Hercules Continues with Deep-Sea Survey of Croatian Waters

Hercules nastavlja s dubinskim pretraživanjem hrvatskog podmorja

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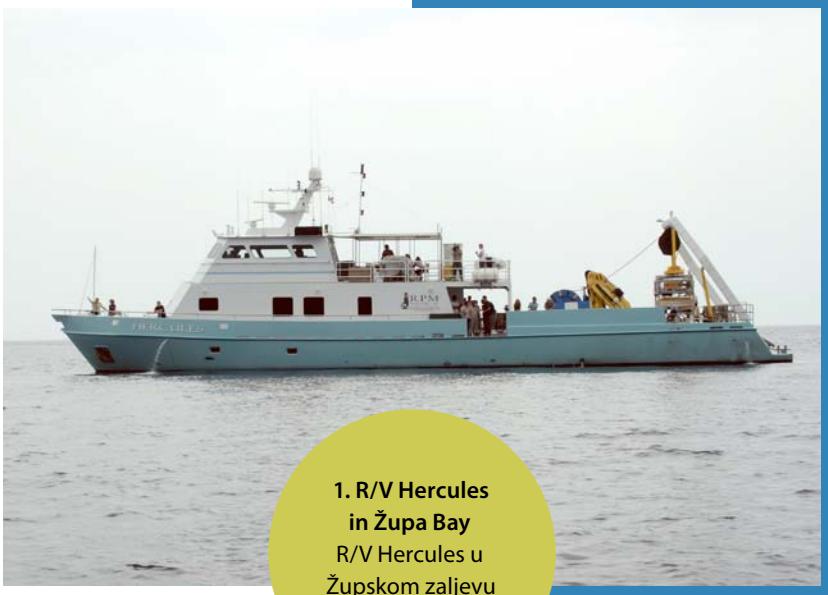
Staffers of the International Centre for Underwater Archaeology in Zadar again this year took part in the deep-sea survey of Croatian waters, assisted by the highly sophisticated and costly equipment of the research vessel (R/V) Hercules owned by the USA-based RPM Nautical Foundation.

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.



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

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 Fundation) 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 multibeama 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

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 multibeam 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.

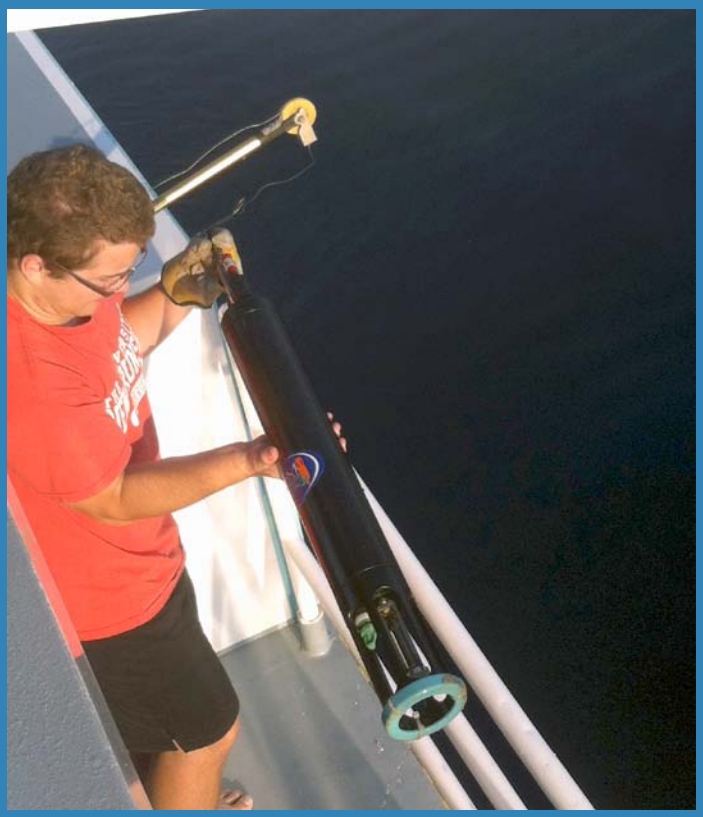
The ROV, part of the ship's equipment, was not deployed during this year's survey as it was decided to use only sonar this year

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)

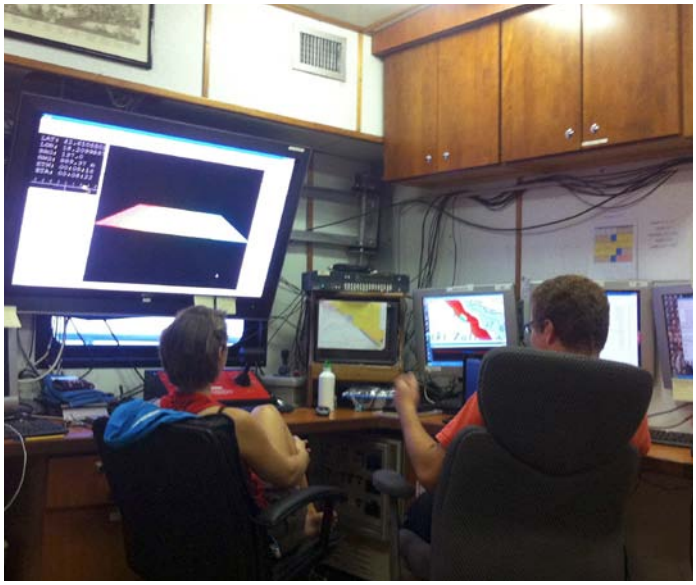
apsolutno svaki milimetar podmorja. Dnevno Hercules nekoliko puta zastaje na odabranim lokacijama kako bi se u more spustio uređaj koji bilježi parametre brzine zvuka, saliniteta mora itd zbog kalibracije uređaja.

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



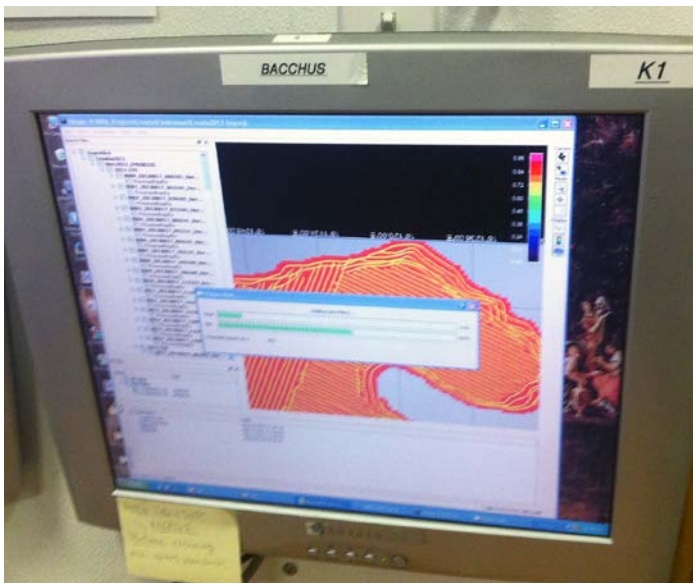
5. The sound velocity probe
Uređaj za mjerenje brzine zvuka (photo: M. Šimičić)



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 Maslać 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

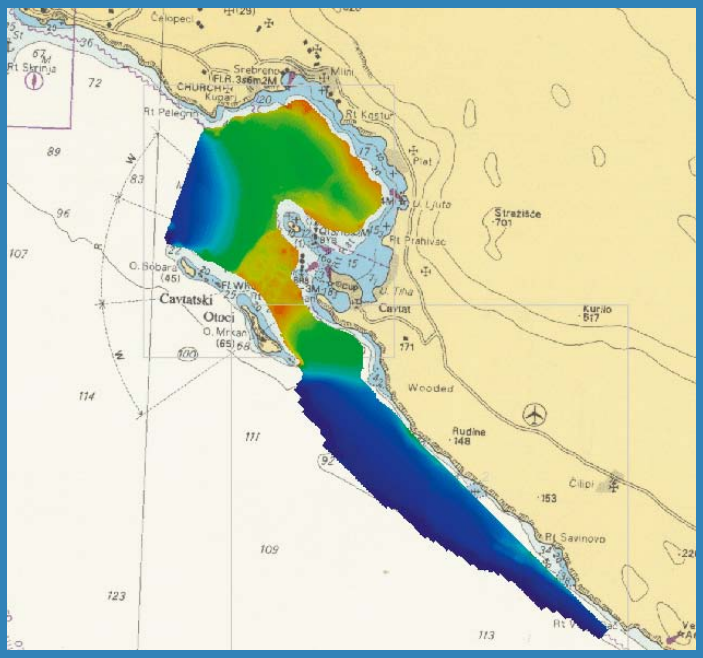


7. The processing of data from the scanning of the seafloor after the collection phase
Obrada podataka dobivenih skeniranjem dna nakon faze prikupljanja (photo: M. Šimičić)

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 slijedeće godine moglo posvetiti više vremena radu s robotom.

Ipak, pliće pozicije već ove godine su pregledavane roniocima, 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 Maslać 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.

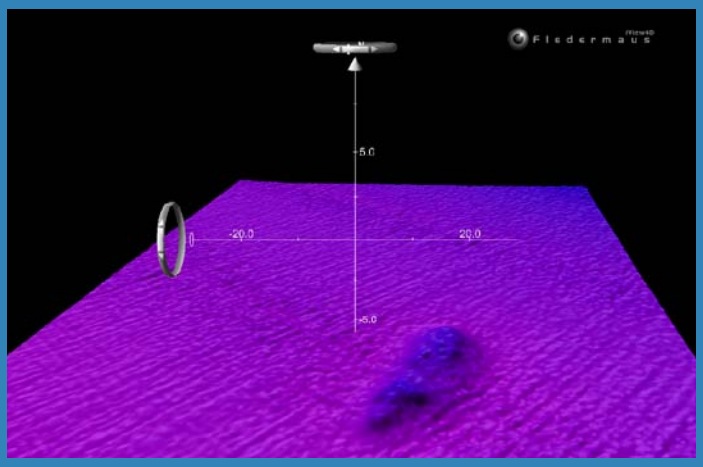
Prva anomalija uočena je na sredini Župskog zaljeva i dubini od oko 43 metra, a prema svojim karakteristikama nalikovala je na manji antički brod s amforama. Ova pozicija provjeravana je ronjenjem ali na njoj arheolozi nisu pronašli ništa. Zbog činjenice da je u moru tada bila jaka struja te je vidljivost 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 šiljatim 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 spušteno 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 collected 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.

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)

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
Ronioc 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 brodskog 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 ronioci 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 incrusted 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 a 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 višesnopnim 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)

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