Martin Lemke
George Nuţu
Marta Bajtler
Karolina Trusz

THE DANUBE UNDERWATER HERITAGE PROJECT — FIRST STEPS

Abstract: The overall idea of the Danube Underwater Heritage Project is to examine and assess archaeological remains at the bottom of the Danube River in its delta, the nearby Razim-Sinoe Lagoon, and selected places on the Romanian Black Sea coastline. An important issue is to evaluate the sediment in the river delta and the resulting limitations for underwater investigations.

Significant settlements appeared around the Black Sea during the period of Greek colonization. In the first century AD, army camps were built along the last stretch of the Danube between the Yantra tributary and the river delta, facilitating even more intense ship traffic and connecting the Greek cities operating as supply bases.

The first season of the non-invasive underwater project took place in September 2017, when various sites within the Danube Delta were verified, followed by a second campaign in 2019.

Key words: Danube Delta, underwater archaeology, Roman limes, army supply, Histria, Argamum

Introduction

The Danube Underwater Heritage Project was started in 2017 following a cooperation agreement between the Eco-Museum Research Institute "Gavrilă Simion" in Tulcea and the Centre for Research on the Antiquity of Southeastern Europe of the University of Warsaw. The overall idea is to examine and assess archaeological remains on the bottom of the Danube river in its delta as well as the nearby Lake Sinoe, Razim lagoon and selected spots on the Romanian Black Sea continental shelf [Fig. 1].

Finds from antiquity, the Roman period in particular, will be given preference, but any information regarding overall research conditions and preserved finds on the sea bottom are also considered valuable. Of prime importance at first is to evaluate the sediment in the river delta and the resulting limitations for underwater investigations.

The Danube Delta in the Roman period — a logistical crossroads

Significant settlements appeared around the Black Sea during the era of Greek colonization.[1] There is a well-grounded theory that in the first century Rome incorporated the area known today as Dobrudja for reasons of logistical security: the Danube was the most important communication

[1] Among these are the cities of Histria/Istros and Orgame/Argamum close to the Danube Delta. Cf. Matei Popescu 2014; Lemke *et alii* 2019.

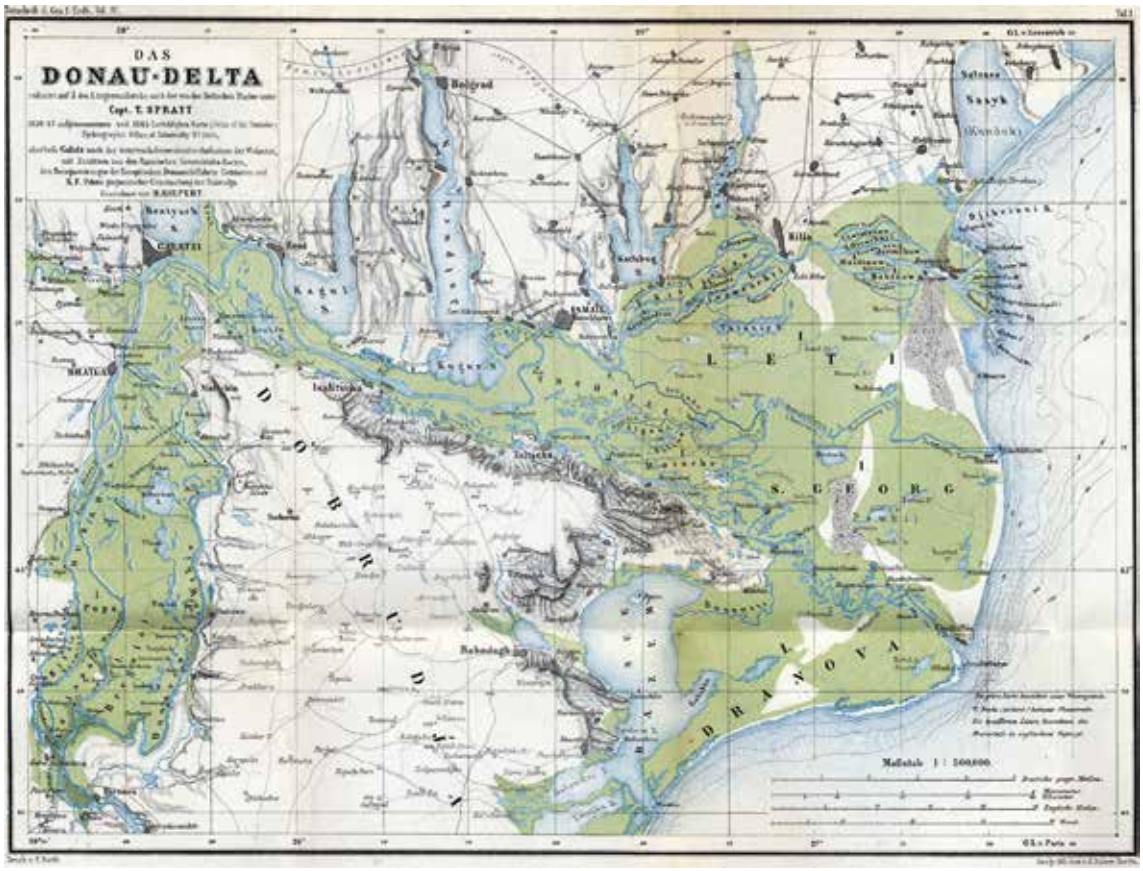

Fig. 1. The Danube Delta in 1867 (T. Spratt, from wikipedia.org)

and supply route for extant and emerging limes-outposts below the Iron Gates. It was crucial to control the entire length of the Lower Danube. As a result, more army camps were built along the last stretch of the Danube between the Jantra-tributary and the river delta, resulting in even more intense ship traffic and connecting the Greek cities that functioned as supply bases[2] [Fig. 2].

In spite of the risks involved, the Roman army preferred water transportation, because it was cheaper and quicker than movement overland and much more convenient for heavy loads.[3] The Romans regularly transported by ship grain, wine, olive oil, wood and stone, as well as bricks.[4] With the frontier of the Empire following the Rhine and Danube, many legionary camps were located there,[5] and in Moesia Inferior most of the goods were transported up and down the Balkan rivers.[6] While the fleet was supposed to patrol the limes and stop enemies from crossing the river (capturing their vessels should the need arise), its main task was delivering supplies to the camps.[7] Stamped legionary tiles from the cities on the Black Sea give proof of intensive transport of building material on ships, not only to but also from the army camps, in which bricks and tiles were produced.[8] The Danube was the ideal axis for the supply ships, connecting the big ports on the Black Sea with the limes sites.

[2] Lemke 2015.
[3] Aricescu 1980, p. 114; Roth 1999, pp. 190–191; Rickman 1980, p. 120; Livy 38.3.11. On Roman logistics overall: Lemke 2016.
[4] Casson 1965, p. 31; Sarnowski 1997, p. 498.
[5] Cf. Monfort 2002, p. 76.
[6] Bounegru 1997, pp. 311–313; Bounegru 2006, pp. 12, 101–104.
[7] Luttwak 1976, p. 78; Żyromski 1994, pp. 118–119; Bounegru, Zahariade 1996, p. 8; Kritzinger, Zimmermann 2019, p. 295, n. 60.
[8] Sarnowski 1988, p. 78.

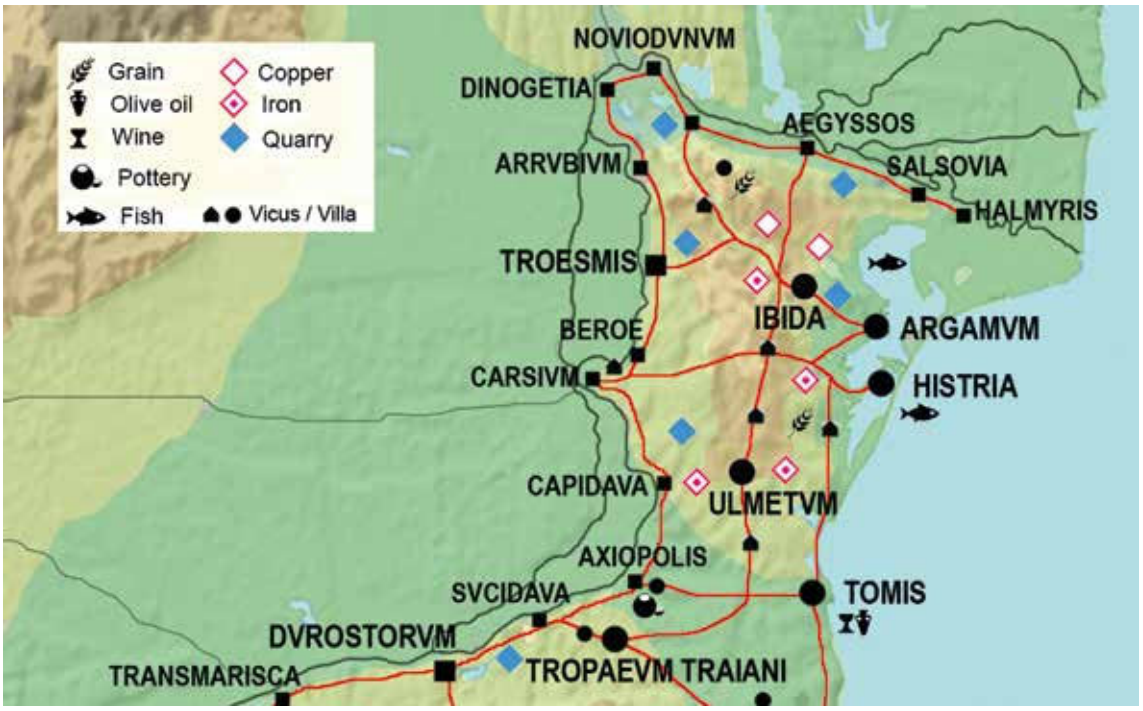

Fig. 2. The Danube Delta in Roman times (after Lemke 2017)

The Moesian fleet, operating since Claudius or Nero,[9] was reorganized by Vespasian after 69/70, receiving the name *Flavia*. Its main base was not too far from the delta, at Noviodunum,[10] the seat of the *praefectus classis*, where in second and third century a *vexillatio* of the *legio I Italica* was stationed.

State of underwater archaeological research in the region

"Only a handful of ancient ships, whether they lay under the open sea, in lakes or on land, had been studied prior to the post World War II spread of aqualung diving".[11] Anthony J. Parker's statement from over 30 years ago, still applied to the state of underwater archaeological research on the Romanian continental shelf, even though it had started in Romania more or less contemporaneously with this kind of research in Western Europe. In 1966, the Romanian Navy Captain-Lieutenant Constantin Scarlat and the engineer Vasile Cosma embarked on the investigation of a series of underwater structures: the ancient harbor of Tomis/Constanța, the "Genoese" pier, the submerged city-structures and the harbor of Callatis/Mangalia, as well as a number of ancient shipwrecks, badly damaged by sea bottom erosion.[12] The latter discoveries deserve special attention in view of the scarce information on their investigation.

The first ancient wreck (Mangalia A) was discovered in shallow water during dredging operations south of the present day harbor area of Mangalia (ancient Callatis). Its cargo consists of Hellenistic amphorae.[13] Continuous dredging of the modern harbor for the past 30 years and more

[9] Sarnowski 2006, p. 89; Eck, Pangerl 2006, p. 96.
[10] Aricescu 1980, p. 31; Matei-Popescu 2016.
[11] Parker 1986, p. 31.
[12] Scarlat 1973, pp. 537–539; Moşneagu 2006, p. 129; Moşneagu 2007, pp. 108–112. For the ancient harbor of Callatis, see Gramatopol 1966, pp. 383–385; Scarlat 1973, pp. 529–540; Bounegru 1986, pp. 267–272; Stanecka 2013, pp. 325–333.
[13] Cosma 1973a, pp. 51–54; Cosma 1973b, pp. 34–37, 55–64; Parker 1992, p. 93, no. 160.

has probably completely destroyed this wreck. The second shipwreck (Mangalia B), 35 m long and 6 m wide, seems to have been one of the most impressive ships of the third–second centuries BC.[14] Two piles of amphorae[15] clustering on the seabed, at depths of 8 to 10 m according to V. Cosma, marked the cargo of this Greek wreck. The ship had a hatch cover made of pan and cover tiles.[16]

Another possible ancient shipwreck was briefly mentioned without giving more details,[17] as were several other significant underwater finds. These include a wooden wreck, possibly Roman, from the area of Zătoane (south of the Sfântu Gheorghe distributary of the Danube), identified during dredging operations,[18] and some other submerged targets recently identified in the area of the ancient harbor of Tomis and optimistically associated with the remains of Roman shipwrecks.

The Sulina and Sfântu Gheorghe are two of the three distributaries in the Danube Delta flowing into the Black Sea [Fig. 3]. Information about potential archaeological remains in the Sulina River came from local fishermen and coastguard officers. Three late medieval / early modern wrecks, made of sheet metal-covered wood, were found earlier in the Bazinul Mare ("Great Basin", on the Sulina branch). In the Sfântu Gheorghe, there is at least one potential site of a Roman wreck. During the 1980s, an entirely preserved early Roman amphora of the Shelov C/SinIVC type (second century AD) was discovered during dredging operations[19] and in 2016 similar operations at the mouth of the distributary brought up a possible segment of an Ottoman merchantman of the late medieval period, which is now under conservation at The Eco-Museum Research Institute in Tulcea.[20]

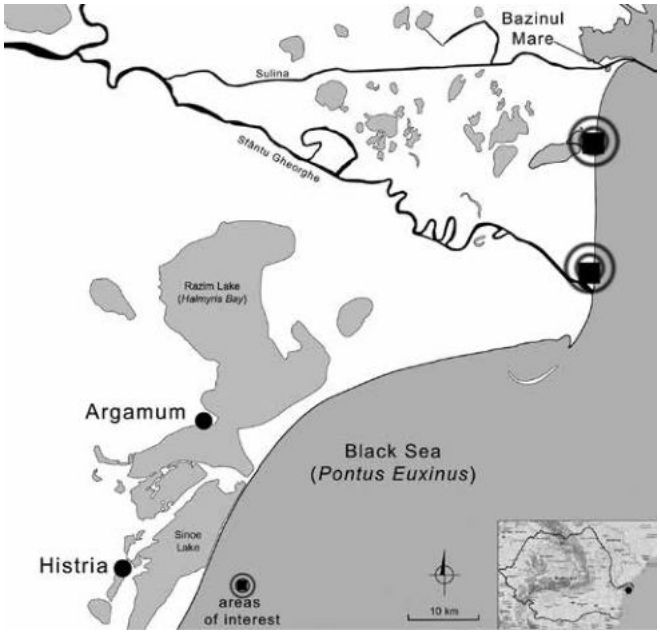

Fig. 3. The research area today (M. Bajtler)

[14] Cosma 1973a, pp. 54–58; Cosma 1973b, pp. 37–38; Scarlat 1973; Parker 1992, pp. 93–94, no. 161.

[15] According to Buzoianu 2013, pp. 295–296, the cargo of Mangalia B consisted of two types of amphorae: Heraclea Pontica, dated to the second half / third quarter of the fourth century BC and Rhodian amphorae from the first decades of the second century BC. It would make plausible the existence of two wrecks in this area instead of one "Mangalia B wreck".

[16] Munteanu, Vochițu 2010, pp. 407–412.

[17] Cosma 1973b; Scarlat 1973, pp. 537–539; Parker 1992, p. 943.

[18] Parker 1992, p. 457, no. 1247.

[19] Paraschiv 2006, p. 43, no. 12, pl. 2; Nuțu, Mihailescu-Bîrliba 2018, p. 90. A Greek amphora (from Chios) was discovered in 1967 during dredging operations in the mouth of the Sfântu Gheorghe and is now in the collection of the Museum in Tulcea (see Baumann 1973–1975, pp. 39–40, no. 26, pl. 5/4).

[20] Unpublished find.

Zmeinÿi Island (ancient Leuke) near the Chilia arm of the Danube Delta had drawn attention since the early nineteenth century with the remains of two presumed temples dedicated to Achilles.[21] Largely destroyed when the local lighthouse was built, the ancient remains were rather neglected despite their importance and the underwater heritage was barely mentioned. Some Greek-period amphorae, architectural elements, anchors and lead bars were discovered during several expeditions to the island, but no ancient shipwreck was ever reported.[22]

There have been no major changes in the development of underwater archaeology in Romania in the past decade, with the exception of some large side-scan sonar and marine magnetometer surveys prompted by the reshaping of coastal beaches south of the Romanian shoreline and a joint Romanian-Bulgarian project focusing on the development of underwater tourism in this area.[23] The most important discovery of recent years is the Portița A wreck, discovered in March 2016 during a trial survey undertaken by The Eco-Museum Research Institute in Tulcea together with The Bavarian Society for Underwater Archaeology from Kempten and the Ludwig Maximilian University of Munich.[24] This second-century-AD wreck sunk off Gura Portiței (the ancient entrance to Halmyris bay coming from the Black Sea, today known as the Razim-Sinoe-Golovița lagoon). The cargo was estimated to consist of over 1000 amphorae of the so-called "light clay narrow neck" type (Shelov C/SinIVC), most of them entirely preserved and arranged in six rows. This wreck is unique in the shallow waters of the Black Sea due to its outstandingly well-preserved hull with many of the planks, the mast and other wooden structure elements in pristine condition. At least eight frames rise out of the seabed and the mast has a diameter of 53 cm. Two trial trenches were made during two excavations seasons.[25]

In the last three years, large side-scan (L3 Klein Systems 3000, Hummingbird Helix 12 and DeepVision DE3468D) and cesium marine magnetometer (Geometrics G-882)[26] surveys off Gura Portiței led to identifying many targets, but only a handful were investigated by diving due to cost and time limitations. These surveys highlight the importance of underwater archaeology off Romania, an incipient stage of this discipline but also holding great scientific promise assuming long-term investment.

Methods and approach in the Danube Underwater Heritage Project

The underwater surveys have been divided into two stages. The first stage was the application of non-invasive methods of collecting data from the river- or seabed, the second stage comprised verification of selected anomalies by divers working in pairs. Intensive research of this type required the use of specialized equipment: side-scan sonar and sub-bottom profiler.[27] Acoustic devices used to create an image of the seabed provide two-dimensional images and bathymetric maps that help to find shallows of breakwaters and dams and potential wrecks or other objects.[28] The images and maps obtained in this way were analyzed and places for verification by divers were selected based on this data. Photographic and descriptive documentation of selected finds was made *in situ* during the underwater prospection. The collected data were mapped.

[21] Rusayeva 2003, pp. 1–16.
[22] Galata 2015, p. 56.
[23] http://www.herasprojectcbc.eu/. For a recent overview of the underwater discoveries in Romania, see Paraschiv-Talmaţchi, Custurea 2015–2016, pp. 243–247.
[24] Pflederer, Fiederling, Ahl 2016, pp. 5–6.
[25] Nuţu *et alii* 2017, pp. 56–58.
[26] Dimitriu *et alii* 2018, pp. 855–862.
[27] Maarleveld, Guérin, Egger 2013, pp. 104–105.
[28] Maarleveld, Guérin, Egger 2013, pp. 105–107.

The 2017 season

The first season of the non-invasive underwater project took place in September 2017.[29] Accordingly, various sites within the Danube Delta were verified. The prospection included Bazinul Mare (Sulina estuary), Lake Sinoe adjacent to ancient Histria and Lake Razim where ancient Argamum is located. Relevant areas were chosen after consulting archaeologists in charge of the excavations.

In the first case, we were dealing with a natural swamp, which was enlarged for the needs of large vessels on the Sulina. Bazinul Mare is a fairly shallow reservoir (maximum depth 9–10 m) and underwater visibility is very poor due to a direct connection with the river. Local interviews[30] indicated that the "Great Basin" had been created several decades ago, in an area which had been a shallow bay south of the Sulina estuary just a hundred years ago. According to Drăghicescu's vivid description, many ships failed to reach the entrance at the mouth of the distributary due to demanding navigational conditions; in 1850 "... the mouth of Sulina presented the sad sight of a forest of masts stuck in the sands and was sown with the hulls of foreign ships".[31] Construction works on the reservoir during the 1970s uncovered shipwrecks buried by the growing Danube Delta.[32]

The area was investigated with a sonar and sub-bottom profiler and selected places were verified by divers and documented wherever possible.[33] Five of the 21 anomalies recorded were identified as potential wrecks. Only three of these places could be verified owing to very low diving visibility [Fig. 4].

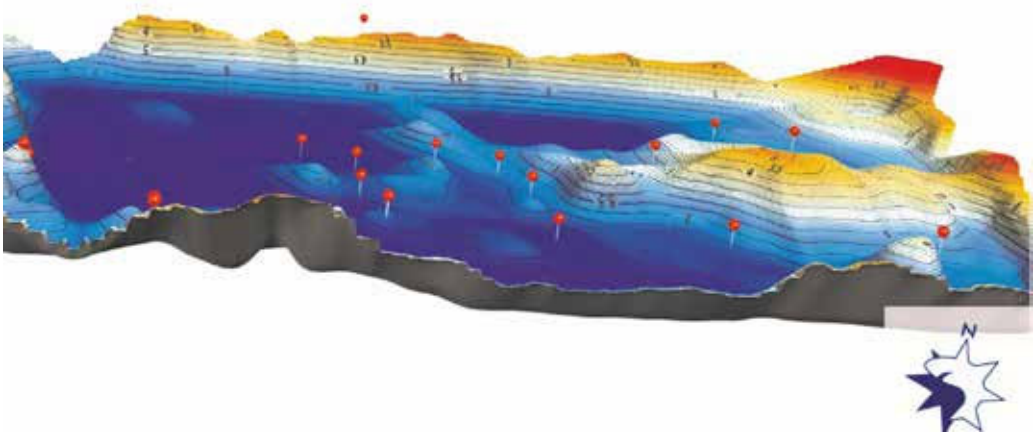

Fig. 4. Bathymetry of the "Bazinul Mare" with potential targets
(The Danube Underwater Heritage Project)

[29] The underwater prospection of the Sulina and Sfântu Gheorghe distributaries (Danube Delta) in Romania was carried out with financial support from the University of Warsaw Advisory Council for the Student Scientific Movement (sign. 10/II/2017) and a micro-grant awarded by the University of Warsaw. The project was carried out by members of SKN "Wod.o.Lot" in cooperation with Archcom Company. George Nuțu carried out his study under a grant from the Romanian Authority for Scientific Research and Innovation – CNCS – UEFISCDI, project number PN-III-P4-ID-PCE-2016-0852 (in PNCDI III).

[30] We are grateful to Mr. Gheorghe Comârzan (Sulina) for sharing with us his vast knowledge of local history.

[31] Drăghicescu 1943, p. 367. Nowadays there are two contemporary wrecks in the proximity of the Sulina estuary.

[32] Delta growth is not uniform throughout the area. The southern part of the Sulina deltaic lobe (south of the jetties) generally suffers from severe coastal erosion. Sedimentary growth occurs only on the first 5 km of coastline (Stanică, Dan, Ungureanu 2007, pp. 557, 562). For an overview of the evolution of the Sulina mouth bar, see Budileanu 2013, pp. 49–55.

[33] The first mentions of wooden wrecks in the Sulina's Bazinul Mare came from professional divers who carried out investigations in 2015 without contacting an archaeologist. Three wooden "ships" were located on May 20 with information from Mr. Gheorghe Comârzan (Roibu 2016, pp. 30–34; Dobre 2016, pp. 205–206).

The results are as follows:

Shipwreck Sulina A, the best preserved of the discovered wrecks. Located at a depth of 6 m, practically zero visibility. The stern is invisible, buried in sediments. The preserved length is about 30 m, a wooden hull with metal reinforcements. The frame is 25 cm wide, the thickness of the planks measures 5 cm [Fig. 5].

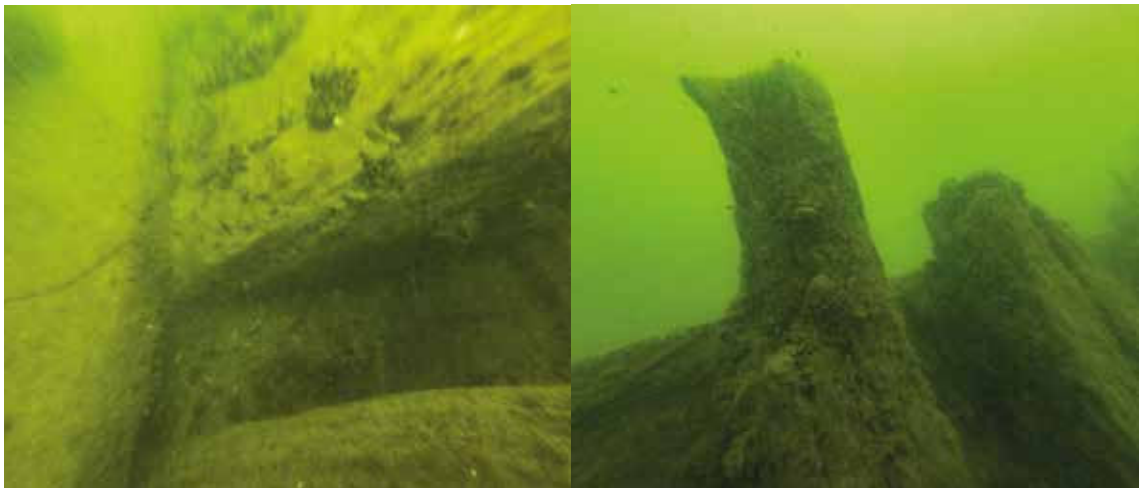

Fig. 5. Sulina A shipwreck: a) keelson, bilge futtocks, garboards and planking (left);
b) frames and planks (right)
(The Danube Underwater Heritage Project)

The wreck contained cannonballs and probably cannons. Numerous projectiles (diameter 30 cm) and a wooden wheel from a cannon were found. The cannons themselves could not be located because of poor visibility. A chain patented in 1810 was also discovered on the wreck, giving us a *terminus post quem* [Figs. 6 & 7].

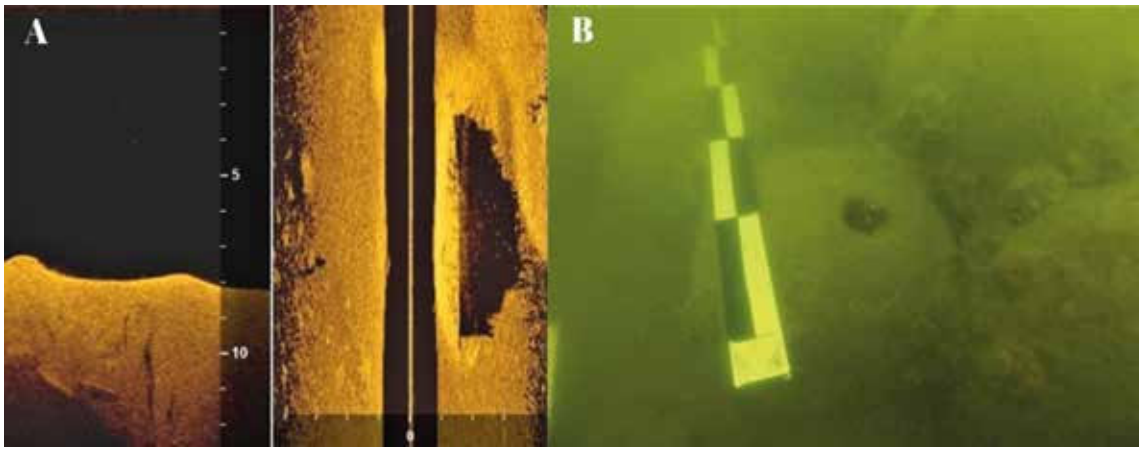

Fig. 6. Sulina A shipwreck: a) side-scan sonar view (left);
b) cluster of cannonballs in the hold of the wreck (right)
(The Danube Underwater Heritage Project)

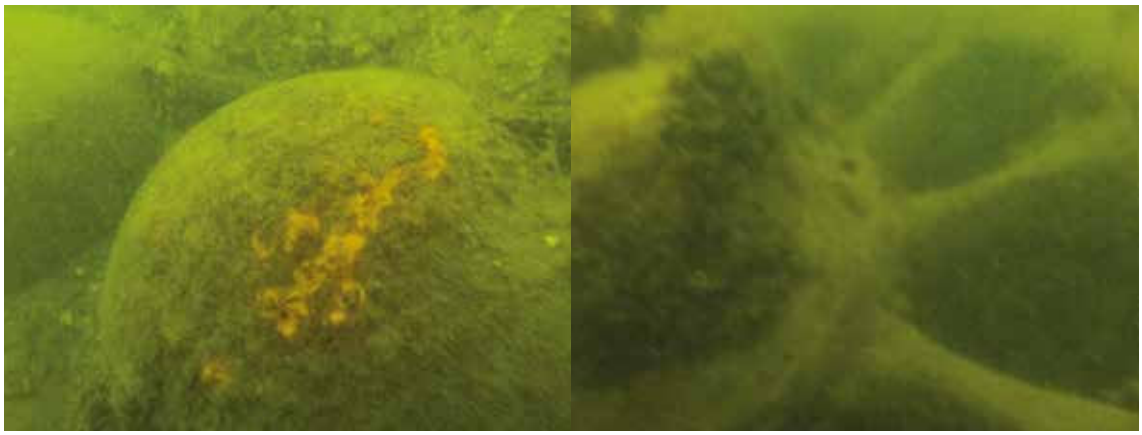

Fig. 7. Sulina A shipwreck:
a) details of cannonballs clustering in the hold of the wreck (left);
b) cannon-wheel (?) *in situ* (right)
(The Danube Underwater Heritage Project)

Shipwreck Sulina B, a wooden wreck at 8 m depth. With zero visibility all that could be done was to confirm the presence of a wooden unit.

Shipwreck Sulina C, a wreck at a depth of 6–7 m: wooden construction, reinforced with metal plates. Buried in the silt.

Prospection on the lakes was much more difficult. In both cases the reservoirs were shallow with zero visibility. Part of the archaeological site of Histria[34] is now underwater.[35] Reports mention walls observed in the lake at low water level. Local researchers believe that these might have been early Roman city walls. A stone structure, under a layer of silt, was measured with a mobile RTK measuring device, but further verification is needed [Fig. 8 a]. A photomosaic was also prepared of the whole site.

One theory has it that part of ancient Orgame/Argamum,[36] which was located on a high cliff, had collapsed into lake Razim during an earthquake. The area off Argamum towards the Bisericuţa islet was investigated with a sonar and bottom profiler [Fig. 8 b]. Selected anomalies will be re-visited during the next research season.

[34] We wish to thank Dr. Mircea Angelescu, Director of excavations at Histria, and Dr. Mircea Dabîca (Bucharest) for their hospitality and permission to undertake the research.

[35] For an overview of the archaeological work at the site, see: Bilde *et alii* 2007–2008, pp. 126–127. For the ancient harbor of Histria, see: Hockmann 1999, pp. 37–45; Hockmann 2001, pp. 169–175; Hockmann *et alii* 1997, pp. 209–217; Hockmann, Peschel, Woehl 1996–1998, pp. 55–102; Bounegru 2003, pp. 84–104; Dabîca 2010, pp. 381–392; Angelescu 2018, pp. 343–384.

[36] For an overview of the archaeological investigations at the site, see Bilde *et alii* 2007–2008, pp. 127–128. For the ancient harbor, see Bony *et alii* 2015, pp. 186–203.

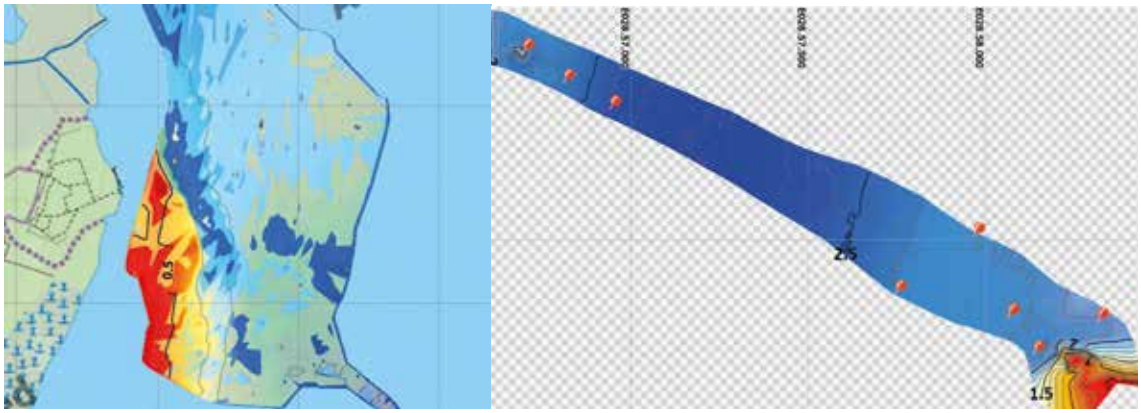

Fig. 8. a) Bathymetry of Histria (left);
b) Argamum towards Bisericuța islet (right)
(The Danube Underwater Heritage Project)

The 2019 season[37]

The coastal waters of the Black Sea between the Sulina and Sfântu Gheorghe distributaries were investigated in late August and early September 2019. The area was chosen on the grounds of finds of ancient ceramics dumped on the beach by the sea, something that occurred in significant quantities to the south of the Sulina estuary.

A beach survey and sonar work from a boat were conducted concurrently. The specificity of the Danube Delta (wetland with canals) enabled access to the designated area only by boat from the seaward side. Therefore, the survey group left the boat at some distance from the beach to check also the coastal waters, while the second group worked with the sonar at a safe distance from the shore.

The survey area covered a 6-km stretch of beach from about a kilometer north of the Gârla Impuţita Channel to a point 2.5 km south of the Sondei Channel. Ceramic sherds were found on the beach and in the shallow waters of the estuary. Oral testimony from residents indicated that the amount of pottery on the beach intensified after every storm and that the sherds included well-preserved diagnostic elements. The area covered by the boat survey was characterized by an irregular bottom and small depth (about 2 m). The sandy seabed without any vegetation favoured the formation of underwater shoals. These processes likely occurred very quickly, resulting in a continuous change of the seabed in the coastal zone.

The shallow reservoir caused the seabed mapping to be carried out at winds below 15 knots. Low waves did not interfere with reception of signals from the seabed. The non-invasive underwater surveys covered approximately 1319 hectares. Several shallow water areas reaching 0.5 m were recorded, 500–600 m from the shoreline; the maximum depth was 4 m.

Sites for exploration in the coastal zone were selected based on finds of ancient ceramics and metal artifacts, including anchor fragments. The finds were located on sand patches with a densely grassed bottom at a depth of approximately 0.5–0.7 m. These were documented photographically and mapped. Places selected based on sonar images were checked. Currents at such low water levels cause the rise of marine sediments, making full observation underwater difficult. The large

[37] With the financial support of the Polish National Science Centre, grant no. 2018/02/X/HS3/01745.

thickness of organic bottom sediments excluded any chances for the discovery of clear wreck structures or sediment. A bathymetric plan of the verified part of the Black Sea was prepared [Fig. 9].

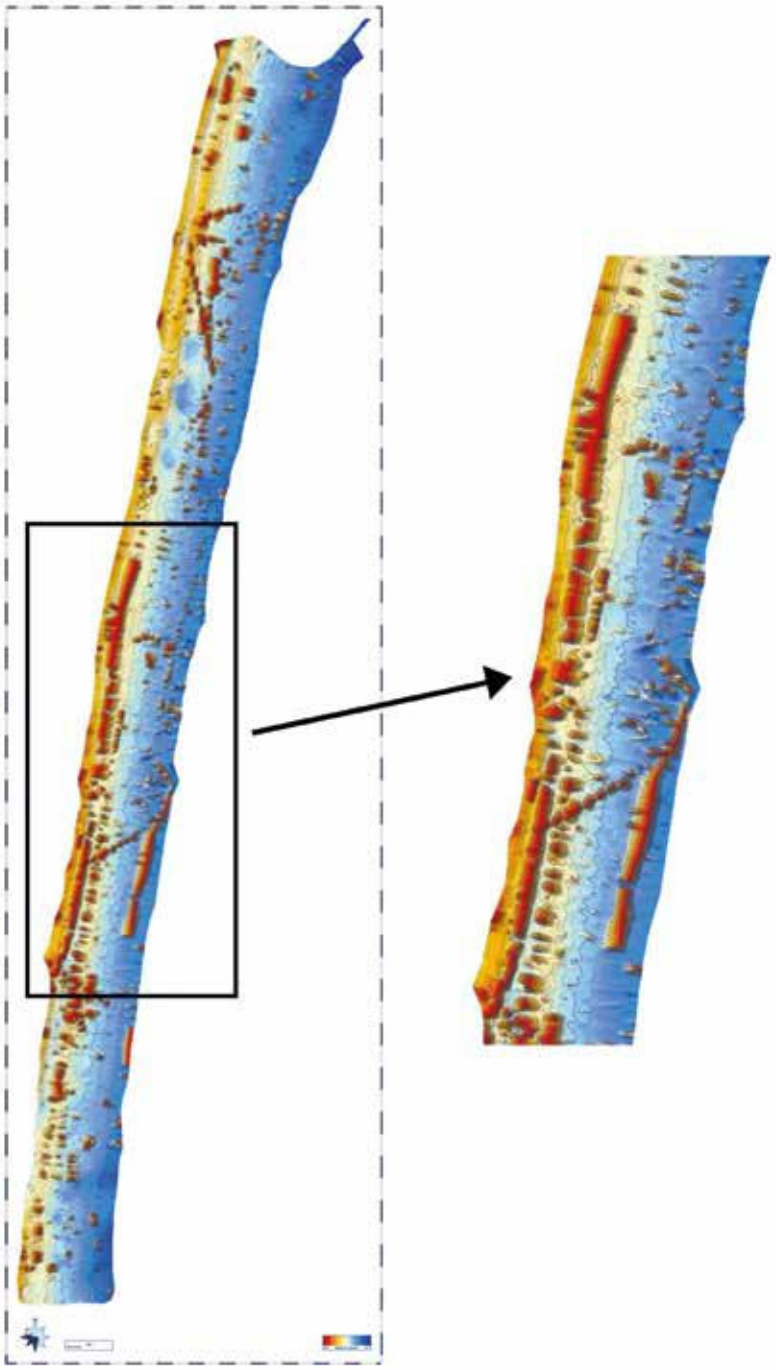

Fig. 9. Bathymetric plan of the Black Sea area verified during the 2019 campaign (The Danube Underwater Heritage Project)

The beach prospection yielded mainly amphora fragments [Fig. 10], most of them quite heavily encrusted.

Fig. 10. Small finds and pottery documented during the 2019 campaign
(The Danube Underwater Heritage Project)

Diagnostic elements were collected for typological identification. A preliminary look at the material, the study of which is in progress, indicated a predominance of amphorae of the Shelov C type.

Towards the future

Not much is known about the maritime activity and coastal settlement in the Danube Delta. The area continues to change dynamically, continuously growing because of sediments deposited by rivers and at the same time reduced by sea currents in certain parts of the delta. Current knowledge is that south of the Sulina River the land is steadily declining,[38] which is why the sea can destroy archaeological sites, causing irreversible losses. The program will enable the discovery and full documentation of underwater finds, contributing to a broader knowledge of this particular area and helping to ascertain whether settlement in antiquity was multiphase or seasonal.

[38] In the southern stretches of the Sulina, the coastline has retreated by around 10–12 km: Stănică, Dan, Ungureanu 2007, p. 557, fig. 2.

Non-invasive research coupled with systematic underwater investigations in the Danube Delta is a first in this region.[39] Moreover, the Romanian continental shelf (Tulcea county) has not been surveyed on a large scale in the past three years, not to mention regular underwater excavation, with the exception of an area of about 15 km^2 investigated by side-scan sonar in the Gura Portiței area. In fact, such research is virtually nonexistent in Romania, with the prominent exception of the Portița A joint project. Thus, the development of an effective survey method will provide an opportunity to extend the activities to the whole coastline of Romania and to document wrecks or submerged settlement points.

A systematic and comprehensive survey along Romania's Black Sea coast is foreseen as a future project. It will make it possible to reconstruct the course of the ancient coastline with settlements and sea routes used by ships transporting, among others, supplies for the legionary camps on the Danube. It will also assess the viability of underwater archaeology projects on a larger scale.

Bibliography

Angelescu 2018 — M. Angelescu, "Histria. Quelques notes sur le port antique", [in:] *Koinè et mobilité artisanale entre la Méditerranée et la Mer Noire dans l'Antiquité*, ed. A. Avram, L. Buzoianu, V. Lungu (= *Pontica* 51, Supplementum 5, Festschrift P. Dupont), Constanța, pp. 343–384.

Aricescu 1980 — A. Aricescu, *The Army in Roman Dobrudja*, Oxford.

Baumann 1973–1975 — V. H. Baumann, "Considerații asupra importului de amfore grecești în nordul Dobrogei", *Peuce* 4, pp. 29–47.

Bilde *et alii* 2007–2008 — P. G. Bilde, B. Bøgh, S. Handberg, J. M. Højte, J. Nieling, T. Smekalova, V. Stolba, A. Baralis, I. Bîrzescu, D. Gergova, V. V. Krapivina, K. Krusteff, V. Lungu, A. A. Maslennikov, "Archaeology in the Black Sea region in Classical Antiquity 1993–2007", *Archaeological Reports* 54, pp. 115–173.

Bony *et alii* 2015 — G. Bony, Ch. Morhange, N. Marriner, A. Baralis, D. Kaniewski, I. Rossignol, V. Lungu, "History and influence of the Danube delta lobes on the evolution of the ancient harbour of Orgame (Dobrogea, Romania)", *Journal of Archaeological Science* 62, pp. 186–203.

Bounegru 1986 — O. Bounegru, "Considerații privind portul cetații Callatis în antichitate", *Pontica* 19, pp. 267–272.

Bounegru 1997 — O. Bounegru, "Considérations concernant le transport des marchandises et le revitaillement de l'armée sur le limes du Bas-Danube", [in:] *Proceedings of the 16th International Congress of Roman Frontier Studies*, ed. W. Groenman-Van Waateringe *et alii*, Oxford, pp. 311–313.

Bounegru 2003 — O. Bounegru, "Portul Histriei în antichitate", [in:] O. Bounegru, *Economie și societate în spațiul ponto-egeean (secolele II a.Chr. – III p.Chr.)*, Iași, pp. 84–104.

Bounegru 2006 — O. Bounegru, *Trafiquants et navigateurs sur le Bas Danube et dans le Pont Gauche à l'époque romaine*, Wiesbaden.

Bounegru, Zahariade 1996 — O. Bounegru, M. Zahariade, *Les force navales du Bas Danube et de la Mer Noire aux I^{er}–VI^{e} siècles* (= *Colloquia Pontica* 2), Oxford.

Budileanu 2013 — M. Budileanu, "Evolution of Sulina mouth bar (Danube river)", *Revista de geomorfologie* 15, pp. 49–55.

Buzoianu 2013 — L. Buzoianu, "Decouvertes sous-marines de la zone du littoral roumain de la Mer Noire", [in:] *PATABS III. Production et commerce amphorique*

[39] In the spring of 2016, the Romanian-German team carried out a brief side-scan sonar survey off Capul Dolojman (Orgame/Argamum) towards Bisericuța islet without results. See also Lemke *et alii* 2019.

en Mer Noire. Actes de la Table Ronde internationale de Constanța, 6–10 octobre 2009, ed. L. Buzoianu, P. Dupont, V. Lungu, Constanța, pp. 287–304.

Casson 1965 — L. Casson, "Harbour and river boats of ancient Rome", *Journal of Roman Studies* 55, pp. 31–39.

Cosma 1973a — V. Cosma, "Amphoras from Callatis (Romania)", *International Journal of Nautical Archaeology* 2, pp. 51–58.

Cosma 1973b — V. Cosma, "Prospectări arheologice submarine", *Buletinul Monumentelor Istorice* 42/1, pp. 31–38.

Dabîca 2010 — M. Dabîca, "Hypotheses for the location of the harbour at Istros", [in:] *Antiquitas Istro-Pontica. Mélanges d'archéologie et d'histoire ancienne offerts à Alexandru Suceveanu*, ed. M. V. Angelescu, I. Achim, A. Bâltâc, V. Rusu Bolindeț, V. Bottez, Cluj-Napoca, pp. 381–392.

Dimitriu *et alii* 2018 — R. G. Dimitriu, G. Nuțu, A. Popa, M.-B. Barbu, "High resolution geophysics off Danube Delta's shore line for the evaluation of its cultural heritage load. Case study: the mouth of New Dunavat paleodistributary", [in:] *18th International Multidisciplinary Scientific Geoconference SGEM 2018. Conference Proceedings Volume 18. Science and Technology in Geology, Exploration and Mining 1.1. Geology, Applied and Environmental Geo-physics, Proceedings of the Conference held in Albena 2 July – 8 July 2018*, Albena, pp. 855–862 (doi.org/10.5593/sgem2018/1.1).

Dobre 2016 — L. Dobre, "Arheologia subacvatică. Epave din lemn descoperite în România în perioada 1989–2015", [in:] *Tendințe și curente în protecția patrimoniului arheologic în România și Republica Moldova*, ed. S. Mustață, Chișinău – Iași, pp. 191–209.

Drăghicescu 1943 — M. Drăghicescu, *Istoricul principalelor puncte pe Dunăre de la Gura Tisei până la Mare și pe coastele Mării de la Varna la Odesa*, Bucharest.

Eck, Pangerl 2006 — W. Eck, A. Pangerl, "Neue Diplome für die Auxiliartruppen in den mösischen Provinzen von Vespasian bis Hadrian", *Dacia* NS 50, pp. 93–108.

Galata 2015 — S. Galata, *Underwater Archaeology and Black Sea Region*, International Hellenic University, unpublished dissertation (https://repository.ihu.edu.gr//xmlui/handle/11544/14526, accessed on 10th December 2018).

Gramatopol 1966 — M. Gramatopol, "Un port comercial la Callatis", *Revista Muzeelor* 3/4, pp. 383–385.

Hockmann 1999 — O. Hockmann, "Der antike Hafen von Histria", *Skyllis* 2/1, pp. 37–45.

Hockmann 2001 — O. Hockmann, "Harbour investigations at Histria", [in:] *Studia archaeologica et historica Nicolao Gudea dicata*, ed. C. Cosma, D. Tamba, Zalău, pp. 169–175.

Hockmann *et alii* 1997 — O. Hockmann, O. Muller, G. Peschel, A. Woehl, "Histria an der Kuste des Schwarzen Meers. Prospektionsarbeiten im antiken Stadtgebiet", *Antike Welt* 28, pp. 209–217.

Hockman, Peschel, Woehl 1996–1998 — O. Hockman, G. Peschel, A. Woehl, "Zur Lage des Hafens vom Histria. Die Prospektionskampagne von 1996", *Dacia* NS 40–42, pp. 55–102.

Kritzinger, Zimmermann 2019 — P. Kritzinger, K. Zimmermann, "Die Heeresversorgung des 4. Jahrhunderts im Spiegel von Historiographie und Sphragistik", [in:] *Aspetti di tarda Antichità. Storici, storia e documenti del IV secolo d.C.*, ed. T. Gnoli, Bologna, pp. 279–316.

Lemke 2015 — M. Lemke, "Towards a military geography of Moesia Inferior", [in:] *Limes XXII. Proceedings of the 22nd International Congress of Roman Frontier Studies, Ruse, Bulgaria, September 2012*, ed. L. Vagalinski, N. Sharankov, Sofia, pp. 845–852.

Lemke 2016 — M. Lemke, "Danube, limes & logistics. Some thoughts on Roman army supply chains in Moesia Inferior", *Novensia* 27, pp. 9–38.

Lemke *et alii* 2019 — M. Lemke, M. Bajtler, K. Trusz, "Naval supply lines for the Roman army in Moesia Inferior — Basic considerations for the Danube Underwater Heritage Project", [in:] *Archaeology: Just Add Water*, vol. II, ed. A. Chołuj, M. Mileszczyk, M. Nowakowska (= *"Światowit" Supplement Series U: Underwater Archaeology* 2), Warsaw, pp. 39–58.

Luttwak 1976 — E. Luttwak, *The Grand Strategy of the Roman Empire*, London.

Maarleveld, Guérin, Egger 2013 — T. J. Maarleveld, U. Guérin, B. Egger, *Manual for Activities Directed at Underwater Cultural Heritage. A Guide on the Rules Annexed to the UNESCO 2001 Convention on the Protection of the Underwater Cultural Heritage*, Paris.

Matei-Popescu 2014 — F. Matei-Popescu, "The western Pontic Greek cities and the Roman army", [in:] *Die Außenbeziehungen pontischer und kleinasiatischer Städte in hellenistischer und römischer Zeit*, ed. V. Cojocaru, C. Schuler, Stuttgart, pp. 173–208.

Matei-Popescu 2016 — F. Matei-Popescu, "Vicus Nov(iodunum) and vicus classicorum: On the origins of the municipium Noviodunum", *Ancient West & East* 15, pp. 217–226.

Monfort 2002 — C. Monfort, "The Roman military supply during the Principate. Transportation and staples", [in:] *The Roman Army and the Economy*, ed. P. Erdkamp, Amsterdam, pp. 70–87.

Moşneagu 2006 — M. Moşneagu, "Arheologia submarină. O prioritate şi o atracţie pentru Muzeul Marinei Române", *Anuarul Muzeului Marinei Române* 9, pp. 125–143.

Moşneagu 2007 — M. Moşneagu, "Momente din evoluţia arheologiei submarine româneşti", *Anuarul Muzeului Marinei Române* 10, pp. 103–122.

Munteanu, Vochiţu 2010 — C. Munteanu, A. Vochiţu, "Roof tiles from the ancient Greek shipwreck 'Mangalia B', Black Sea coast, Romania", *International Journal of Nautical Archaeology* 39/2, pp. 407–412.

Nuţu *et alii* 2017 — G. Nuţu, B. I. Päffgen, T. Pflederer, M. Fiederling, M. Ahl, "Epava Rusu. Platforma continentala a litoralului românesc al Marii Negre, între Golful Musura la nord şi zona situata la sud de Gura Portiţei, jud. Tulcea. Punct: Epava Rusu", *Cronica cercetarilor arheologice din România. Campania 2016*, Bucharest, pp. 56–58.

Nuţu, Mihailescu-Bîrliba 2018 — G. Nuţu, L. Mihailescu-Bîrliba, "Roman pottery in the countryside of Dobruja. Topolog as case study", *Studia Antiqua et Archaeologica* 14/1, pp. 83–104.

Paraschiv 2006 — D. Paraschiv, *Amfore romane şi romano-bizantine în zona Dunării de Jos (sec. I–VII p.Chr.)*, Iaşi.

Paraschiv-Talmaţchi, Custurea 2015–2016 — C. Paraschiv-Talmaţchi, G. Custurea, "Nouvelles données sur les découvertes sous-aquatiques du litoral roumain", *Pontica* 48–49, pp. 241–279.

Parker 1986 — A. J. Parker, "The evidence provided by shipwrecks for the ancient economy", *Thracia Pontica* 3, pp. 30–45.

Parker 1992 — A. J. Parker, *Ancient Shipwrecks of the Mediterranean & the Roman Provinces* (= *British Archaeological Reports. International Series* 580), Oxford.

Pflederer, Fiederling, Ahl 2016 — T. Pflederer, M. Fiederling, M. Ahl, "Schwarzes Meer, Rumänien. Das römerzeitliche Wrack 'Rusu'", *Jahresbericht der Bayerischen Gesellschaft für Unterwasserarchäologie e. V.* 17, pp. 5–6.

Rickman 1980 — G. Rickman, *The Corn Supply of Ancient Rome*, Oxford.

Roibu 2016 — P. Roibu, *Vremea căutărilor. Jurnalul unui scafandru*, Constanţa.

Roth 1999 — J. Roth, *The Logistics of the Roman Army at War (264 B.C. – A.D. 235)*, Leiden – Boston – Cologne.

Rusayeva 2003 — A. S. Rusayeva, "The temple of Achilles on the Island of Leuke in the Black Sea", *Ancient Civilizations from Scythia to Siberia* 9/1–2, pp. 1–16.

Sarnowski 1988 — T. Sarnowski, *Wojsko rzymskie w Mezji Dolnej i na północnym wybrzeżu Morza Czarnego* [The Roman army in Lower Moesia and on the northern Black Sea littoral] (= *Novensia* 3), Warsaw.

Sarnowski 1997 — T. Sarnowski, "Legionsziegel an militärischen und zivilen Bauplatzen der Prinzipatszeit in Niedermösien", [in:] *Proceedings of the 16th International Congress of Roman Frontier Studies*, ed. W. Groenman-Van Waateringe *et alii*, Oxford, pp. 497–501.

Sarnowski 2006 — T. Sarnowski, "Ti. Plautius Silvanus, Tauric Chersonesos and *classis Moesica*", *Dacia* NS 50, pp. 85–90.

Scarlat 1973 — C. Scarlat, "Portul antic Callatis. Cercetări de arheologie submarină", *Acta Musei Napocensis* 10, pp. 529–540.

Stanecka 2013 — E. Stanecka, "Callatis as a seaport", *Studies in Ancient Art and Civilisation* 17, pp. 325–333.

Stanică, Dan, Ungureanu 2007 — A. Stanică, S. Dan, V. G. Ungureanu, "Coastal changes at the Sulina mouth of the Danube River as a result of human activities", *Marine Pollution Bulletin* 55, pp. 555–563.

Żyromski 1994 — M. Żyromski, "Dowódcy floty mezyjskiej w okresie pryncypatu" [Commanders of the Moesian fleet during the Principate], [in:] *Studia Moesica*, ed. L. Mrozewicz, K. Ilski, Poznań, pp. 117–128.

Martin Lemke
ORCID: 0000-0002-1213-5426
University of Warsaw
Center for Research on the Antiquity
of Southeastern Europe
m.lemke@uw.edu.pl

George Nuţu
ORCID: 0000-0002-6418-6364
Institutul de Cercetări Eco-Muzeale
"Gavrilă Simion"
Tulcea, România
nutugrg@yahoo.com

Marta Bajtler
ORCID: 0000-0003-0127-0590
Polish Academy of Sciences
Institute of Mediterranean and Oriental Cultures
mbajtler@wp.pl

Karolina Trusz
ORCID: 0000-0002-5812-1126
University of Warsaw
Institute of Archaeology
k.trusz2@uw.edu.pl