

**Denis Averdung**

### **Chair meets ship - Wood Connection Techniques in Comparison**

Wood was one of the most important materials in antiquity. Houses, carts, tools and all different kind of things were partly or in general made of it. Wooden objects seldom survived till modern times. This paper is concerned to compare connection, techniques in shipbuilding

furniturebuilding and cartbuilding in the Mediterranean from Bronze Age to Iron Age. The consideration is, if the techniques for very different objects give some answers for the transition from sewn boats to ships with mortise and tenon joints.

**Luka Bekić and Roman Scholz**

### **Fotobasierte Dokumentationsmethoden in der limnischen und maritimen Archäologie, A Case Study of a Shipwreck off Veruda Island**

Eine neuere Methode wird unter dem Begriff Structure from Motion (SFM) zusammengefasst und findet in den letzten Jahren zunehmend seinen Weg in die Bodendenkmalpflege. Dieses, allein auf Bilddaten gestützte, Aufnahmeverfahren ermöglicht eine relativ problemlose Erzeugung von 3D-Modellen, mit denen anschließend sehr genaue Zeichnungen und Videoanimationen erstellt werden können. Erste Tests in der Praxis haben gezeigt, dass diese Methode auch unter Wasser einsetzbar ist. Structure from Motion wird in Zukunft zu einer enormen Verbesserung der Forschungsarbeiten im Unterwassersektor beitragen, da damit gerade komplexe, dreidimensionale Objekte gut zu erfassen sind.

Darüber hinaus bietet die Methode auch für Fundplätze in großer Tiefe, die für den Forschungstaucher nur kurze Arbeitszeiten zulassen, erstmals eine zufrieden stellende Lösung. Die Qualität dieser Daten zeigt, das SFM grundsätzlich auch unter Wasser eingesetzt werden kann. Das Potenzial auch für andere Anwendungen, z.B. dem Überwachen von Veränderungen an Unterwasserbauten, kann nicht groß genug eingeschätzt werden. Mit Hilfe der besseren Aufnahme der in situ Situation des Objektes ist es nun möglich, selbst komplexe Situationen für die weitere Bearbeitung zu dokumentieren.

Das International Centre for Underwater Archaeology in Zadar, die Römisch-Germanische Kommission in Frankfurt a. M. und die Hochschule für Technik und Wirtschaft Dresden arbeiten derzeit an einem Projekt (The Analysis of Modern

Documentation Methods: A Case Study of a Shipwreck off Veruda Island) zur Weiterentwicklung der SFM-Methode. Im Rahmen erster Voruntersuchungen wurden Testdaten, die bei Taucharbeiten im Mittelmeer und der Ostsee gewonnen wurden, mit zwei SFM-Programmen gerechnet. Sowohl die kommerzielle Software aSPECT 3D der Firma ArcTron, als auch die kostenlose Programmlösung VisualSFM lieferte verwendbare Ergebnisse. Wie zu erwarten war, ist die Erzeugung brauchbarer Bilddaten bei schlechten Sichtverhältnissen in der Ostsee (Sicht unter 1,5 Meter) eine große Herausforderung. Es zeigt sich, dass im Vergleich zum Mittelmeer mit Sichtweiten weit über 5 Metern, eine größere Anzahl an Bildern für die Erstellung eines Modells in der Ostsee benötigt werden. Da dies die Arbeitszeit für den Fotografen unter Wasser deutlich erhöht, wird im Rahmen dieses Projektes auch die Verwendung von Videodaten getestet und für den Unterwassereinsatz angepasst.

Im Vergleich zu bislang üblichen Dokumentationsmethoden sind die gerechneten Modelle um einiges genauer. Im Rahmen dieses Beitrages werden die derzeitigen Erfahrungen und Ergebnisse dieser Forschungsarbeit und der weitere Projektplan vorgestellt. Dabei wird auch auf eine optimierte Datengewinnung bei Tauchgängen und die zu verwendende Ausrüstung eingegangen. Da gerade diese Faktoren entscheidend für die Qualität der Modelle sind, wird diesem Aspekt in der weiteren Untersuchung eine wichtige Bedeutung beigemessen.

**Mike Belasus et. al.**

### **Between North Sea and Norwegian Sea – Interdisciplinary Studies on the trade of the Hanse in the North Atlantic**

The German Leibniz Association founds the Project “Between the North Sea and the Norwegian Sea-Interdisciplinary studies on the trade of the Hanse in the North Atlantic”. It started in February 2015 at the German Maritime Museum and will last for three years.

The project is focussing on the trade of German merchants with the North Atlantic islands of Faroe, Shetland and Iceland, which was dominated by merchants from Bremen and Hamburg between the late 15<sup>th</sup> century and ca. 1700. The main trade items were stockfish and sulphur.

Compared to other regions the Hanseatic League’s trade with the North Atlantic islands was less extensive and important. Still the presence of German merchants at their North Atlantic destinations had a major impact on the islands economy as well as their social and cultural life.

Only an interdisciplinary approach allows a thorough analysis of the relationship between merchants and islanders. For this reason, a researcher team has been assembled consisting of a land

archaeologist, a historian, an archaeo-zoologist and a ship archaeologist.

The basic research questions for the team are:

- How was the trade organised in the homeports and the ports of call?
- How were the merchants connected to each other?
- How were the ships build that could sail the open North Atlantic?
- Had the North Atlantic trade an impact on shipbuilding or had the development in shipbuilding an impact on the trade?
- Who consumed what goods and why?
- What was the nature of the impact of these long-term trading relations on the islands societies?

Natascha Mehler  
Christian Küchelmann  
Bart Holterman  
Mike Belasus  
The German Maritime Museum

**Olivier Berger**

**How can we better preserved the finds and make underwater archaeology more accessible to the public?**

We are developing the idea of how to keep visible artifacts in situ and display them in an underwater museum. This concept has been our main focus for more than ten years.

The challenges of complicated preservation, conservation of the objects in the natural but sometimes hostile environment combined with the technical limits to display artifacts underwater and the considerable cost to realize a museum project under the sea, are unfortunately the reality.

The stabilization and conservation treatment are a necessary requirement which keeps the objects hidden for considerable periods of time. Some projects have been done in the past with displays like show room-laboratories, open to the public, where treatment baths were like aquariums. But the opportunities to

involve the public in an underwater project are rare, and so many times they stay in a scientific form, without publications or displays to the public. Consequently the underwater excavation needs a budget that includes professional conservation, restoration and curatorial management. Raising a lab with professional restorers and specialized equipment must be set up before any excavation and the costs have to be part of the total budget from the beginning. Too often neglected, the conservation and restoration of the underwater artefact is a real challenge on each excavation project. In the last few years two projects have been done successfully with an "exhibition concept", one about sunken cities in Egypt and another one about the Anticythera ship wreck.

**Massimo Capulli**

### **In Situ Preservation: An Archaeological and Engineering Project in the Upper Adriatic Sea**

Underwater archaeological heritage is exposed not only to natural environmental stresses, but also is threatened by human activity. As a matter of fact, both commercial fishing and recreational diving have caused considerable damage to several major wrecks in the northern Adriatic Sea. The Archaeological Superintendence of Friuli Venezia Giulia and of Veneto have thus initiated an interdisciplinary collaboration with the University of Udine, involving the Department of History and Preservation of Cultural Heritage, and the Department of Electrical, Management and Mechanical Engineering, in order to develop a project that has as its primary objective the protection of underwater sites by both surface and underwater video surveillance. It was also decided to start an experimental trial on the wrecks Caorle 1 (I a.C.) and Grado 2 (III a.C.), with the intention to monitor the sites remotely using the same

technology. The video collected from underwater cameras installed on the metal protective structure, and by surface cameras placed on a buoy in the vicinity of the site, are sent to a management and processing system. This system, autonomous with respect to its power supply, is the central node for video acquisition and recording. Part of the images are radio-transmitted to a remote server that is in charge of their distribution, in order to permit a virtual visit of the site to remote visitors, as well as to identify potential threats that can be later investigated with the help of the recorded video. The necessity of a stand-alone system on the buoy and the distance from the coast impose stringent technological constraints on the efficiency of processing and communication. These aspects constitute the main technological challenges of the project.

**Deborah Cvikel**

**The Akko Tower Wreck (Israel):  
A multidisciplinary research project based on underwater archaeology**

During the 18th and 19th centuries, the city of Akko (St. Jean d’Acre), with its harbour, was considered the key to the East, and was the centre of several important naval events. The shipwreck designated as the Akko Tower Wreck was discovered in Akko harbour in 1966, and surveyed in 1975 and 1981. The researchers came to conflicting conclusions regarding the original ship. Following these, three seasons of underwater excavation were conducted in 2012, 2013 and 2015.

The shipwreck was found in 4.4 m of water, and is 17.8 m long and maximum 6.4 m wide. Among the hull remains were the hog timber, rising wood, keelson and sister keelsons, hull planks, framing timbers, ceiling planks, and limber boards. Artefacts found include rigging elements,

wooden objects, stones, bricks, and ceramic tiles.

This multidisciplinary research project combines underwater archaeology, history, and geography. The artefacts are studied typologically and by the relevant scientific methods: petrographic and neutron activation analysis to determine the origin of the stones and clay; and metallographic and chemical analyses to establish manufacturing processes, date of manufacture and origin of the metal finds.

Based on the ship's construction and finds, it is suggested that the Akko Tower Wreck is the remains of a merchant brig, dated to the first half of the 19th century, which sailed to Akko from a western Mediterranean port. However, the full story of the ship and its place in the maritime history of Akko remains untold.

**Hans Wilhelm Daehnhardt und Hristomir Hristov**

## **Der Sturm der Seevölker und die Seeschlacht im Nil-Delta**

Im Mittelpunkt des Referats stehen die Ereignisse im Ostmittelmeer um 1200 v. Chr., die mit den Seevölkern in Zusammenhang stehen. In einer kurzen Einführung werden die Umwälzungen in der damaligen Staatenwelt geschildert. Dann werden auf interdisziplinäre Art und Weise sowohl die historischen als auch die archäologischen Quellen zu den Angriffen der Seevölker genauer analysiert, die zum Vernichten bedeutender Stätten spätbronzezeitlicher Kultur wie beispielsweise Ugarit, Enkomi, Karkemisch usw. führten. Im Anschluss daran wird die Bedeutung der Seeschlacht im Nil-Delta hervorgehoben, die im 8. Jahr der Regierung des Pharaos Ramses III. stattfand und bei der die Ägypter einen eindrucksvollen Sieg über die Seevölker errangen, wodurch ihre Expansion zu Ende gebracht wurde.

Im Unterschied zu einer Vielzahl anderer Veröffentlichungen zu den Seevölkern stehen aber hier im Mittelpunkt nicht die

Fragen nach ihrer Herkunft wie ethnischer Zugehörigkeit. Die Analyse schriftlicher Quellen und archäologisch nachgewiesener Zerstörungshorizonte lässt vielmehr einen bestimmten Algorithmus bei den Angriffen erkennen. Dies erlaubt die Entwicklung eines theoretischen Modells zum Feststellen nicht nur des Hauptzieles der Seevölker bei ihrem Angriff gegen Ägypten, das sich somit als unterschiedlicher und bedeutender als eine einfache Plünderung erweist, sondern auch gewährt die Möglichkeit, einen Vorschlag zum Bestimmen des Bereiches vom Nil-Delta auszurichten, in dem die Schlacht vermutlich stattfand.

Mit dem Referat wird eine Diskussion erzielt, die zu künftigen Forschungen und somit zum Erweitern unseres Kenntnisstandes nicht nur zu den angesprochenen Fragestellungen, sondern auch insgesamt zu den Seevölkern führen werden kann.

**Katerina Delaporta**

**Methodology: Deontology, ethics and practice in underwater archaeology**

The lecture attempts a retrospection introduction of underwater archaeology as a sub discipline of archaeology.

Initially it examines issues of basic underwater archaeology methodology and practice, focusing among others on the variety of distinct terminology according of different cognitive fields, i.e. maritime, nautical, coastal, submerged, etc. from a social, economic and political perspective;

then it approaches a range of ethical and practical issues related to the interdisciplinary deepwater archaeological research and exploration.

Finally it gives a critical point of view of various modern practice ethics and politics of management, in accordance with local, national and international law standards and principles for the protection of underwater cultural heritage.



**Stella Demesticha**

### **Amphorae as cargoes: from drawings to 3D models**

Cargoes of maritime transport containers, commonly known as amphorae, are the commonest type of ancient shipwreck sites in the Mediterranean. Amphora sizes in any given shipment can document very well amphora standardization modes, and certain aspects of seaborne trade mechanisms, such as the measures and weights, while the stowage system in a ship provides evidence of the sophistication in lading techniques and space arrangement on board. As the conditions of wreckage vary significantly from case to case, amphora cargo assemblages can be found today in different configurations, such as scattered, disturbed or coherent. The documentation of any type of such shipwreck site is a difficult and painstaking process, because the amphora positions are random and the containers are rarely identical to each other. Thus, despite the hundreds of shipwrecks with transport containers discovered during the last 60 years, very

little is known about amphorae as cargoes, beyond typological classifications or provenance studies.

Recent developments in digital mapping and 3D parametric modelling techniques as well as interdisciplinary approaches to the data acquired during excavation, have provided new potential and perspectives on the interpretation of amphora cargoes as sources for the size and capacities of ancient ships. Such techniques have been applied for the documentation of the Mazotos shipwreck amphora cargo, a fourth century BC site, surveyed and partly excavated off the south coast of Cyprus, which is discussed in this paper. Emphasis is given to both the new technologies used for amphora documentation and the different ways that these new tools have affected the process of archaeological fieldwork and the interpretative approach.

**Jonas Enzmann and Feiko Wilkes**

**How to document a wreck that you barely see?  
Advantages of Structure from Motion in waters with visibility less than one  
meter**

This paper shows different examples of how Structure from Motion could be applied on archaeological investigations in low visibility waters. Background are archaeological surveys from 2015/16 of the Task-Group for Maritime and Limnological Archaeology of the University Kiel (AMLA) in the Baltic Sea and the limnic waters with different depth conditions.

Due to low visibility often it is difficult to get a clear overview of the investigated

site, therefore we want to show how easily you can apply the Structure from Motion technology to get an overview you would never see in reality. The precept of our work is to be as cheap and time efficient as possible. Based on our experiences the goal of this paper is to propose a standardised fieldwork strategy for similar conditions, that easily could be applied on other archaeological investigations.

**Benedykt Hac, Andrzej W. Święch and Tomasz Neubauer**

### **Interdisciplinary research of the sunken Legacy from World Wars**

Both the 1st and 2nd World Wars left numerous wrecks of ships and aircrafts in the Baltic Sea. Many of them are lying on the bottom of Polish waters. Often they are objects of interest for recreational and technical divers, and less often for scientists, especially in the humanities area.

However, recently, in the last few years, research on selected shipwrecks has been taken on by oceanographers from the Maritime Institute in Gdańsk. The aim is to focus the impact of metallic wrecks on the environment. However, this investigation brings out also much opportunity for information and chances for archaeological and historical studies. Thanks to progress in survey techniques we are able to survey the causes of shipwrecks, with more precision, with full seabed coverage. As a

result smaller anthropogenic objects are found and documented according to archaeological standards. In addition, due to interdisciplinary research many of the discovered objects can be easily identified and the time and place of their origination can be easily determined. Our initiative is the first of this kind in Poland, to bring together archaeologists, oceanographers and historians in order to investigate World Wars' wrecks. Regardless of the fact that our common research and collaboration is still in its early stages, we would like to present the potential of, and opportunities for, this kind of research.

Maritime Institute in Gdańsk, Operational  
Oceanography Department  
Polish Naval Museum in Gdynia

**Kulesza, Wojciech**

### **Interdisciplinary research of site Żółte in Poland**

The site Żółte is an island located on Lake Żarańskie in West Pomerania voivodeship and is an example of early medieval settlement complex, excavated by Institute of Archaeology of the Nicolaus Copernicus University in Toruń. The research was undertaken both on land and underwater within the island, during which was also used sciences such as archeobotany, archeozoology, dendrology, geomorphology and hydrology.

Linking together these types of disciplines in course of archaeological research allows for more accurate understanding of site in terms of its function or formation during its use. Without this kind of contribution we

are not able to identify the most important, at least for archaeologists, investigated aspects of the excavated area.

Very important role was also played by conservation due to the huge number of finds in the underwater areas of Żółte site, in whose inventory includes items of wood, bone, metal, fragments of clothes, jewelery or coins.

A summary of the current research is contained in a monograph of 2014 „The Island in Żółte on Lake Żarańskie. Early Medieval Gateway into West Pomerania” edited by Wojciech Chudziak and Ryszard Kaźmierczak.

**Nili Liphschitz and Smiljan Gluscevic**

### **Zaton Boat 2, Croatia: A Dendroarchaeological Investigation**

The Roman harbor at Zaton (a village ca. 15 km from Zadar) which existed as the harbor of the Roman municipium of Aenona (today the town of Nin) was discovered in the mid sixties. Remains of vessels were found there and in 1982 excavations have began which continued with interruptions until 1987.

The Zaton 2 Boat was excavated 28 years ago (during 1987) by Brusic and Gluscevic. It was attributed with certainty to the Liburnian boatbuilding tradition. It was better preserved than the others, with 27 frames and a double base for fixing the mast. During the next 26 years the boat remains were preserved in a basin with water and only two years ago, for the first time, Smiljan Gluscevic got the opportunity to start working on Zaton Boat 2. First were taken all frames, then the planks were cut in transversal direction just below the frames and at the end the keel was cut in few parts and taken out as well. The pieces which 'floated' around were collected too. The preserved length of the boat is about 8 meters and the preserved width is about 2 meters. The estimated

length is about 15 meters and its estimated width is about 4-5 meters.

A comprehensive dendroarchaeological research of Zaton 2 boat carried out on 2015 showed that the frames were made of two oak species: *Quercus cerris* (Turkey oak) and *Quercus petraea* (Sessile oak, Durmast oak) and the pegs inserted in those frames were all made of *Acer pseudoplatanus* (Sycamore maple). The keel was made of *Acer pseudoplatanus* and its pegs were made of *Abies alba* (Common silver fir). The planks were mainly made of *Fagus sylvatica* (European beech), but few were of *Abies alba* and of *Acer pseudoplatanus* (a single samples). The pegs inserted in those planks were made of *Abies alba* and *Acer pseudoplatnus* (one peg). The majority of the UM floating samples (unidentified members), which were frame pieces, were also made of *Quercus cerris* and *Quercus petraea*.. One UM floating frame sample was of *Acer pseudoplatanus* and two were of *Fagus sylvatica*.

Comparison is made with the results of the dendroarchaeological investigation carried out several years ago on the two Nin boats.

**Andrey Vasilyevich Lukoshkov, Ageev Dmitriy Mikhailovich, Galaida Ivan Igorevich**

### **The Atlas of undersea historical objects in Northwest Russia**

The main direction of the National Undersea Research Center's expeditions is the search for dead ships, the information about which is included in a special Atlas. The search covers the waters of the eastern part of the Gulf of Finland and adjacent rivers and lakes, by which the trade corridors between Europe and Asia have been passing since ancient times. Judging by the abundance of findings, the routes through the Gulf of Finland and along the rivers of the region were used with high intensity, although specific routes varied depending on the political situation and military conflicts in different historical periods. Given the large water areas, the reconstruction of specific sailing routes made on the basis of archival sources are the basis for the annual searching program. Areas potentially dangerous due to hydrographic conditions are shown in them, as well as the areas of active hostilities, as it was in the case of reconstructing the Vyborg battle in 1790, during which over 60 vessels crashed in 7 areas. This approach has proven to be effective: up to 50 objects may be detected

annually in the course of searching. Then the examination of findings, their identification, fixing their condition and position at the bottom of the sea are carried out. Usually the ships are in a good condition, though the hulls crashed at depths less than 10 meters in open areas are often disintegrated or buried into the ground. In the latter case, probing of soil layer is used for fixing the remnants. The methods of fixing the objects lying on the ground depend on their size, depth and water transparency. The initial fixation is carried out by the acoustic survey of the bottom relief, which allows receiving accurate images of the remnants, determining their linear dimensions and orientation in space. Then the measurements of the structure are carried out, as well as the creation of photoplans or three-dimensional images at sufficient water transparency. The identification of findings creates more problems, as the variety of types of dead ships in age and identity is very large.

**Iván Negueruela et alii**

**After the Odissey spoil: the archaeological Campaign of August-2015 in  
"La Mercedes",at 1.200 m. depth**

We have made an underwater exploration in the ship Nuestra Señora de las Mercedes, the one who was violated by an american treasure-hunting company, "Odissey marine Exploration", in 2007. The spanish government applied to the Supreme Court of Washington, and in

january 2012 that S. Court decided that 600.000 silver coins were the property of Spain, and the coins came to my museum in decembre 2012.

So, in August 2015 we have made an exploration of the site at 1150 m. depth.

**Andonis Neophytou**

**Managing digital mistakes: restructuring the documentation system of the Mazotos shipwreck site**

According to Gould (2000:19) ‘the choice of archaeological techniques and controls to be employed at a particular site ... is perhaps the most critical decision the archaeologist faces.’ The limitations on surveying methods and the constraints of the underwater environment often dictate the objectives of an excavation project. Hence, underwater mapping and documentation has long been a major concern for archaeology, especially before the digital era.

During the last decade, digital technologies and photography in particular, changed the archaeological fieldwork process dramatically. These new tools facilitate detailed photographic documentation and mapping. Reliable results, however, require know-how from disciplines other than archaeology both in the fieldwork and the post-excavation data processing.

The Mazotos shipwreck project is a representative example of an excavation where such tools have been extensively

used. Since 2007 we have fine-tuned, redefined, altered, complemented, developed, subtracted, or abandoned various procedures and methods. Seven years of work have produced three different kinds of data sets, acquired with more than seven different types of software, suggested by three associates. In 2013 the team decided to seriously re-assess and restructure the documentation methodology. During this process, one computer scientist and a multimedia graphic designer worked together to regenerate the excavation, re-create and correct the position of 795 tagged finds in the 3D model of the site. This paper discusses this new approach to underwater archaeological fieldwork since then, with an emphasis to the lessons learned, the choices made and the expectations for the future.

Gould, R. A. 2000. *Archaeology and the Social History of Ships*. Cambridge: Cambridge University Press.



**Sergey Olkhovskiy**

### **Acoustic Profiling in Phanagoria water area in 2012-2015**

Commonly used method of research of bottom surface by side-scan sonar proved ineffective in Phanagoria' water area: all the ancient objects are covered with sand and silt, main part of the bottom densely covered with tall sea grass. Hydromagnetic survey shows good results in this case, but it can not find local objects – like wooden ships, clusters of local stones.

Only acoustic profiler can identify such type of objects – by fixing anomalies in the

natural sediment stratigraphy. In 2012, 2014, 2015 we tested 3 different profiling systems in Phanagoria - SyQuest StrataBox, Bathy 2010PC Chirp, Tritech SeaKing Parametric SBP. The analysis of these surveys is still going, but good potential of acoustic profiling to search for objects of cultural heritage, covered with bottom sediments, is already evident.

**Alessandro Pellegrini**

**GIS technology as a support for the interpretation of submerged sites and the reconstruction of ancient environmental**

In recent years we had the opportunity to test GIS-oriented applications in two very different situations: one is an Intra-site project realized in a submerged Bronze Age lake-dwelling, located on the southern shore of Lake Garda (North Italy). This project was oriented to spatial analysis useful for building reconstructions and it's based on the interaction among archaeological data, paleobotanic information and the results of a topographic relief. The second project, conducted in the lagoon of Venice, was aimed to obtain territorial information at an inter-site level ,by datasets acquired

through historical, archaeological, geomorphologic and palaeo-environmental investigations coupled with information retrieved by direct survey, in order to realize an archeological map useful even as a cultural resource and as a tool for territorial planning.

These experiences testify that GIS technology can be helpful in managing many different kind of data, coming out from a interdisciplinary research and connecting them to spatial data in order to perform many analyses useful for the reconstruction of ancient environmental.

**Roman Yuryevich Prokhorov, Igor Valerievich Galaida, Andrey Vasilyevich Lukoshkov. (Saint Petersburg, Russia)**

### **Excavation and conservation of the German ship ‘Archangel Raphael’**

The Museum of Navy of Peter I Period is being established in Saint Petersburg. It is planned to exhibit both replica and authentic ships of the beginning of the eighteenth century, the remains of which have been found at the bottom of the Gulf of Finland. Among the latter is the German cargo ship ‘Archangel Raphael’ built in Lübeck in 1693 and crashed while returning from Saint Petersburg in 1724. The ship has been found at a depth of 16 meters and is relatively well preserved, although its stern part has collapsed. Research works were divided into several stages after searching for the ship, which occurred in a short time. The first was to fix the marine hull and its fragments at the bottom of the sea and the preparation of a photoplan, which became a basis for the excavation planning. The second was the parsing of collapsed structural hull elements within the marine hull with their marking and stacking at the bottom of the sea. The third was the sediments washing-out within the hull, fixing the found

structural elements and rising the small valuable items. A special photography to create three-dimensional images was conducted at the washed-out sections. Simultaneously, the preservation of items raised was conducted. They include preserved clothing (camisole, pants, leather footwear and belt), dishes, navigation tools, guns, scales, etc. The excavations allowed the ‘opening’ of cargo barrels lying in the hold. The next stage involves the raising and conservation of cargo and the elements of interior arrangement, as well as the raising of structure elements previously collected from the marine hull. This enables the beginning of washing-out of the hull and its fragments lying around. Performing these steps is constrained by the buildup of capacities necessary for carrying out large volumes of conservation work. This is necessary because there are parallel works on washing-out, gradual recovery and preservation of the remains of the Peter I Navy battleship, which has taken all the available capacities.

**Michaela Reinfeld**

**News from the Red Sea – The Underwater Archaeology Project of the University of Marburg**

The ancient seafaring in the Red Sea, especially along the Saudi Arabian coast, is archaeologically not well studied so far. Only occasionally artifacts discovered by recreational divers reached the hands of the Antiquities Service or museums. A systematic localization and documentation of the archaeological sites has not yet taken place, but if one believes the literary sources for seafaring in the Red Sea, an archaeological investigation of the Saudi Arabian coast does not seem to be promising.

Already in the first century AD, the author of the “Periplus Maris Erythraei” describes the Arabian coast as inhospitable, with only a few ports but many dangerous reefs. Moreover, the inhabitants of the country are malignant. They attack people and enslave the shipwrecked. It would be best to make a wide berth around the coast and not to stop until more hospitable places are reached...

In contrast to the literary sources, the archaeological evidence indicate a different picture of ancient seafaring in the Red Sea. Shipwrecks demonstrate that the Saudi Arabian coast was not widely circumnavigated but deliberately approached by ships. As part of a multiyear cooperation project between the Saudi Commission for Tourism and National Heritage (SCTH) and the Philipps-University Marburg, these evidence of ancient seafaring will be systematically located, documented and studied for the first time. The presentation gives an overview of achievements so far and future challenges.

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**Manuela Ritondale et al.**

**The Roman shipwreck of Punta dell'Arco (Ventotene) and the lead transport in the late Republic**

The pivotal position of the Pontine Islands along the main antique trade routes is testified by the huge number of shipwrecks found in the area. Among them is one discovered in 1986 at the west point (Punta dell'Arco) of the Ventotene Island in a depth of around 40 m. It was carrying an uncertain number of lead ingots and amphora Dressel I B. A *dolium* was also found close to the wreck although there is no evidence that it belongs to the same cargo.

The shipwreck of Punta dell'Arco has never been completely excavated and documented, nonetheless thanks to chemical and Pb-isotope analyses as well as typological and epigraphical investigations carried out on a group of 14 lead ingots – now stored in the local Museum of Ventotene – important information like the dating of the shipwreck or the reconstruction of at least one stage of the ship's journey, means where the ingots had been loaded, are now available.

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**Felix Rösch**

## **The late 11th c. Schleswig waterfront – infrastructure and organization of a major trading port between Viking Age and Hanseatic League**

Vorbemerkung:

Das Referat fällt in die Kategorie der neuesten Untersuchungen bzw. Ergebnisse in der Feuchtbodenarchäologie, geht aber auch auf methodische Fragestellungen ein, indem die Möglichkeiten der Prozessierung von größeren hölzernen Befundkomplexen mithilfe von GIS aufgezeigt werden. Inhaltlich liegt der Fokus des Referats auf der Organisation und dem Aufbau eines Hafenviertels in einem der größten nordeuropäischen Handelszentren des Hochmittelalters.

Schleswig, the mediaeval successor of the well-known Viking Age trading place Hedeby, has recently moved into the focus of new investigations. One aspect is the analysis of a number of old excavations, whose features have always been connected to the harbour of Schleswig. As settlement layers below the water table provided very good preservation conditions, large numbers of wooden structures have been uncovered and well documented. Using GIS and database programs these structures have been systematically recorded digitally and analyzed in a whole for the first time. They draw an image of a complex and rapidly developing waterfront in the transition from the Late Viking Age to the High Middle Ages. Within a time span of just 25 years, a large part of the shore of the old town peninsula as well as neighboring shallow waters have been systematically occupied. Starting in the 1070ies with a plot layout and a connecting road infrastructure, the building activities

quickly reached out into the Schlei fjord where large dams were erected in alignment to the plots. While the major initiative behind these actions must be traced back to a high-ranked authority, most structures have been established individually by different actors. Furthermore several specific artifact types proof the engagement of those people into the long distance trade. With the construction of plots and dams they created themselves properties on an advantageous spot for commercial transactions. The structures provided easy and secure access to the Schlei and therefore to trading ships, but they were also favorable for foreign merchants who were according to contemporary sources hosted by the inhabitants. This attraction is to be understood as the main reason for the occupation of the Schleswig waterfront, whose outstanding rapid development doesn't accidentally takes place in a period of increasing professional merchant seafaring.

**Laura Sanna**

**Man vs Robot in Underwater Archaeology:  
Advantages and Limits of Using Technology in the Study of a Wreck-Site**

The possibility to investigate a submerged wreck-site by using different research methods and devices has permitted the author to compare advantages and limits of different strategies. In this paper, the author presents a case study through which it is possible to compare the results obtained while investigating a submerged site both with “robotic” and “human” operators. The paper deals with the research carried out on a Roman shipwreck with a cargo of roof-tiles sunken off Terracina coasts, in the Southern Latium Region – Central Italy. From 2010, in fact, this site has been first surveyed with different instruments, like ROV, SSS and SBP and then by underwater archaeologists. After the instrumental campaign, in fact, the author has conducted, on behalf of the Local Superintendence, two different underwater

surveys, working with a team of divers and underwater archaeologists to acquire new information about the shipwreck and its load. During these two “human” diving campaigns, the author has also been able to compare the differences between the use of open-circuit SCUBA systems and electronic Closed-Circuit-Rebreather systems. Being located at a depth of about 25 meters, this site has in fact permitted to evaluate which equipment and procedures can be considered more useful for underwater archaeological investigation. According to the data achieved thanks to this multidisciplinary approach, the paper will then try to discuss how and when the archaeological instrumental survey can be considered self-sufficient and how and when an integrated man-robot approach can provide a greater number of data.

**Dimitrios Skarlatos and Eleni Savvidou**

### **Coastal Survey of archaeological sites using drones**

Nowadays, the use of 3D maps and orthophotos is widely recognized and accepted in archaeology as a standard tool for site documentation and excavation progress monitoring. Such products can provide much more visual information and may be used as a backdrop for existing information to help interpretation and understanding of the relationship among the site and its surroundings in a context rich map. The latter is particularly important when conducting survey study of an archaeological site, or in coastal areas. Existing mapping techniques for shallow waters are either too expensive, or provide limited information.

Drones and the aforementioned products, are an excellent tool for bridging submerged and coastal structures, as well as cost and rich visual information. Nevertheless, the water refraction in combination with the unknown depths impose limits to the processing and

attained accuracy, and therefore no attempts are reported for orthophoto production over shallow waters. Additionally, lack of control points over the sea further reduces accuracy. This paper suggests an iterative photogrammetric model for processing data over coastal sites, in order to produce precise and seamless 3D maps and orthophotos over land and shallow waters up to 12m, depending on water visibility. Two case studies in Cyprus will be presented; Amathounta and Agia Napa. The former one, will be used to explain the model and act as a test site with bathymetric points for model verification. The latter one, is a large coastal area that needed a fast archaeological survey. A drone was used to produce a high detailed orthophoto which acted both as an overview map for planning exploratory survey dive lines, as well as a backdrop to finds.



**Antonia Sciancalepore and Egidio Severi**

**New computer technologies applied to the underwater archaeology of Lake Bolsena (Lazio - Italy)**

The bottom of Lake Bolsena is an extraordinary ‘container’ of different archaeological finds: the protohistoric settlement of Gran Carro, the two Bronze Age logboats (Punta Calcino and Monte Bisenzio); the wrecks of Punta Zingara (Bisentina Island) and the most recent one of Martana Island; the ancient harbours of Martana Island and Bisenzio.

Since the development of the underwater archaeology, around the '60 years, the researches have used the documentation techniques of the epoch. Nowadays, to those documentations, starts to add new ‘informatic’ technologies that allow the development of the excavation data, to complete and to make them more legible not only to experts, but also to the public and the common visitors. Particularly, among 2012 and 2015, the researches at the villanovian village “Gran Carro” are restarted, using new techniques of relief, employing tools as the photo-technigraph, that allows to perform a 3D restitution of the excavated layers. Besides, the

excavations are restarted planning the topographical positioning to make an archaeological complete GIS of the village. The results of photorestitution have allowed us to reconstruct the living sequences of the settlement and many applications of them permitted to study better all the materials recovered during the excavations on the site.

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The Research Centre “Lake Bolsena Scuba School” is an Association of volunteers, coordinated and led by a highly qualified technical-scientific team and has the objective to become a reference for the scientific researches of the lake. All the operations and researches have been performed in collaboration with the Archaeological Superintendence for the Southern Etruria.

**Lucy Semaan**

**Surveying the waters of Anfeh, Lebanon:  
preliminary results and future prospects**

This paper looks at the preliminary results of a recent underwater visual survey of the waters of the Anfeh peninsula and its immediate coastal stretch, undertaken in October 2013. The archaeological site of Anfeh is located on a nose-shaped promontory called Ras el-Qalaat, some 70 km north of Beirut. The occupation of the site stretches back from the Crusaders period to the Bronze Age.

This underwater survey is the first scientific endeavour to study the underwater cultural heritage at Anfeh. Indeed, previous sporadic surveys were undertaken in the seventies and in the early nineties at the site, and material was unsystematically collected. The 2013 survey is the primary step towards a better understanding of the maritime cultural landscape of the Ras el-Qalaat and the coastal stretch of the modern village of

Anfeh. It succeeded in providing a preliminary assessment of the archaeological potential of the area, while recording the spatial distribution of artefacts, as well as the underwater physical features. In order to carry out successful and systematic diving operations, as well as to record the archaeological and topographical assets, an accurate bathymetry map of the targeted area was produced. Meanwhile, the visual survey methodologies were adapted to the underwater geomorphology.

The greater potential of future research at Anfeh lies in understanding the relationship its ancient peoples had with the sea in terms of exploiting the maritime resources, navigating its waters, and accordingly modifying the landscape through time.

**Francesco Tiboni**

**Instrumental Archaeology in Italy –  
Ten Years of Experiences in Different Scenarios**

From 2004, the author has been involved in different projects of underwater archaeological researches held by the Ministry for Cultural Heritage and Activities of Italy around the coasts of Puglia, Basilicata, Calabria, Tuscany, Latium, Liguria, and recently on the Lake of Garda. During all these projects, the possibility to direct the operations with ROV, SSS, SBP, MBES and Magnetometers on-board the vessels has permitted to obtain important information about how different devices operate in different scenarios. Further, the possibility to act often as SSS technician and ROV pilot, as well as archaeological consultant during Archaeological Impact Evaluation for marine infrastructure all around Italy,

has permitted to compare how different tools can be used, according to the purposes of the projects. Starting from these ten years experiences, in the paper the author would like to discuss the results achieved from a technical point of view, trying to put in evidence the limitations of some of the instruments as well as of the underwater archaeologists involved in their use or interpretation. Particularly, this paper deals with the problem of the interpretation of acoustic reliefs, of the reading of photogrammetry and of the efficiency of the different instrumental techniques, comparing what can be expected and what is obtained, while working in “commercial archaeology” or in “institutional research projects”.

**Sebastiano Tusa**

**The wide role of technology in the management of Underwater Cultural Heritage. Sicilian case studies**

According to our experience made in the frame of innovative European projects, traditional sea surveys and excavations, as well as in the field of underwater archaeological sites management, we are in the position to express our idea that technology could be very important to optimize research, protection and management of UCH. The use of electronic devices (side scan sonar and multibeam) gave us the possibility to fulfill very important tasks such as the discovery of Egadi Battle site, the discovery and study of deep sea wrecks in the Aeolina islands, the study of *naves lapidariae* wrecks etc. The use of remotely controlled video systems gave us the possibility to control underwater archaeological sites and let the people watch them inside museums or directly on the web. Experiments done with AUV gave us the possibility to understand the advantages and the bias of

such device in comparison with ROV. ROV gave us the possibility to perform deep sea excavations using robotic arms and remotely controlled water pumps. Mini submarine gave the possibility to our archaeologists to investigate deep sea wrecks staying for ours at few cms from their cargoes. The use of chips inserted in archaeological objects left on the sea bed gave us the possibility to avoid looting and give to the visitor divers informations.

But, according to our experience, it is clear that humane eyes and direct investigation and analysis by archaeologists are absolutely necessary. All those technical devices could be very important – we can say that they are essential for UCH research, protection and management – but only if their use is done in the frame of well settled projects run by human intelligence.

**Kateryna Valetryrova**

### **Metal Artifacts and Weapons from the Medieval Shipwreck in the Black Sea: Various Aspects of Research**

The Center for Underwater Archaeology of the Taras Shevchenko National University of Kyiv has been excavating a 13th century Italian galley since 1999. The shipwreck is situated in the Sudak bay, in the south-eastern part of the Crimean peninsula, Ukraine.

The archaeological material from the shipwreck site is presented by diversity of finds. Weapons and metal artifacts are separated into two individual groups. The first group includes daggers, chaps, fragments of scabbard, pommel of the sword and knives. These steel and iron objects are mostly poorly preserved. Metal

ware, clasps, nails and other items compose the second group.

The study of the weapons and metal objects from the shipwreck requires applying various methods. On the one hand, we need to find analogues and to create the typology for our material. On the other hand we need to apply chemical and physical analysis. The important issues are also the restoration, preservation and storage. Currently our research is in active phase, thus we hope to get new important results.

**Chiara Zazzaro, Romolo Loreto and Enzo Cocca**

### **3D Surveying of an Eighteenth-Century Merchantman off the Red Sea coast of Saudi Arabia**

In September 2015 a team of the Saudi Commission for Tourism and National Heritage (SCTH) and of the Università di Napoli “L’Orientale” started an underwater survey in the area comprised between Yanbu and Umm Lajj on the Red Sea coast of Saudi Arabia.

The main focus of the survey was to identify the location of an eighteenth-century merchantman wrecked at a reef to the north of Umm Lajj, off the Saudi coast. The wreckage area extends about 36 metres in length and 10 metres in width. Parts of the hull and of the cargo are exposed and are clearly visible. The presumed stern area is characterised by the presence of a large mound of around one thousand jars.

Surveying methods included the use of video recording and 3D reconstruction

methods. Meanwhile, handmade measurements and drawings have been used for small objects, such as single pottery artefacts and isolated elements of the hull.

A 3D survey of the wreckage area has been conducted by simply using an underwater camera. The images have been processed with the structure-from-motion (SfM) method. The resulting 3D model has been used to obtain orthorectified images which were used as a base map to extrapolate plan views and sections of the shipwreck and its cargo.

The results of the 3D survey of the Umm Lajj wreck will be presented. Problems and advantages of using this survey method will also be discussed.

**Vesna Zmaić Kralj, Jerko Macura and Igor Miholjek**

**Underwater Archaeology in Croatia – Scientific diving methods used in underwater research and surveys**

The Department for Underwater Archaeology of the Croatian Conservation Institute carries out systematic and protective research on underwater archaeological sites along the Croatian coastline of the Adriatic Sea. The Department's field of work covers a large time span, and encompasses sites from prehistory, classical antiquity, the Byzantine period, Medieval and postmedieval shipwrecks, and wrecks from the First and the Second World War.

This lecture provides an overview of various scientific diving methods and techniques implemented during underwater archaeological research. It displays examples of documentation techniques, *in situ* protection, mixed gas diving, monitoring, remote sensing, underwater photogrammetry and airborne laser bathymetry. Examples shown in the lecture were utilized in the research of the particular archaeological sites which were researched in the last several years.

### **Arbeitsgruppe für Maritime und Limnische Archäologie**

AMLA, which stands short for „Working Group of maritime and limnic Archaeology“, was founded in 1997. The members of AMLA are European Scientific Divers, and are mostly archaeologists on different levels of education, but there also members from related sciences like biology, geology or oceanography.

The primary task of the AMLA is to conduct research on the Underwater Cultural Heritage and bring it more into focus of the terrestrial archaeology. On the other hand the AMLA wants to create a public awareness of the Underwater Cultural Heritage, which is endangered due to the building of pipelines, offshore windparks and the deepening of rivers for economic purposes. Another important aim is the education of the next generation of archaeologists in the special conservation situation underwater and the training of methods for excavation, investigation and interpretation in Maritime and Underwater Archaeology.

The majority of AMLA members were trained as Scientific Divers by the Centre for Scientific Diving at the Institute of Geology at the Christian-Albrechts-University. Another cooperation exists with IFM GEOMAR Institute, which

allows the AMLA to conduct regular field trips with the research vessels FB Polarfuchs and FK Littorina into the Kiel Fjord, to survey, monitor and document wrecks. Together with the Lighthouse Foundation the AMLA has built an archaeological park under water, where students and recreational divers can be trained in proper diving methods at archaeological sites. The AMLA maintains a close cooperation with the State Department of Archaeology and the State Museum in Schleswig. Over the past decade members of the AMLA took part in projects from the Lower Saxony Institute for Historical Coastal Research and the Maritime Archaeology Program of the University of Southern Denmark in Esbjerg.

Since 2004, the working group's internet site is available at [www.amla-kiel.de](http://www.amla-kiel.de). The visitor will find general information as well as news about on-going research projects and articles of completed projects.

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**David Badovinac**

### **Excavation and lift of the roman logboat from Ljubljana river**

The research of the logboat was part of a large project partly financed by the EEA Financial Mechanism Programme 2009-2014 and conducted by the Municipality of Vrhnika (Občina Vrhnika), the Museum and galleries of Ljubljana (Muzej in galerije mesta Ljubljane) and the Biotechnical Faculty of the University of Ljubljana (Univerza v Ljubljani, Biotehniška fakulteta). The project's mission is to solve the most acute threat to the unique monument in Slovenia, threatened due to its location, degree of degradation and type of material. Our further objective is to allow a considerably easier access to the cultural heritage and natural attractions of the Ljubljana River to the public and develop an efficient platform for a revitalisation of heritage in Vrhnika and the wider region.

All results of the project are intended for the general public, and we strive to achieve sustainable effects by searching for long-term solutions, which allow access to the

heritage to future generations. Raising awareness of the local community is one of the fundamental tasks of the project. The content and programs that concern the wider area of the Ljubljana river create a potential for the development of tourism and an expansion of target audiences. Excavation and lift of the roman logboat was lead by Institute of Underwater Archaeology. In the summer of 2015 we began an underwater archaeological research which was focused on excavation, documentation and lifting of the logboat. The research was performed by divers from the Institute for underwater archaeology (Zavod za podvodno arheologijo) with the help from the International Centre for Underwater Archaeology in Zadar. The poster will present our usage of 3D photogrammetric as the sole method for creating archaeological documentation and the technique we used for the lift of the logboat.

**Marta Bajtler**

### **Maritime finds from Berenike, Egypt**

The Berenike Project is a Polish-American expedition which is conducted since 2007 in Berenike at Red Sea coast. This mission is a continuity of American-Dutch excavations from years 1994-2001.

Berenike was located in II B.C. by Ptolemy II on the Red Sea coast. At the beginning the port was used for reloading transport of African elephants, which pharaoh used in his wars. The city very fast grew and became one of the most important coast center responsible for trade with Arabia and India.

Presently site is covered by sand of Eastern Desert and moved from the present coast

line. A lot still can be said about ancient maritime activity. Thanks to the very dry climate, organic materials at site were preserved very well. To this group belongs also maritime artifacts, like: ropes, brailing rings, fragments of ship hull or fragments of rigging. Based on this finds we can also try to explain the context. Some of them were find in rubbish area, but another of them in probable harbor area. Based on kind of material, of which were they made we can also say a lot about the origin of artifacts. Were they produced locally or imported?

**Andrea Breda et al.**

## **Deep Water Archaeology in the Garda Lake – A Multi Disciplinary Approach**

The poster will present the methods actually in use for deep-water researches in the North/Western area of the Garda Lake. Further, it will discuss how the cooperation with the Ministry for Cultural Heritage and Activities, the ATENA CUMANA association and the local corps of Volontari del Garda has permitted to achieve important results in the field of underwater archaeology. Starting from the presentation of the instruments and the techniques in use by the latter for the research and rescues activities they use to manage on the behalf of the local office of Police and Navy, the poster will discuss how these tools and methods can be applied to archaeological and historical researches. It will even present some important results achieved, as for instance the discovery of

historic wrecks and sites from 60 to 300 meters in the Garda Lake, providing high quality pictures and maps.

Lastly, the poster will present a new project, just launched, that involves local divers to map and protect historic sites in the Western part of the Lake.

Dott. Andrea Breda (Ministry for Cultural Heritage and Activities - Soprintendenza per i Beni Archeologici della Lombardia)

Dott.ssa Laura Sanna (ATENA CUMANA)

Dott. Francesco Tiboni (Université Aix-Marseille 1, CCJ UMR 7299)

Luca Turrini (Volontari del Garda – Nucleo Sommozzatori)

Mauro Fusato (Volontari del Garda – Nucleo Sommozzatori)

**Anna Czerepok**

### **Lake Kucukcekmece – forgotten harbors in the vicinity of Constantinople**

Aim of the study was the analysis of the stone piers and underwater structures occurring in the area of Lake Kucukcekmece, located 18 km west of today's Istanbul. Efforts were made to obtain information on the chronology, materials and function of selected objects. Attempt was made to understand the nature of the discovered structures that were analyzed in terms of their location, cultural context and potential functions. Research in this area had been conducted since 2007 by a team of Turkish archaeologists. In 2014 a multidisciplinary Polish team joined the project which allowed to conduct direct observations. In 2008 and 2015 there were made geophysical surveys and sonar research which showed the existence of a stone quay surrounding the peninsula. This structure is located partly on the ground, and partly under water. It may be a relic of the defensive wall. At the shore remains of columns, marble blocks and sarcophagus are still visible. 250 m to the south of the

peninsula, under the water surface, there can be seen an interesting structure. It consisted of precisely machined blocks of stone, remains of the wall, elements of marble floor, as well as fragments of pottery and a significant amount of brick tiles. Summary of research shows that in this place could be a lantern. The whole complex is divided into three research areas. Carried out excavations established the existence of two harbors, which are called Great and Little Harbor. Furthermore Turkish-Polish research team conducted next excavations in 2014 which revealed another coastal structure. Further work will be undertaken to determine its chronology and function. Kucukcekmece area is an extremely interesting settlement complex, which started in prehistoric times and was existing until XI century. Found traces of a great ancient buildings, as well as byzantine churches, martyrium, large walls and cistern shows the great importance of the region, and its character as a harbor seems to be undisputed.



## **The Society for the Promotion of Underwater Archaeology (FUWA)**

### **FUWA e.V. - Support for archaeological underwater projects**

FUWA e.V. has already supported three archaeological research programmes in the Croatian Adria: Project Gagiana, Project Caska and new in 2016 Project Šipan. FUWA e.V. supports official projects under the supervision of scientific and heritage authorities. During weeks of excavation, FUWA e.V. divers have already conducted about 1,000 dives and have supplied technical equipment and logistics since 2013.

The Society for the Promotion of Underwater Archaeology (FUWA) is a non-profit organisation. A major concern of FUWA e.V. activities is the training of sports divers in theory and practice of underwater archaeology. A key element is the organisation and delivery of events and special dive trainings on underwater archaeology in cooperation with DEGUWA (German Society for the Promotion of Underwater Archaeology e.V.) and VDST (Organisation of German Sports Divers e.V.) for sports divers. Lectures, events, trainings: these events serve the purpose of exchanging experience and information.

We bring together interested sports divers and researchers and provide the former with a chance to actively engage in underwater archaeology under professional guidance.

All FUWA e.V. divers are highly experienced divers in freshwater and maritime environments and have taken part in recognised training programmes on underwater archaeology.

FUWA e.V. can staff extensive dive projects and will supply complete technical and diving equipment, such as compressor, Nitrox filling station and Nitrox dive equipment, diving cylinders, dredges with pump, suction pipe and hose, lifting bags, floating work platform, gps-mapping device, mobile office and so on. In addition, the FUWA e.V. can partially cover financial costs, e.g. of boat use, cylinder filling, board and accommodation, through members' fees and donations.

We are looking forward to you getting in touch with us - at any time.



**Philipp Grassel**

**Mobility and sea trade of late Hanseatic merchants with Shetland, Faroe and Iceland. The sea shipping of Hamburg and Bremen with the North Atlantic area**

Between the 15<sup>th</sup> and 17<sup>th</sup> centuries Bremen and Hamburg were the main Hanseatic traders in the North Atlantic area. Trade reached its greatest volume in the 16<sup>th</sup> century. After the direct trade to the Island was permitted in the late 14<sup>th</sup> century by the Norwegian authorities, Hansa merchants travelled to the North Atlantic area regularly. The prohibition of foreign trade in the Danish realm, determined after 1604 A.D. by King Christian IV., finally blocked the Hanseatic trade at the North Atlantic Islands. The main commodity of the north was the well-known stockfish but other goods like sulphur, gyrfalcons, wool cloth or butter were also traded. The ships of the Hansa merchants had an average

size of 60 last (120 - 180 tons) for the bigger ships and an average size of 20 to 30 last (40 - 90 tons) for the smaller ones. The small quantity of wreck finds from the Hanseatic (and also pre-Hanseatic) periods and the lack of precise ship measurements or constructional information in contemporary sources is the main reason for the currently unsatisfactory state of the knowledge of Hanseatic seafaring and shipbuilding. Especially in the North Atlantic Islands, the archaeological evaluation of possible medieval/late medieval wreck sites and harbour areas is still only beginning and a lot of maritime archaeological surprises can hopefully be expected here!

**Lars Kröger**

**Within the network of fluvial ports**  
**Efficiency and infrastructural development of inland waters and their vessels**

As a rule, trading centres depend on their infrastructural links to regional and transregional traffic systems. The research on ancient overland routes has already a long tradition. In contrast, there is a considerable lack of studies concerning waterways that eventually transformed trading centres into harbours. Navigation on seas and larger lakes required human interference with nature only for the creation of landing and transshipment points. In order to make navigation possible on rivers, however, much larger infrastructural changes were required: river beds had to be cleared, towpaths were created, and already existing disturbances of the cultural landscape (such as mill and fishing weirs) had to be removed. When, how, and on whose account these measures were implicated in Central Europe, is currently not known.

A new project situated at the “Deutsches Schiffahrtsmuseum” in Bremerhaven will fill this gap by collecting a suitable amount of data, especially concerning the findings of inland vessels, but also combining them with written and iconographic sources. By comparing and contrasting the usage histories of the rivers Main and Neckar differing patterns of developments will be demonstrated and integrated into the binary correlation of “ships and harbours”. Moreover, a catalogue of archaeologically attested inland vessels in Central Europe is going to be prepared. The project aims at establishing a model of anthropogenous river development and transport in the Early and High Middle Ages, which will form a solid basis for our understanding of harbour structures of this age.

**Kuratorium Pfahlbauten, H. Pohl, crazy eye, R. Weßling**

## **Structure from Motion zur systematische 3D-Dokumentation der unterwasserarchäologischen Grabung Seewalchen am Attersee, Österreich.**

150 Jahre nach Entdeckung der ersten Pfahlbauten in Österreich können durch moderne wissenschaftliche Methoden vollkommen neue und außergewöhnliche Erkenntnisse aus diesen einzigartigen archäologischen Quellen unter Wasser gewonnen werden. Um die Oberösterreichischen Landesausstellung 2020: „Versunken - Aufgetaucht. Pfahlbaukultur am Attersee und Mondsee“ besonders informativ und nach dem letzten wissenschaftlichen Stand zu gestalten, werden durch das Land Oberösterreich neue Forschungsprojekte realisiert, die eine

moderne Sicht auf das Phänomen Pfahlbauten ermöglichen. Das Pilotprojekt 2015 dient der Sicherung und archäologischen Aufnahme einer Abbruchkante in Seewalchen am Attersee. Während dieser ersten unterwasserarchäologischen Ausgrabung in Österreich seit 35 Jahren wurde Structure from Motion zur systematische 3D-Dokumentation eingesetzt. Erste Erfahrungsberichte zum Einsatz dieser Methode für die flächige Grabungsdokumentation werden vorgestellt.



**Barbora Machová**

**Archaeology of watercourse and water area.  
Development and methodology application of underwater  
archaeology in different underwater environments in the Czech  
Republic**

The paper follows up beginnings of underwater archaeology in the Czech Republic and its applicable methodology. Two underwater surveys were undertaken by 2015 in different environments. The main issue of this poster is to compare the

survey methodology of watercourse on the example of the Elbe River (Třikřížkova railroad) and water area survey on the example of the Orlik Reservoir (Korazovice-Vystrkov hillfort).

**Broder J. Merkel**

## **GAUSS (German Academy of Underwater Sciences) e.V.**

### **Aufgaben, Pflichten, Verantwortung und Haftung beim wissenschaftlichen Arbeiten unter Wasser**

Der innerbetriebliche Arbeitsschutz in einem Unternehmen reicht vom PC-Arbeitsplatz, über Werkstätten und Labore bis zur Tätigkeit in einem Bergwerk oder als Taucher unter Wasser. Für alle Bereiche muss der Arbeitsgeber geeignete Vorkehrungen treffen, damit es möglichst zu keiner Beeinträchtigung der Gesundheit der Arbeitnehmer kommt. Diese Aspekte werden am Beispiel des wissenschaftlichen Arbeitens unter Wasser erläutert. Dies betrifft die Ausbildung der tauchenden Wissenschaftler, Arbeitsschutzanweisungen und die jeweilige Risikoanalyse in Abhängigkeit von den lokalen Gegebenheiten am Arbeitsort. Es werden insbesondere die Randbedingungen in Deutschland angesprochen.

### **Tasks, duties, responsibilities and liabilities regarding scientific work under water**

In-house occupational safety in an enterprise is a wide field from a PC workplace, working in workshops and labs or working in a mine or as diver under water. It is in the employer's responsibility to make dispositions needed to protect the health of employees. These aspects will be discussed using the example of scientific work under water. This concerns the education of scientific divers, occupational safety regulations and the perspective risk assessment analysis with respect to the local boundary conditions at the working site. Notably the boundary conditions in Germany will be addressed.

**Małgorzata Mileszczyk**

## **Wetland Battlefield by Muchawka River – Major Inconvenience or Local Heritage?**

With the permission of the Masovian Provincial Heritage Protection Office, in September 2015 the University of Warsaw's Underwater Expedition began the new inland project. Muchawka, a small river in eastern Masovia, was the landmark of the victorious battle of Iganie (the November Uprising, 10th April 1831). The team of archaeologists was joined by Rafał Dmowski, the local history researcher and the author of numerous publications concerning the battle and supported by "Our Iganie" Society.

The decision to catalogue the residues from the river bottom was made because of the massive destruction of the local area caused by the arrangements of the river

dredging. Moreover, the terrain was a matter of a continuous interest of the "amateur antiquarians", who were permanently robbing the site of the artefacts.

As a full-member of UNESCO UniTwin Network for Underwater Archaeology, we are working on the basis of the organisation's statute guidelines concerning the environment protection, therefore the project will be executed in the possibly least destructing way (on the contrary to the deeds of the amateur explorers association, that only lately gained a controversial legal permission to scavenge the site...).

**Isabell Nittel**

**Ein Pfahlfeld und ein hölzernes Schiffswrack in Rostock Hohe Düne –  
Methoden und Ergebnisse einer Untersuchung im Rahmen einer  
Masterarbeit**

Im Rahmen einer Masterarbeit wird von mir zurzeit eine Untersuchung zweier Fundplätze in Rostock Hohe Düne durchgeführt, welche aus einem Pfahlfeld sowie eines hölzernen Schiffswracks bestehen. Die Fundplätze wurden 2013 durch die Gesellschaft für Schiffsarchäologie Rostock e.V. gefunden und seitdem betaucht. Die erhobenen Daten werde ich derzeit aus, beendet wird die Arbeit spätestens im März 2016. Die Methoden und Ergebnisse meiner Untersuchung möchte ich gern als Poster auf der DEGUWA-Tagung im April 2016 vorstellen. Dabei soll es eine generelle Übersicht des Fundplatzes geben; zudem sollen die Arbeiten unter Wasser sowie die Methoden vorgestellt werden, welche von mir angewendet wurden, um zu einem zufriedenstellenden Ergebnis, möglichst in Form einer Interpretation des Fundplatzes,

zu gelangen. Ob eine Interpretation möglich ist, kann jedoch noch nicht klar vorhergesehen werden, da die Arbeit noch nicht abgeschlossen ist. Die Ergebnisse selbst werden auf dem Poster auch vorgestellt werden.

Bei dem Pfahlfeld handelt es sich um ein circa 30m x 30m großes Feld, in welchem massive Pfähle eine Art Viereck umranden und zudem in der Mitte des Feldes zu finden sind. Die Distanz zum Ufer beträgt etwa 200m. Das Schiffswrack befindet sich an der nordwestlichen Seite des Pfahlfeldes und wurde wohl in Klinkerbauweise gebaut.

Bei meinem Poster handelt es sich nicht um neue wissenschaftliche Methoden und Techniken der Unterwasserarchäologie, sondern um die Bearbeitung eines neu entdeckten Fundplatzes.

**Detlef Peukert**

## **Die mittelalterliche Mühle „mole zu ‚Wyrde‘: Archäologischer Erstnachweis in der Lahn bei Wetzlar - Die älteste Wassermühle in Hessen?**

Bei der vom Landesamt für Denkmalpflege Hessen (Dr. Sabine Schade-Lindig) genehmigten Unterwassernachforschung wurde per Side-scan Sonar die 1314 erstmalig erwähnte „Werderfurt“ wiederentdeckt. Tauchuntersuchungen der Bayerischen Gesellschaft für Unterwasserarchäologie (BGfU [www.bgf.de](http://www.bgf.de)) ergaben ein Mühlenwehr der „mole de Werden“ (Ersterwähnung 1318). Dieses hatte Roman Scholz (RGK), mit Jürgen Reitz vermessen. Erhalten blieb die ca. 80 cm unter Flussgrund liegende Mühlradgrube. Auf einer „Werth“ fanden sich Bauholzreste und Pfosten der Mühle die von Dr. Thorsten Westphal zwischen 1106 und 1199 AD datiert wurden.

Ein Mühlsteinrest nahe Typ Aventicum B aus Eifel-Basalt wurde von Dr. Fritz Mangartz (RGZM) zwischen 800 und 1200 AD datiert. Der mehrfach sekundär genutzte Läufersteinrest diente als Achslager des Wellbaums, Kompositbodenstein und Gegengewicht.

Seine Nutzung als Anker oder zum Festmachen an einem Anleger kann nicht ausgeschlossen werden.

Rillen, Gruben und Nuten am mittelalterlich genutzten Stein im Stil römischer Technologie weisen eine Vielzahl von Spuren auf, die den Technologietransfer nachvollziehen lassen. So ist die Arbeitsweise des jüngeren Müllers beim Schärfen des Steins im Detail nachzuvollziehen. Selbst die Größe des mittelalterlichen Müllers ließ sich durch die Analyse bogenförmiger Schärfrillen auf ca. 1,65 m kalkulieren.

Die Dendrodatierung der erstmalig archäologisch nachgewiesenen Mühle ermöglichte eine Datierung um ca. 210 Jahre vor ihrer Ersterwähnung.

Die Analyse der Urkundenbücher ergab Evidenzen für den Untergang der Mühle durch die Magdalenenflut vom 19.–25. Juli 1342, einer Jahrtausendflut mit ca. 10 m Hochwasser.

**Inês Vaz Pinto, Ana Patrícia Magalhães, Patrícia Brum and Johann Müller**

### **Troia: the largest fish salting production centre of the Roman Empire**

The Roman ruins of Tróia, Portugal, are the remains of the largest fish-salting production center of the Roman Empire, with 26 fish-salting workshops identified and a production capacity that surpasses that of all other sites of the kind. Built in the first half of the 1st century AD, it developed into an urban settlement with houses, baths, cemeteries and an early Christian basilica and was inhabited probably until the 6th century.

Built very close to the shoreline to facilitate the transportation of fish, salt and amphorae, this archaeological site is nowadays threatened by marine erosion, due to the rise of the sea level and the periodic removal of sand by the tidal

movement. Many of its fish-salting workshops are presently reached by the tides and suffer a process of disaggregation.

In 2007, on the occasion of beach nourishment carried out partially in the affected area, four workshops were covered with sand as a protective measure. Yet the protective effect will be only temporary since the sand is being slowly taken away by natural processes so that the ruins will again be exposed to the tides after a few years. So the question is: “How can this important European cultural heritage be preserved for future generations?”

**Marie-Claire Ries**

## **Multidisciplinary Research on a Bronze-Age settlement at Lake Attersee (Austria)**

The Austrian Alpine Foreland is home to numerous lakes but most of their inundated underwater heritage has yet to be explored on an interdisciplinary level. New investigations have been carried out since 2013 at the protected UNESCO World Heritage site of Abtsdorf I. This lacustrine site is the first and until now, the only, Early Bronze-Age lake settlement located in Austria. Since the inception of new investigations, intensive collaboration between paleoecologists and archaeologists has been necessary. Pollen analysis, in particular, was applied to this site to gain insight into the development of the cultural landscape. Therefore systematic core extraction of sedimentary archives was

conducted during an underwater archaeological survey. The samples were taken to Kiel University for further analysis. Providing a basic insight into the human influence on the landscape was the main focus. The analysis was conducted using a multidisciplinary approach, including palynological investigation, in order to develop a better understanding of landscape transformation processes and to trace possible subsistence patterns during prehistoric settlement phases reflected in the palaeoenvironmental record. The results illuminate patterns in vegetation dynamics associated with human-impact history.