim pigmentima u prahu, nanašanjem gipsa na kalup načinjen od plastelina. Nakon sušenja gips je fino ispoliran brusnim papirom fine granulacije. Uslijedilo je

that held the heavy fragments in place until the adhesive fully cured – this structure was subsequently removed through cavities in places where fragments were missing. Because of the small contact surface between fragments, the joints were additionally reinforced from the inside with fibreglass strips soaked in Mecosan L-TR adhesive.

The missing sections were filled with alabaster gypsum (Kremer) toned with powdered natural earth pigments, with the plaster applied on a plasteline mould. After drying the plaster was finely polished with fine granulation sandpaper. This was followed by the nuancing of the plastered sections with acrylic paints in a neutral colour similar to the colour of the surface of the pottery. The surface of the pottery was protected with a coating of a 3% solution of Mowilith 50 PVA resin (Kremer) in toluene. As a result of the consolidation and protective coating the surface of the pottery darkened for one nuance into a darker yellow-brown colour. After conservation and restoration the amphora is presented in its full height of 55.5 cm and width at the belly of 35.5 cm.

The Conservation and Restoration of Amphora No. 3

The amphora from the Rovinj - Veštar site was received in a highly fragmented condition, evidently missing its lower section (Figure 9). It was found in marine silt and as such we do not find large accumulations of encrustations and other remains of marine organisms. The complete drying of the ceramic fragments was followed by the impregnation procedure. During drying it was established that the physical characteristics (hard-



10. Taking an impression of the shoulder and belly of amphora No. 3 using silicone

Uzimanje otiska ramena i trbuha amfore br. 3 pomoću silikona (photo: I. Martinović)

ness, firmness) of the ceramic fragments was impaired. The impregnation was thus conducted by immersing the fragments in a very diluted impregnant (a 3% solution of Akрил ME acrylic dispersion in distilled water) in order to achieve the best possible penetration of the impregnant into the structure of the ceramic. The process of immersing the ceramic into the impregnant and drying was repeated three times until a satisfactory result was achieved in terms of the physical characteristics of the ceramic.

The completion of the impregnation procedure was followed by the next step in the conservation-restoration operation – this

nijansirane gipsanih dijelova akrilnim bojama u neutralnu boju sličnu boji površine keramike. Površina keramike je zaštićena premazivanjem 3% otopinom PVA smole Mowilith 50 (Kremer) u toluenu. Kao posljedica konsolidacije i zaštitnog premazivanja površina keramike je potamnila za jednu nijansu u tamnije žuto-smeđu boju. Nakon konzerviranja i restauriranja amfora se prezentira u punoj visini koja iznosi 55,5 cm, te širini u području trbuha 35,5 cm.

Konzerviranje i restauriranje amfore br.3

Fragmentirana amfora s nalazišta Rovinj - Veštar zaprimljena je u velikom broju fragmenata, s očitim nedostatkom donjeg dijela amfore (Slika 9). Nalazila se u morskome mulju, te stoga na njoj površini ne nalazimo veće nakupine okamina i drugih



9. The condition of amphora No. 3 as found
Zatečeno stanje amfore br.3 (photo: M. Ćurković)

ostataka morskih organizama. Nakon potpunog sušenja keramičkih fragmenata slijedio je postupak impregniranja. Prilikom sušenja utvrđeno je da su fizikalne karakteristike (tvrdoća, čvrstoća) keramičkih fragmenata narušene. Zato se impregniranje vršilo potapanjem fragmenata u rijetki impregnant (3% otopina akrilne disperzije Akрил ME u destiliranoj vodi) kako bi se postigla što bolja penetracija impregnanta u strukturu keramike. Postupak potapanja u impregnant i sušenja keramike ponavljao se tri puta dok se nisu postigli zadovoljavajući rezultati što se tiče fizikalnih karakteristika keramike.

Završetkom postupka impregniranja krenulo se na sljedeći korak konzervatorsko - restauratorskog zahvata a to je spajanje (lijepljenje) fragmenata keramičke amfore. Lijepljenje se vršilo sintetičkim ljepilom Mecosan L - TR uz pomoć ljepljivih papirnatih traka. Višak ljepila uklanjao se vatenim štapićima natopljenim acetonom. Nakon lijepljenja uslijedio je postupak rekonstruiranja amfore. Lijepljenjem se došlo do zaključka da spojeni fragmenti daju samo djelomičnu sliku o izvornom

being the bonding (gluing) of the fragments of the ceramic amphora. Bonding was done with the synthetic adhesive Mecosan L – TR assisted by adhesive paper strips. The excess adhesive was removed using cotton swabs soaked in acetone. Bonding was followed by the process of reconstructing the amphora. The bonding process led to the conclusion that the joined fragments offered only a partial picture of the original appearance of the amphora. Considering that an analysis of the amphora's typology also did not result in conclusions as to the original appearance of the amphora, it was decided that only a partial reconstruction should be undertaken. The reconstruction began by taking an impression of the existing section using silicon for impressions of the industrial name Koraform K31 (Alpina - Technische Produkte GmbH). Coating the "cap", i.e. reinforcing the impression was done with a two-component mixture known as Acrytal Basic (Acrytal Sàrl) in combination with cotton gauze as reinforcement (Figure 10). The impression was then transferred to the missing section of the amphora to which alabaster gypsum was applied to fabricate the missing sections. After drying the alabaster gypsum was further worked with hand-held files (rasps) and fine granulation sandpaper.

Once the desired level of reconstruction was achieved it was followed by final patination of the reconstructed sections. Patination was executed by a mixture of acrylic paint applied by brush and sponges to achieve a colour similar, but sufficiently different from the colour of the ceramic surface.

This article describes conservation-restoration work on the examples of three amphorae from the underwater archaeological sites of Roman ports at Pakoštane - Janice and Rovinj - Veštar. Each of the cited amphorae constitutes a particular conservation-restoration challenge given their differing levels of preservation. The artefacts were subjected to the processes of desalination, consolidation, the bonding of fragments, reconstruction and the toning of replaced sections, adapted to the individual artefacts, with particular attention given to certain phases of work and to the selection of materials used in the conservation-restoration procedure and the methods of their application. The conservation-restoration procedure aims to slow the process of the artefact's deterioration, to conserve the condition as found and to restore the former visual identity and provide for its long-term preservation. The work was conducted in adherence to the rules of the profession, using reversible materials and not altering the character of the artefacts (Figure 11).

izgledu amfore. Kako se nije ni kroz proučavanje tipologije amfora došlo do zaključka o izvornom izgledu amfore, odlučeno je da se izvrši njena djelomična rekonstrukcija. Zahvat rekonstrukcije započet je uzimanjem otiska postojećeg dijela pomoću silikona za uzimanje otisaka industrijskog naziva Koraform K31 (Alpina - Technische Produkte GmbH). Nalije- v a n j e "kape", odnosno ojačanja otiska vršilo s e pomoću dvokomponentne smjese pod nazivom Acrytal Basic (Acrytal Sàrl) u kombinaciji za pamučnim gazama kao armaturom (Slika 10).



Otisak je pre- bačen na nedostajući dio amfore te su nalijevanjem alabaster gipsa izrađeni nedostajući dijelovi. Alabaster gips je nakon sušenja dodatno obrađen ručnim turpijama (raš-pama) i brusnim papirom finije granulacije.

11. Amphorae Nos. 2, 3 and 1 after completed conservation-restoration work
Amfore br. 2, 3 i 1 nakon provedenih konzervatorsko-restauratorskih radova (photo: M. Ćurković)

Kad se postigla željena razina rekonstrukcije slijedilo je završno patiniranje rekonstruiranih dijelova. Patiniranje se vršilo mješavinom akrilnih boja uz pomoć kistova i spužvica do boje slične ali dovoljno različite od boje površine keramike.

U ovome članku opisani su konzervatorsko - restauratorski radovi na primjeru triju amfora s podvodnih arheoloških nalazišta antičkih luka Pakoštane - Janice i Rovinj - Veštar. Svaka od spomenutih amfora predstavljala je zasebnu konzervatorsko - restauratorsku problematiku nalazeći se u različitom stupnju očuvanosti. Na predmetima su provedeni postupci desalinizacije, konsolidacije, spajanja fragmenata, rekonstrukcije i toniranja nadomještenih dijelova, koji su bili prilagođeni pojedinom predmetu, pridavajući posebnu pozornost određenim fazama rada, tako i odabirom materijala korištenih u konzervatorsko - restauratorskom postupku i načinu njihove primjene. Konzervatorsko-restauratorskim postupkom nastojalo se usporiti proces propadanja predmeta i konzervirati zatečeno stanje, te vratiti nekadašnji vizualni identitet i omogućiti njegovo dugotrajno očuvanje. Pri izvedenim radovima poštovana su pravila struke, korišteni su reverzibilni materijali te se nije mijenjao karakter samih predmeta (Slika 11).

Bibliography / Literatura.

- Bekić, L., Brusić, Z., Meštrov, M., Parica, M., Pešić, M., Sholz R. 2011 - Nova podvodna arheološka istraživanja u Pakoštanima kod Zadra, Potopljena baština / Submerged Heritage 1, Zadar, 25-31.
- Bekić, L., Pešić, M. in print- Evidences of maritime trade on the Eastern Adriatic coast based on the underwater finds from two roman ports in Croatia, u: Per Terram, Per Mare, Nicosia, in print.
- Buys, S., Oakley, V. 1993 - Conservation and restoration of ceramics, Butterworth Heinemann, Oxford.
- Ćurković, M. 2011 - Ceramic, Stone and Glass Archaeological Material, in: Bekić, L. (ed), Conservation of Underwater Archaeological Finds, I. edition, Zadar.

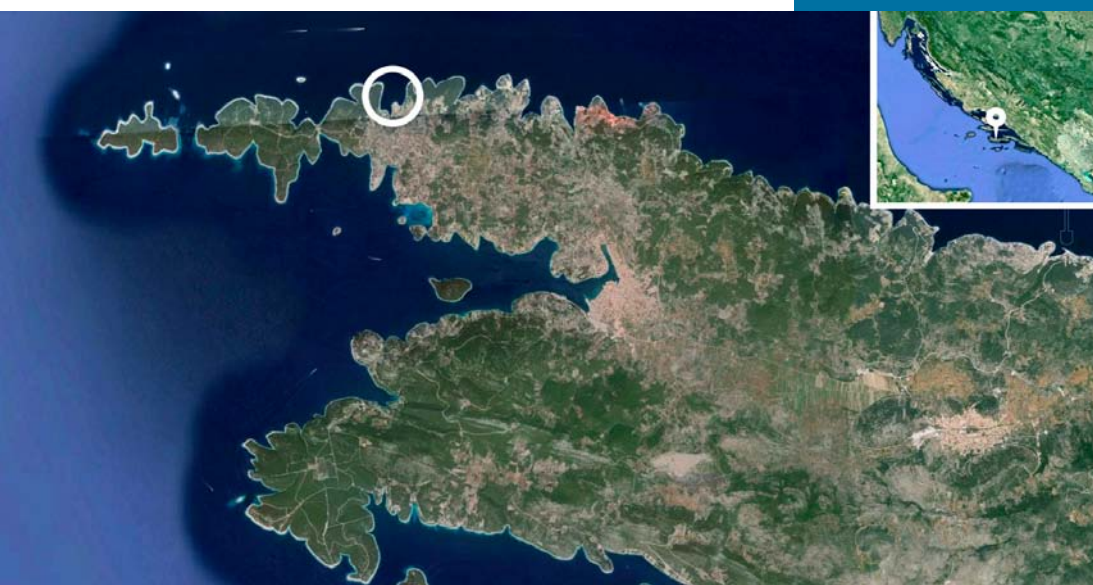
Archaeological Finds in the Waters of Tankaraca Cove, Island of Korčula

Arheološki nalazi u podmorju uvale Tankaraca, otok Korčula

IGOR BORZIĆ - igorborzic@gmail.com

Unlike the southern, eastern and western sides of the island of Korčula (Gjivoje 1972, 148-157; Vrsalović, 1979, 235-237; Jurišić 2001, 189, 192; Radić Rossi 2005, 49-63), the northern

Sjeverna strana otoka Korčule, na kojoj se nalazi i uvala Tankaraca, za razliku od onih južnih, istočnih i zapadnih (Gjivoje 1972, 148-157; Vrsalović, 1979, 235-237; Jurišić 2001, 189, 192; Radić Rossi 2005, 49-63), nije nikada bila predmetom konkretnih podmorsko arheoloških pregleda. Moguće je da je negostoljubivost njezinih obala izražena kroz izostanak značajnijih prirodnih luka te široku otvorenost sjevernim, niz južne padine Hvara spuštajućim, vjetrovima ovaj dio korčulanske obale izmakla izvan glavnih plovidbenih ruta i time je u arheološkom smislu odredila kao neatraktivnu. Jedini lokaliteti koji se bilježe u literaturi jesu rt Kneža u Pelješkom kanalu okarakteriziran kao sidrište (Vrsalović 1979, 235-237), te otočić Pločica u Korčulanskom kanalu kod kojeg je evidentiran brodolom s teretom grčko-italskih amfora iz 3. st. pr. Kr. (Jurišić



1. The western part of the island of Korčula indicating the position of Tankaraca Cove

Zapadni dio otoka Korčule s označenom pozicijom uvale Tankaraca (GoogleEarth)

side – site of Tankaraca Cove – has never been the subject of concrete underwater archaeological scrutiny. It is possible that the inhospitality of its shores, evident in the lack of significant natural harbours, and its high level of exposure to the northern winds flowing down the slopes of the nearby island of Hvar, left them off the chief routes of navigation and rendered them archaeologically unattractive. The only sites mentioned in literature are Cape Kneža in the Pelješac Channel, characterised as an anchorage (Vrsalović 1979, 235-237), and the islet of Pločica in the Korčula Channel, where the wreck of a 3rd century BCE ship transporting Greco-Italic amphorae has been recorded (Jurišić 2001). It is precisely for this reason that every bit of archaeological data is exceptionally valuable and contributes to creating an as realistic as possible placement of the waters of northern Korčula in the frame of historical navigation routes in this part of the Adriatic. It was with this objective in mind – in contact with the local inhabitants and following multiple surveys of individual positions – that I undertook to gather information on possible finds from the seafloor of the area in question.

Among the many coves on the northwest part of the island of Korčula, Tankaraca stands out in the positive sense by its position, the high level of coastal indentation and its relative accessibility. It can roughly be divided into three smaller

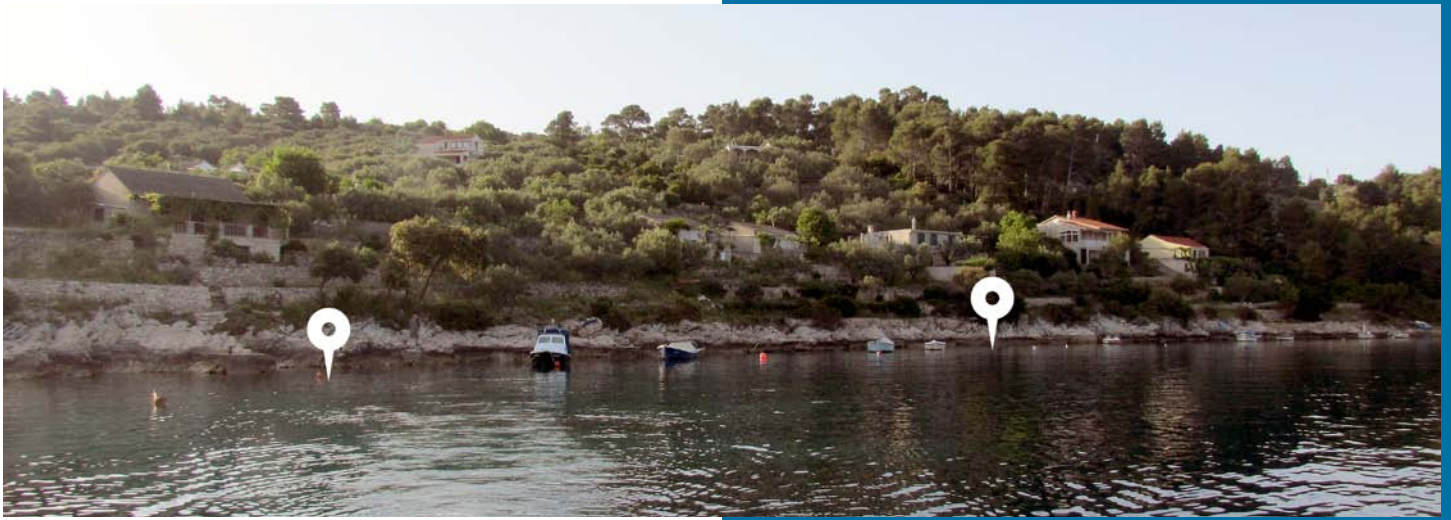
2001). Upravo zbog toga svaki je arheološki podatak iznimno vrijedan i služi što realnijem postavljanju sjevernokorčulanskog akvatorija u okvire povijesnih plovidbenih ruta ovim dijelom Jadrana. S tim ciljem je, razgovarajući s domicilnim stanovništvom te višekratnim rekognosciranjem pojedinih pozicija, autor redaka pristupio sakupljanju informacija o eventualnim nalazima iz podmorja navedenog prostora.

Među brojnim uvalama na sjeverozapadnom se kraju otoka Korčule svojim položajem, razvedenošću i relativnom pristupačnošću obale pozitivno ističe uvala Tankaraca, generalno gledano



2. Aerial photo of Tankaraca Cove indicating the site location

Zračni snimak uvale Tankaraca s označenom pozicijom lokaliteta (Geoportal)



3. The site position in Vela Tankaraca Cove

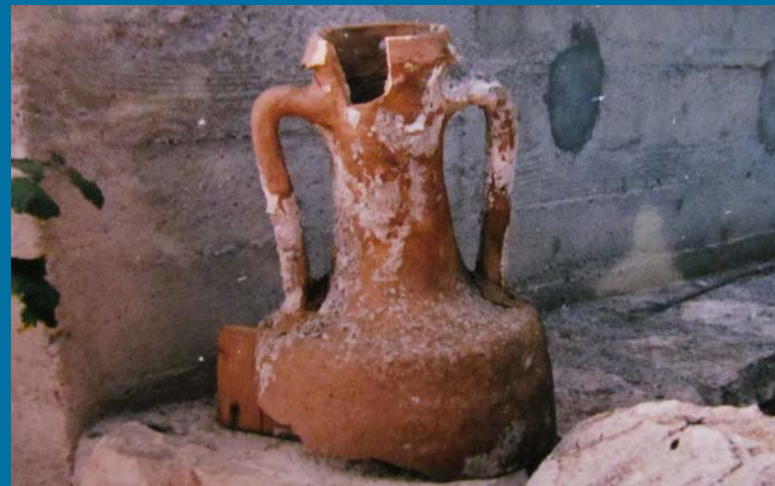
Pozicija lokaliteta u uvali Vela Tankaraca (photo I. Borzić)

sections: Podorsan and Mala Tankaraca as the extremities and Vela Tankaraca as the central and most interesting position. Although offering a broad approach directly facing north, the deep inland recess formed by this central section of the cove quite certainly contributed to its use as an anchorage, haven and overnight refuge from the Roman period to the present day, borne out above all by the underwater archaeological finds. Directly alongside its most protected eastern shore, namely, at a depth of from 2 to 5 metres, on a gentle slope about 5 metres wide and 60 metres long, one finds an unstratified, scattered and not overly large quantity of Roman, Medieval and Post-Medieval ceramic material mixed in among amorphous stones. With the exception of two small mounds of stone, there are no observable remains at the site itself of possible structures erected with the purpose of organising the space. The domicile population of the cove already knows of this location, and there are a number of amphorae sherds in private hands with which, along with the forms observed in the waters, one might assess their typology and the chronological determination of the site. It appears that the greatest number of

somewhat more complete amphorae are of the Late Republican Lamboglia 2 type, among which we can single out the early variants transitioning from Greco-Italic amphorae in the 2nd century BCE, and the classic, already developed forms of the late 2nd and 1st centuries BCE. Furthermore, from the mostly smaller diagnostic sherds, the presence of 1st century Dressel 2-4 type wine amphorae – whose provenance is difficult to ascertain – can be demonstrated, as can the presence of 2nd century northern Italic flat-bottomed amphorae of the Forlimpopoli type. Sherds of eastern Mediterranean Late Roman I amphorae, dated to the 5th to 6th century, bear witness to the use of the cove in the Late Roman period.

Registered at the site along with amphorae was a small quantity of other Roman pottery, for the most

podijeljena na tri manje cjeline, Podorsan i Mala Tankaraca kao krajnje i Vela Tankaraca kao središnja i ujedno najzanimljivija. Iako širokog pristupa otvorenog direktno na sjever, duboka uvučenost u kopno upravo tog središnjeg dijela uvale sasvim je sigurno pridonijela njegovom korištenju kao sidrišta, skloništa,

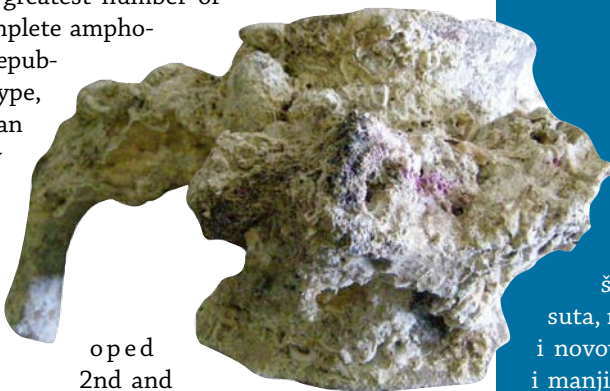


4. Amphorae of the Lamboglia 2 type from the waters of V. Tankaraca Cove

Amfora tipa Lamboglia 2 iz podmorja uvale V. Tankaraca (photo I. Borzić)

prenočišta još od antičkih vremena pa sve do danas, o čemu prije svega govore podmorski arheološki nalazi. Naime, neposredno uz njezinu najzaštićeniju istočnu obalu, na dubini od 2 do 5 m, na blagoj kosini u širini od 5 i dužini od 60-tak m prati se neuslojena razasuta, ne pretjerano velika količina antičkog srednjovjekovnog i novovjekovnog keramičkog materijala izmiješanog s većim i manjim amorfnim kamenjem. Na samom se položaju, osim dvije manje kamene gomile, ne uočavaju ostatci eventualnih konstrukcija rađenih u službi organizacije prostora.

Ova lokacija je među domicilnim stanovništvom uvale poznata još od ranije te se u privatnom vlasništvu nalazi nekoliko ulomaka amfora putem kojih se, uz uočene oblike u podmorju, može raspravljati o njihovoj tipologiji, ali i kronološkom određenju lokaliteta. Čini se da najveći broj nešto cjelovitijih amfora pripada kasnorepublikanskom tipu Lamboglia 2, među kojima se izdvajaju rane, iz grčko-italskih amfora prijelazne varijante 2. st. pr. Kr., te one klasične već razvijene forme s kraja 2. i 1. st. pr. Kr. Nadalje se,



5. Amphorae of the Late Roman I type from the waters of V. Tankaraca Cove

Amfora tipa Late Roman I iz podmorja uvale V. Tankaraca (photo I. Borzić)

part from the category of kitchenware pots and bowls for which, unfortunately, the high level of fragmentation precludes a determination of provenance and dating. Also registered was a small quantity of brickmaker's products, tegulae in particular.

Particularly interesting finds from the waters of Tankaraca Cove are several small blocks, by all account of the mineral mica – its role as an augments of the plasticity of clay mixtures and of the resistance of pottery to fluctuations in temperature has been a staple of the potter's trade from prehistoric times (Miletić 2008, 351). In this case it was evidently Roman period commercial merchandise, the origin of which only mineralogical analysis can determine.

The continuity of the use of the location is confirmed by a small quantity of Post Medieval ceramic and glass material, prominent among which is a fragment of a small square-shaped bottle, a glazed jug (invetriata) and sherds of 17th and 18th century kitchenware.

All of the cited finds, i.e. their quantity and character both in terms of use and level of preservation, speak in favour of the hypothesis that the position along the eastern shore of Vela Tankaraca Cove, and some other similar positions at which smaller quantities of Roman material have been recorded (the coves Žukova, Prihonja and Badnjena), were most likely used during the Roman period as a short-term anchorage, overnight haven or shelter during inclement weather. The possibility, for example, of linking the anchorage to a rural estate is slim, considering that an archaeological examination of the onshore part of the cove did not yield any results, and the fact that nearby villa rusticae are turned towards much and proximate harbours, one at Gradina

in particular the Cove in Vela Luka Bay which has been in use in continuity since prehistoric times (Borzić 2009, 82-97). The Post Medieval material in the cove can be explained in the same manner,

and one should not overlook the fact that the character of the shore is such that it allowed for the formation of a great number of limekilns, the builders of which (klakari) could thus have left traces of their presence.



6. The mineral mica from the waters of V. Tankaraca Cove

Mineral liskun iz podmorja uvale V. Tankaraca (photo I. Borzić)



7. A small glass bottle from the waters of V. Tankaraca Cove

Staklena boca iz podmorja uvale V. Tankaraca (photo I. Borzić)

prema uglavnom manjim dijagnostičkim ulomcima, može dokazati i prisutnost vinskih amfora tipa Dressel 2-4 teško odredive provenijencije iz 1. st., te sjevernoitalskih amfora ravnog dna tipa Forlimpopoli iz 2. st. Korištenje uvale i u kasnoantičkom razdoblju svjedoče ulomci istočnomediteranske amfore tipa Late Roman I datirane u 5./6. st.

Osim amfora, na lokalitetu je zabilježena i manja količina ostalog antičkog keramičkog materijala i to pretežito onog iz kategorije kuhinjskih lonaca i zdjela, kojima je nažalost, zbog velike fragmentiranosti nemoguće odrediti provenijenciju i dataciju. Također je zabilježena i manja količina ulomaka opekarških proizvoda, posebice tegula.

Posebno interesantne nalaze iz podmorja uvale Tankaraca čini nekoliko manjih blokova, prema svemu sudeći, minerala liskuna (tinjac, mica), čija se uloga povećavača plasticiteta glinene smjese i otpornosti keramike na temperaturne promjene u keramičarskom obrtu prati još od prapovijesnih vremena (Miletić 2008, 351). U ovom je slučaju očito bila riječ o antičkoj trgovačkoj robi čije će se izvorište moći precizno utvrditi tek mineraloškim analizama.

Kontinuitet korištenja lokacije potvrđen je i manjom količinom novovjekovnog keramičkog i staklenog materijala, među kojim se izdvajaju ulomak kvadratične bočice, glazirani vrč (invetriata) te ulomci kuhinjskog posuđa iz 17./18. st.

Svi navedeni nalazi, odnosno njihova količina i karakter, kako namjenski tako i onaj vezan uz njihovu sačuvanost, govori u prilog tome da je pozicija uz istočnu obalu uvale Vela Tankaraca, kao i još neke slične pozicije na kojima je evidentirana manja količina antičkog materijala (uvala Žukova, Prihonja i Badnjena), kroz antičko vrijeme najvjerojatnije bila korištena kao kratkotrajno sidrište, prenočište ili sklonište u slučaju nevremena. O nekim drugim mogućnostima, npr. vezivanju sidrišta uz eventualno postojanje ruralnog imanja, teško je govoriti jer arheološki pregled kopnenog dijela uvale nije urodio nikakvim plodom, a obližnje vile rustike u tom su smislu okrenute puno pogodnijim i bližim izlaznim lukama, posebice onoj u uvali Gradina u zaljevu Vele Luke koja bilježi kontinuitet iskorištavanja još od prapovijesnih vremena (Borzić 2009, 82-97). Novovjekovni materijal u uvali je moguće objasniti na isti način, ali ne treba zanemariti ni činjenicu da je karakter obale u uvali takav da je omogućio nastanak velikog broja vapnenica čiji su graditelji (tzv. klakari) i na ovaj način mogli ostaviti tragove svoje prisutnosti.

Bibliography / Literatura

- Borzić, I., 2009 - Uvala Gradina na otoku Korčuli u svjetlu podmorskih arheoloških nalaza in: L. Bekić (ed.) Jurišićev zbornik. Zbornik radova posvećenih uspomeni na Marija Jurišića, Zagreb, 82-97.
- Gjivoje, M. 1972 - Podmorski arheološki lokaliteti otoka Korčule, Zbornik otoka Korčule, 2, Zagreb, 148-157.
- Jurišić, M., 2001 - Podmorski arheološki lokaliteti otoka Korčule, Izdanja HAD-a, sv. 20, Zagreb, 189-196.
- Miletić, I., 2008 - The structure of ceramic materials, Opuscula archaeologica 31, Zagreb, 347-362.
- Radić Rossi, I., 2005 - Dosadašnji rezultati podmorskih arheoloških istraživanja u zapadnom dijelu otoka Korčule, Zbornik radova Blato do kraja 18. st., sv. 3, Blato, 49-63.
- Vrsalović, D., 1979 - Arheološka istraživanja u podmorju istočnog Jadrana, Zagreb.



MEĐUNARODNI
CENTAR ZA
PODVODNU
ARHEOLOGIJU
U ZADRU

INTERNATIONAL
CENTRE FOR
UNDERWATER
ARCHAEOLOGY
IN ZADAR



Under the auspices of
UNESCO

United Nations
Educational, Scientific and
Cultural Organization



Republika
Hrvatska
Ministarstvo
kulture
*Republic
of Croatia
Ministry
of Culture*

