



Archaeology:
Just Add Water

volume II

2019

ŚWIATOWIT Supplement Series U: Underwater Archaeology, vol. II

Editor of the Series:

dr hab. Bartosz Kontny, prof. UW

Editors of the Volume:

Aleksandra Chołuj
Małgorzata Mileszczyk
Magdalena Nowakowska

Reviewers Board:

dr hab. Mateusz Bogucki, prof. IAiE PAN
dr hab. Maciej Karczewski, prof. UwB
dr Piotr Kotowicz
dr hab. Grzegorz Kowalski
prof. dr hab. Kazimierz Lewartowski
dr Henryk Meyza
prof. dr hab. Krzysztof Misiewicz
dr hab. Tomasz Nowakiewicz
dr hab. Agnieszka Tomas
prof. dr hab. Przemysław Urbańczyk
prof. dr hab. Mariusz Ziółkowski
dr hab. Jarosław Żrałka

Financed by:

Polish Ministry of Science and Higher Education (959/P-DUN/2018)
Director of the Institute of Archaeology, University of Warsaw

Cover Photo: Humantay Lake, Peru 2016, by Przemysław A. Trzeźniowski
Back Cover Photo: Underwater Expedition IA UW at the 19th Archaeological Festival in Biskupin,
Poland 2013, by Marcin Bartoszewicz

© Instytut Archeologii UW 2019

© the Authors

ISSN 2719-2997

ISBN 978-83-66210-03-5

Series DOI: 10.35538/uw.2719-2997

DOI of the volume: 10.35538/uw.2719-2997/978-83-66210-03-5

Typesetting and makeup: Aleksandra Chołuj, Małgorzata Mileszczyk, Magdalena Nowakowska
Print and binding: Elpil, Siedlce

„3rd Warsaw Seminar on Underwater Archaeology – zadanie finansowane w ramach umowy 959/P-DUN/2018
ze środków Ministra Nauki i Szkolnictwa Wyższego przeznaczonych na działalność upowszechniającą naukę”



Archaeology: Just Add Water

Underwater Research at the University of Warsaw



Ministerstwo Nauki
i Szkolnictwa Wyższego



United Nations
Educational, Scientific and
Cultural Organization



Unitwin Network
for Underwater
Archaeology



POLISH CHAPTER
ODDZIAŁ POLSKI

WARSZAWA 2019

Preface

Dear Colleagues,

It is our great pleasure to present to you the second volume of the U Supplement Series of the “Światowit” periodical. To a large extent it is based on the papers presented during the 3rd *Warsaw Seminar on Underwater Archaeology*, which took place at the University of Warsaw on the 17th and 18th of January 2019.

An efficient and prompt process of editing we owe to the funding from the Ministry of Science and Higher Education, grant no. 959/P-DUN/2018.

Organization of the Seminar and publication of the hereby volume was possible thanks to the co-operation with the Polish Chapter of the Explorers Club, in particular its President, Professor Mariusz Ziółkowski, and the Vice-President, Marcin Jamkowski, to whom we are deeply grateful.

We would also like to acknowledge and appreciate the support of the University of Warsaw, namely the Vice-Rector Ph.D. habil. Maciej Duszczyk, the Dean of the Faculty of History, Ph.D. habil. Małgorzata Karpińska, Professor UW, as well as the Director’s Board of the Institute of Archaeology: Ph.D. habil. Krzysztof Jakubiak, Ph.D. Michał Starski, and Ph.D. Marta Żuchowska.

The special thank you we traditionally owe to the Diving Museum by the Warsaw Diving Club, especially the Museum’s Curator, Karina Kowalska, and the Club’s President, D.Sc. Grzegorz Kowalski, who have been supporting our activities for many years, and constantly guide and help us in numerous enterprises.

We would like to extend our gratitude to all the Authors and Reviewers, who have been extremely diligent and punctual to keep up with our strict deadlines.

During the editing of the volume we have received invaluable consultations in the matter of ancient languages by Tomasz Płóciennik and Ph.D. Joanna Wegner, who we would also like to thank with all our hearts. The post-editing process was successful due to the the kind assistance of Ph.D. Rafał Dmowski, who we owe enormous gratitude.

The whole book was once again skilfully supervised and managed by the one and only irreplaceable Ph.D. habil. Bartosz Kontny, Professor UW. Him we would like to thank for all the advice and help with difficult choices, as well as the dedication to the organizational matters, even though the really tight schedule.

Last but not least, we would like to thank all the Readers who have reached for the hereby volume. We sincerely hope you will enjoy the outcome of our efforts and wish you pleasant reading!

Aleksandra Chołuj

Małgorzata Mileszczyk

Magdalena Nowakowska

3rd Warsaw Seminar on Underwater Archaeology



3rd Warsaw Seminar on Underwater Archaeology held on 17th-18th of January 2019
at the University of Warsaw
(photos by: M. Sugalska)

Foreword

The volume, which we hereby present to our esteemed Readers, is the vivid proof that underwater archaeology at the University of Warsaw is doing more than well. It is the second publication in the “*Światowit*” *Supplement Series U: Underwater Archaeology*, issued for now (and we hope this pace will be sustained!) with a frequency of a periodical. Within the book one might find i.a. the texts being an outcome of the international 3rd *Warsaw Seminar on Underwater Archaeology*, organized in the Institute of Archaeology, University of Warsaw. The Readers will discover here the articles presenting broad chronological and geographical range of issues: from the Prehistory until the Second World War, from Guatemala and Peru to Poland and Slovakia. We are trying to reflect this diversified character also by the choice of photographs on the cover.

The leitmotif of all this vast range of archaeological issues is **water**: realm bearing a magnificent symbolic character. Changing its colour (even during the day – from the blackness, through greyness, then blue, until the bloody-red at the sunset, turning again into black) and visibility, it has manifested also other features, which can be contemplated as signs of its animation, such as movement: horizontal (currents, waves, tides) and vertical (fluctuations of the surface). It was also the source of life quite literally, providing food and dihydrogen monoxide, essential for living.

Along with its whole mystery and dangerousness, water may also serve as a refuge (lake settlements from the early Iron Age) and a trade route, at the end of which there is a (hopefully) safe harbour. That is how underwater archaeology marches onto the land... Although, it is neither place nor time for the deliberation about the definitions of archaeology related to water environment; the discussion in this matter has lasted for many years, abound in more and more new terminological propositions, still being far from any resolutions. Whichever position we assume in the aforementioned debate, it is impossible not to notice that the symbolism, the rituals, and everyday casual activities essential for life and connected with water pass through each other, which is well-exemplified by the hereby volume. Objects lost during transportation and other kinds of exploitation of water basins, items put in the water as a matter of rituals, military aspects connected with watery environment, lake settlements, harbours, and trade – all of that and even more you can discover in *Just Add Water 2*. To all the Readers, who are going to immerse themselves into this topic, I wish a pleasant intellectual adventure and... good dives!

Bartosz Kontny

The Most Recent Five Years of Underwater Research in the Department of Underwater Archaeology at Nicolaus Copernicus University in Toruń

Mateusz Popek*

Andrzej Pydyn**

Abstract:

The article describes the last five years of research activities of the Department of Underwater Archaeology at Nicolaus Copernicus University, Toruń, Poland. Over this period the Department has made a big progress in the application of new technologies in scientific research. The first significant change took place in the period 2013/2014, when non-invasive technologies such as GPR, sub-bottom profiler, and side-scan sonar were used. Underwater excavations at the Lake Lednica archaeological site (Greater Poland, Poland) started as early as in the 1970's of the 20th century. In the years 2015–2018 new technologies were adopted for research in the lake. Moreover, spectacular discoveries were made, including a new bridge on the island of Ledniczka (Greater Poland, Poland). At the same time, a large logboat was documented (photogrammetry) and risen from the lake. Also, new methods of documentation and research (multibeam sonar, sub-bottom profiler) were implemented at the site. In 2018, after almost a thirty-year-long break, the Department of Underwater Archaeology returned to research on the medieval harbour in Puck Bay (Pomerania, Poland). The activity was connected with a new project: Virtual Arch – Visualise to Valorize. For Better Utilization of Hidden Archaeological Heritage in Central Europe. The main goal of this project is to create 3D visualisation of the medieval harbour.

Keywords:

underwater archaeology, Nicolaus Copernicus University (UMK), Lake Lednica, Puck, medieval harbour, medieval bridge

The beginnings of underwater archaeology at the Nicolaus Copernicus University in Toruń can be seen in 1975 when an underwater scientific and research team was set at the Institute of Archaeology and Ethnography. In 1976, archaeology students were trained for underwater

* M.A.; Nicolaus Copernicus University in Toruń; e-mail: mpopek@umk.pl.

** Ph.D. habil.; Nicolaus Copernicus University in Toruń; e-mail: pydyn@umk.pl.

research (Kola and Wilke 1980: 96). The first underwater archaeologists from Toruń gained their experience during the research of George Bass from the Institute of Nautical Archaeology, carried in Turkey, among other locations, at the site of Yassi Ada (Wilke 1985). In Poland, however, archaeologists from Toruń have been involved in the work of the Central Maritime Museum on the 'Miedzowiec' wreck (Kola and Wilke 1983). After seven years of research, in 1982, the Laboratory of Underwater Archaeology was created and headed by Gerard Wilke, Ph.D. In 1985, the Laboratory was redesignated as the Department of Underwater Archaeology (Chudziakowa 2002: 67–72).

The basic research topic of the Department of Underwater Archaeology was the early medieval bridges of the West Slavs. In addition to many bridges having been found and examined, the most comprehensive studies were carried on the remains of the bridge in Lake Bobiecińskie Wielkie (Pomerania, Poland) in the years 1976–1982 (Kola and Wilke 1985; Szulta 2008; Wilke 1983), and from 1982 to the present day on two bridge crossings leading to Ostrów Lednicki Island (Greater Poland, Poland; Kola 2000; 2014; Kola and Wilke 2000; Kola *et al.* 2016; **Fig. 1**). From the mid-1980's to the first decade of the 21st century regular research and verifications of lake dwellings and lake-side dwellings was also conducted (Gackowski 1993a; 1993b; 2017; Pydyn 2010; Wilke 1988; 1991). At the beginning of the 1990's, the Department of Underwater Archaeology conducted research of the early medieval port in Puck (Pomerania, Poland; Szulta 1993; 1995; 2002a; 2006; **Fig. 2**). Outside the Polish borders, underwater archaeology teams from Nicolaus Copernicus University carried the projects in the ancient city of *Olbia* (Mykolaiv Oblast') in Ukraine (Pydyn 2008; Szulta 2002b), and in the port of Zaton (Dalmatia) in Croatia (Pydyn and Gluščević 2011).

The year 2013 was a breakthrough time for the Department of Underwater Archaeology. It was in that year that a project called: *Non-destructive Comprehensive Recognition of Archaeological Resources of the Bottoms of Lakes and Coastal Zones in Selected Reservoirs of the Iławskie Lake District* was carried, and it was continued under the name: *Recognition of Archaeological Resources of Lakes and the Coastal Zone of the Iławskie Lake District* in 2014 (Pydyn 2016: 79).

During these two projects, the Department team decided to introduce into the prospection technologies that had not been used in inland waters until then. This approach has given exceptionally good results in the lakes where archaeological sites have not yet been discovered.

In the 2013 season 12 lakes from the region of Warmia (Poland) were surveyed: Jeziorak, Łabędź, Trupel, Łodygowo, Młynek, Bartężek, Ruda Woda, Ilińsk Mały, Klasztorne, Kocioł,

Silm, and Mózgowskie (Gulbińskie); in most of them new sites have been located or archival sites have been verified (Pydyn 2013; 2016). Several non-invasive prospection methods have been used during this project. The first of these was a single beam sonar scan with simple side scan sonar (Lowrance HDS 5 Gen), which has been used to create bathymetric maps and search for objects protruding from the bottom. Another method used was the sub-bottom profiler, the purpose of which was to register the archaeological layers of the bottom sediments. The last method applied was based on the use of ground-penetrating radar, which had been expected to detect archaeological structures under the lakebed.

Of the dozen archaeological sites surveyed, four were the most interesting in the 2013 season. The first of them was a bridge on Lake Jeziorak, leading from the island of Wielka Żuława, to the north (**Fig. 3**). During the prospection, the Department of Underwater Archaeology team has located there relics of the bridge crossing and a very large collection of artefacts (Popek *et al.* 2013). This crossing is marked on a map dated back to 1620 (Szczepański 2013: 247). The bridge, dated dendrochronologically, was determined to be from the latter part of the 13th century. A collection of artefacts from the site of the crossing is dated broadly, from the Early Middle Ages to the beginning of the 20th century (Popek *et al.* 2013). The second extremely interesting site is located on the isthmus connecting Lake Jeziorak with Lake Płaskie. At this point, guided by archaeological intuition (on the ground there are no reported traces of archaeological sites) the Department of Underwater Archaeology team has located two bridges and a dugout. The first of the crossings dates back to the middle of the 11th century and the second's chronology was established broadly: between the end of the 8th and the mid-tenth century. In addition, near the older crossing at its northern abutment, prehistoric material appeared over a vast area. Fragments of pottery from the Early Bronze Age and pieces related to the so-called West Balts Barrows Culture from the Early Iron Age have been found there, as well as two antler axes, one of which has been radiocarbon dated with a probability of 95.4% to the period between 1421–267 B.C. (Pydyn 2016; **Fig. 4**).

There is another very interesting site in Lake Klasztorne. This lake is located to the west of the lakes discussed earlier. Researched in the 1990s, two clusters of piles in the bay of the lake were interpreted as a lake dwelling or remains of bridges dated to the Neolithic. In 2013 the research team decided to verify this site. A dozen or so new objects have been found, including an extremely interesting T-shaped axe, radiocarbon dated with a probability of 90.8% between the years 4064 and 3964 B. C. New research results suggest that these objects may be remnants of a fish trap construction (Kofel *et al.* 2014; Pydyn 2016). The last

exceptionally interesting site researched in the 2013 season was two bridge crossings leading to the island of Kurhany on Lake Łodygowo (**Fig. 5**). Although the site was known in the 19th century, there was not enough archaeological documentation. The bridges date from the beginning of the 12th and the beginning of the 14th century. Although they run from other directions, they converge at one point on the island where the gate to the stronghold had been most likely located. The huge number of animal bones was discovered in shallow waters that surround the island. In addition to the significant quantity of pottery, large number of metal objects has been found there (Pydyn 2016; Pydyn *et al.* 2017).

In the 2014 season Lake Hławskie, Lake Mózgowskie (Gulbińskie), Grażymowskie lakes (Eastern and Western), and Lake Gil Wielki (Warmia, Poland) were surveyed. Among them the most surprising was Lake Gil Wielki. In the shallows in the middle of the lake and on nearby peninsulas bone material and prehistoric ceramics have been found. Carbon deposits inside ceramic vessels have been dated using the radiocarbon method. The earliest dated find comes from the middle of the 4th millennium B.C., and the most recent from the latter part of the 2nd millennium B.C. Archaeozoological analyses suggest that the majority of bone remains belong to wild animals. All this suggests that the team is dealing with a multi-phase coastal prehistoric site, with an important phase attributed to the Corded Ware Culture horizon (Pydyn 2016).

From 2013 to 2018 underwater research at Ostrów Lednicki has been conducted every year. The years 2013–2014 have been devoted to continuing the exploration of the western bridgehead of the so-called Poznań Bridge in order to determine its construction details. However, the following years brought very different and interesting findings. In the 2015 season a unique object identified as a fishing trap was found at the abutment of the Poznań Bridge (Gręzak *et al.* 2018; **Fig. 6**). Owing to their very delicate construction, such objects are extremely rare, and finding them *in situ* is exceptional. Thanks to a very precise and delicate exploration, archaeologists managed to document the object at the place of its finding and extract from it several hundred fish bones and three domestic animal bones, probably bait located inside the trap. The high research value of the find led to the decision to extract it and pass to the Museum of the First Piasts in Lednica (Polish: *Muzeum Pierwszych Piastów na Lednicy*). The operation required exceptional delicacy and precision, but it was possible to extract the object. Currently, it is in the Museum of the First Piasts conservation-restoration department and will be exhibited at this facility in the future (Pydyn *et al.* 2018). In 2016, during an underwater archaeological excavation of Lake Lednica, an eleven-metre-long dugout from the Early Middle Ages was excavated. The boat was found in 1989 during

the exploration of the eastern part of the Poznań Bridge. In 2016 at the request of the newly emerging Polish History Museum in Warsaw, the Department of Underwater Archaeology team performed an operation to raise the object. The operation was extremely difficult because of the lime wood of which the boat was made (**Fig. 7**). This material made the object very delicate and even a slight pressure on the surface might have caused irreversible damage. Therefore, it was decided to extract the object in seven parts in accordance with its natural cracks. The operation proceeded smoothly, and the object is currently located at the Laboratory of Documentation and Conservation of the Institute of Archaeology, Nicolaus Copernicus University in Toruń; in the future it will become part of the exhibitions of the Polish History Museum in Warsaw (Radka 2017; Pydyn and Radka 2017).

The year 2017 was a breakthrough in the research of Lake Lednica. In this year, the project entitled: *The Cradle of the Piasts – Archaeological Underwater Prospections in the Area of Lake Lednickie* was implemented. As part of this project, prospections were conducted around the lake, but non-invasive scanning of the water basin itself was also carried. To create an accurate bathymetric map of the selected area a multi-beam (Sea-Bat 7125) probe has been used which made it possible to cover 100% of the lakebed. In addition, a sub-bottom profiler Innomar SES 2000 Medium has been applied, showing the exact location of all objects below the sediments. Finally, the selected area was scanned with a caesium magnetometer (G858 and G882) which has indicated non-metal objects on and under the lakebed. These tasks were carried by the Maritime Institute in Gdańsk. Thanks to this, almost 500 locations that could be of archaeological value were obtained. Only a small number of these readings have been checked, but this contributed to the discovery of not only loose finds, but also a completely new archaeological structure (**Fig. 8**). This new object was a bridge leading from the mainland to the island of Ledniczka. A year later, in 2018, it was decided to excavate a small part of this bridge, which brought some very interesting results (**Fig. 9**). Archaeological remains acquired during the research can be dated mostly to the 13th century. However, both dendrochronological and radiocarbon dating methods indicate two separate results: the 13th and 10th century. Therefore, it can be assumed that two bridges of different chronology had been located here (Pydyn *et al.* 2018).

The third research issue on which the team of the Department of Underwater Archaeology has focused is the reconstruction of the medieval port in Puck (Pomerania, Poland). These activities are carried as part of the project *Virtual Arch – Visualise to Valorize. For Better Utilization of Hidden Archaeological Heritage in Central Europe*. This project is a part

of the Interreg Central Europe framework and will be carried in the period of 2017–2020. The aim of this project is to create an application for mobile devices that will make it possible to ‘explore’ the virtual reconstruction of the port. One of the activities leading to this aim was the collection of the archival documentation of research conducted in this site from the 1980s to 2014 (Szulta 2002a), and its digitalization. The next action was the creation of an accurate bathymetric map of the area of the harbour under investigation with the use of multibeam sonar. These tasks were carried in collaboration with the Maritime Institute in Gdańsk. Next, photogrammetry of the wooden structures appearing there has been made in selected areas, which will serve as a basis for three-dimensional reconstruction (**Fig. 10**). Taking advantage of the opportunity, scans have been made using a completely new so-called parametric sub-bottom profiler, provided by the Innomar company, which allows not only the production of profiles but also three-dimensional visualization of the tested sediments. This gave unexpected results in the form of detailed plans of old excavation trenches already invisible on the surface and a great number of new archaeological objects. As a part of these activities, evidence of the very dynamic destruction of archaeological layers at this site by the activity of the sea has also been gathered; this situation requires the fastest possible archaeological intervention and rescue research.

The most recent five years have been a very dynamic period in the activities of the Department of Underwater Archaeology, Institute of Archaeology, Nicolaus Copernicus University in Toruń. During this period, the team has moved from traditional drawing documentation and search performed by divers to prospection with non-invasive approach to documentation using geodetic methods and photogrammetry, which has pushed the Department’s methodology into the 21st century and made it possible to compete with the leading European centres. This period has also been very abundant in archaeological discoveries. The team has located several dozen new sites in the Iławskie Lake District, several of which have been exceptionally spectacular. Even the research of Lake Lednica, which has been conducted for so many years and which has not foreshadowed any novelties, has brought unique findings of fishing traps and a new bridge crossings. It has also been decided to return to the subject of the port in Puck, which somehow has been forgotten by researchers, and is one of the most interesting underwater archaeological sites in Poland. However, this is only the beginning of a new path in the future of the Department. For the coming years, it is planned to constantly develop and test new technologies, expand research interests towards the underwater cultural landscape, and make new cooperation agreements with leading world centres of underwater archaeology.

Literature:

Chudziakowa J.

2002 *Działalność badawcza i dydaktyczna Instytutu Archeologii i Etnologii UMK w Toruniu (1946–2002)*, (in:) B. Wawrzykowska (ed.), *Archeologia Toruńska. Historia i terażniejszość*, Toruń, 67–72

Gackowski J.

1993a *O potrzebie przeprowadzenia systematycznych badań archeologicznych na osiedlach nawodnych w północno-wschodniej Polsce*, *Acta Universitatis Nicolai Copernici, Archeologia XXI*, 51–67

1993b *Historia i stan badań osad „palowych” na Pomorzu*, *Acta Universitatis Nicolai Copernici, Archeologia XXI*, 6–85

2017 *Osiedla nawodne kultury kurhanów zachodniobałtyjskich w krajobrazie naturalnym i kontekście kulturowym północno-wschodniej Polski*, „*Komunikaty Mazursko-Warmińskie*” 1 (259), 3–22

Gręzak A., Iwaszczuk U., Pydyn A., Popek M., Radka K.

2018 *Średniowieczna wiersza z rejonu mostu zachodniego na Ostrowie Lednickim*, „*Studia Lednickie*” 17, 161–179

Kofel D., Popek M., Pydyn A.

2014 *Long Term Structures in Archaeology. Fishery Activities in the Jeziorak and Klasztorne Lake*, „*Skyllis*” 14/1, 10–15

Kola A.

2000 *Archeologiczne badania na reliktach mostu*, (in:) Z. Kurnatowska (ed.), *Wczesnośredniowieczne mosty przy Ostrowie Lednickim t.1: Mosty traktu gnieźnieńskiego*, Lednica – Toruń, 11–27

2014 *Archeologiczne badania na reliktach mostu (do 2003 roku)*, (in:) A. Kola, G. Wilke (eds), *Wczesnośredniowieczne mosty przy Ostrowie Lednickim t.2: Mosty traktu poznańskiego (wyniki archeologicznych badań podwodnych prowadzonych w latach 1986–2003)*, Kraków, 13–32

Kola A., Wilke G.

1980 *Toruński ośrodek archeologii podwodnej. Potrzeby i perspektywy badawcze*, *Acta Universitatis Nicolai Copernici, Archeologia 6*, 89–100

1983 *The Drawing up of a Height Plan of Late-Medieval Wreck, the “Copper Ship” (W-5) from Gdańsk Bay and its Utilization in Exploratory Work*, *Acta Universitatis Nicolai Copernici, Archeologia 9, Underwater Archeology 1*, 67–80

1985 *Archeologia Podwodna, cz. 1: Badania w akwenach śródlądowych Europy Środkowej i Wschodniej*, Toruń

2000 *Mosty sprzed tysiąca lat. Archeologiczne badania podwodne przy rezydencji pierwszych Piastów na Ostrowie Lednickim*, Bydgoszcz

Kola A., Radka K., Wilke G.

2016 *Mosty traktu „poznńskiego” i „gnieźnieńskiego” świetle badań podwodnych (1982–2015)*, (in:) Z. Kurnatowska, A.M. Wyrwa (eds), *Ostrów Lednicki: rezydencjonalno-stoleczny ośrodek pierwszych Piastów*, Warszawa, 107–129

Popek M., Pydyn A., Solecki R., Stencel P.

2013 *Przeprawa mostowa na wyspę Wielka Żuława na jeziorze Jeziorak*, (in:) Z. Kobyliński (ed.), *Archaeologia Hereditas. Grodziska Warmii i Mazur 1. Stan wiedzy i perspektywy badawcze*, Warszawa – Zielona Góra, 373–380

Pydyn A.

2008 *Preliminary Results of Archaeological Underwater Survey in the Northern Part of the Black Sea Basing on Example of Olbia*, (in:) E. Papuci-Władyka (ed.), *PONTIKA 2006: Recent Research in Northern Black Sea Coast Greek Colonies: Proceedings of the International Conference, Kraków, 18th March, 2006*, Kraków, 135–141

2010 *Archeologiczne penetracje podwodne strefy przybrzeżnej Jeziora Powidzkiego*, (in:) A. Pydyn (ed.), *Archeologia Jeziora Powidzkiego*, Toruń, 15–39

2013 *Wyniki archeologicznych prospekcji podwodnych w wybranych jeziorach Pojezierza Iławskiego*, (in:) Z. Kobyliński (ed.), *Grodziska Warmii i Mazur 1. Stan wiedzy i perspektywy badawcze*, *Archaeologia Hereditas 2*, Warszawa – Zielona Góra, 367–373

2016 *Wyniki archeologicznych prospekcji podwodnych w jeziorach Pojezierza Iławskiego w latach 2013 – 2014*, (in:) Z. Kobyliński (ed.), *Grodziska Warmii i Mazur 2. Nowe badania i interpretacje*, *Archaeologia Hereditas 7*, Warszawa, 79–92

Pydyn A., Gluščević S.

2011 *Archeologiczne badania podwodne antycznego Portu Zaton w środkowej Chorwacji*, *Acta Universitatis Nicolai Copernici. Archeologia 31, Archeologia Podwodna 6*, 23–46

Pydyn A., Popek M., Dębicka D., Radka K.

2018 *Przeprawa mostowa na wyspę Ledniczka – wstępne wyniki badań*, “*Studia Lednickie*” 17, 181–196

Pydyn A., Popek M., Maciejewski J.

2017 *Mittelalterliche Brücken zur Insel Kurhany im Lodygowo-See*, “*Skyllis*” 17/2, 153–160

Pydyn A., Radka K.

2017 *Der König der Einbäume. Ein mittelalterliches Boot aus dem Lednickie-See in Westpolen*, “*Skyllis*” 17/2, 128–134

Radka K.

2017 *Trzecia łódź jednopienna z Ostrowa Lednickiego*, “*Studia Lednickie*” 16, 81–98

Szulta W.

1993 *Z badań nad tzw. wczesnośredniowiecznym portem w Zatoce Puckiej*, (in:) J. Chudziakowa (ed.), *Badania archeologiczne ośrodka toruńskiego w latach 1989–1992*, Toruń, 163–168

1995 *Metody pomiarów geodezyjnych na wybranych podwodnych stanowiskach archeologicznych*, (in:) A. Kola (ed.), *Archeologia podwodna jezior Niżu Polskiego*, Toruń, 91–102

2002a *Badania podwodnych struktur archeologicznych zalegających w Zatoce Puckiej przeprowadzone w latach 1990–1992*, "Nautologia" 1–2, 76–82

2002b *Podwodny rekonesans archeologiczny w ruinach zatopionej części starożytnego miasta Olbia na wybrzeżu Morza Czarnego na Ukrainie w 2001 roku*, "Archeologia Historica Polona" 12, 207–209

2006 *Wraki Zatoki Puckiej*, "Zapiski Puckie" 5, 94–106

2008 *Przeprawy mostowe na ziemiach polskich w średniowieczu*, Toruń

Szczepański S.

2013 *"Wykopaliska" w archiwach – archeologia archiwalna na podstawie wybranych stanowisk pojezierza Iławskiego* (in:) Z. Kobyliński (ed.) *Grodziska Warmii i Mazur 1. Stan wiedzy i perspektywy badawcze*, *Archaeologia Hereditas* 2, Warszawa – Zielona Góra, 233–252

Wilke G.

1983 *Methods of Exploration and Documentation Applied in Archaeological Underwater Research under the Conditions of Limited Visibility on the Relics of an Early Medieval Bridge in Bobiecin (Pomerania) in 1977–1981*, *Acta Universitatis Nicolai Copernici. Archaeology* 9, *Underwater Archaeology* 1, 49–66

1985 *Bodrum – Yassi Ada 1982. Letnia szkoła archeologii podwodnej na tureckim wybrzeżu Morza Egejskiego*, *Acta Universitatis Nicolai Copernici. Archeologia* 11, *Archeologia Podwodna* 2, 89–100

1988 *Studia nad nawodnymi formami osiedli mieszkalnych w kulturach pradziejowych średniowiecznej Europy*, Toruń

1991 *Sprawozdanie z badań wykopaliskowych na stanowisku I w Moltajnach w woj. olsztyńskim w 1986 r. na osiedlu nawodnym kultury kurhanów zachodniobałtyjskich*, *Acta Universitatis Nicolai Copernici. Archeologia* 15, 25–41.

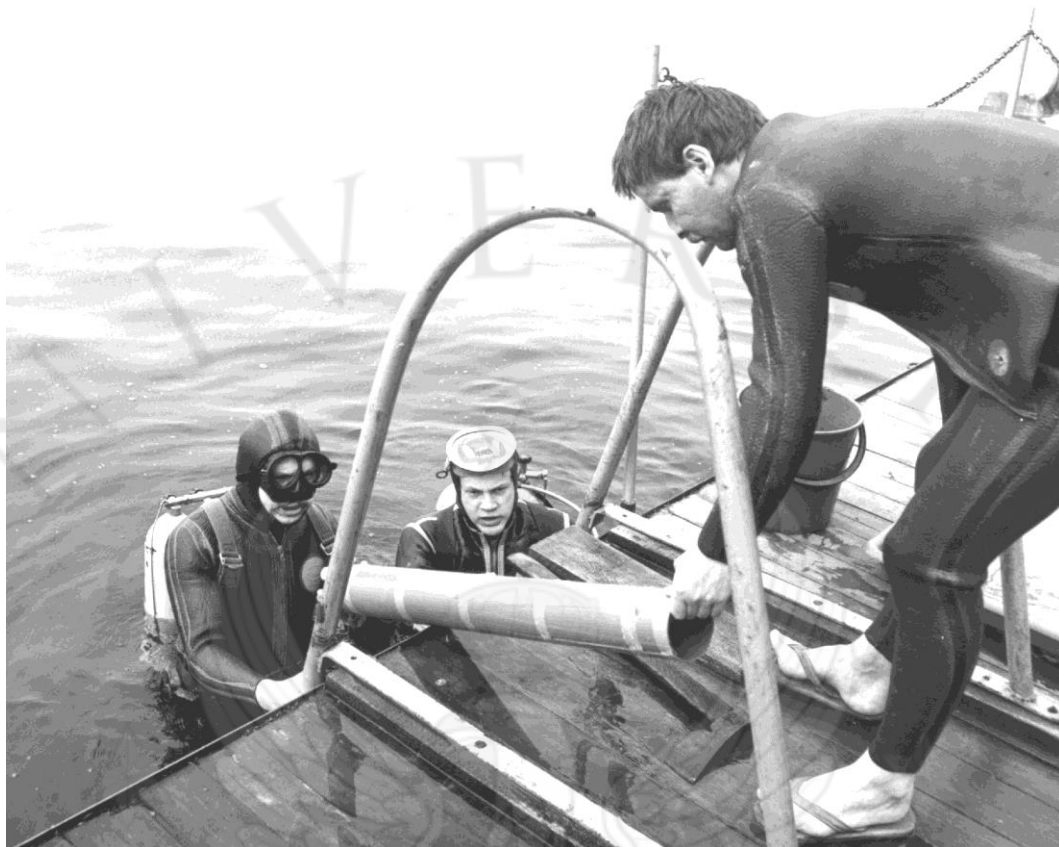


Fig. 1 – Underwater archaeological excavations in Lake Lednica in the 1980s
(Archives of the Department of Underwater Archaeology, UMK)



Fig. 2 – Underwater archaeological excavations in the Puck Bay in 1991
(Archives of the Department of Underwater Archaeology, UMK)



Fig. 3 – Documentation of the remains of the bridge at Lake Jeziorak – the Island of Wielka Żuława (photo by: A. Pydyn)



Fig. 4 – Archaeologist Rafał Solecki with the Bronze Age axe (photo by: D. Kofel)

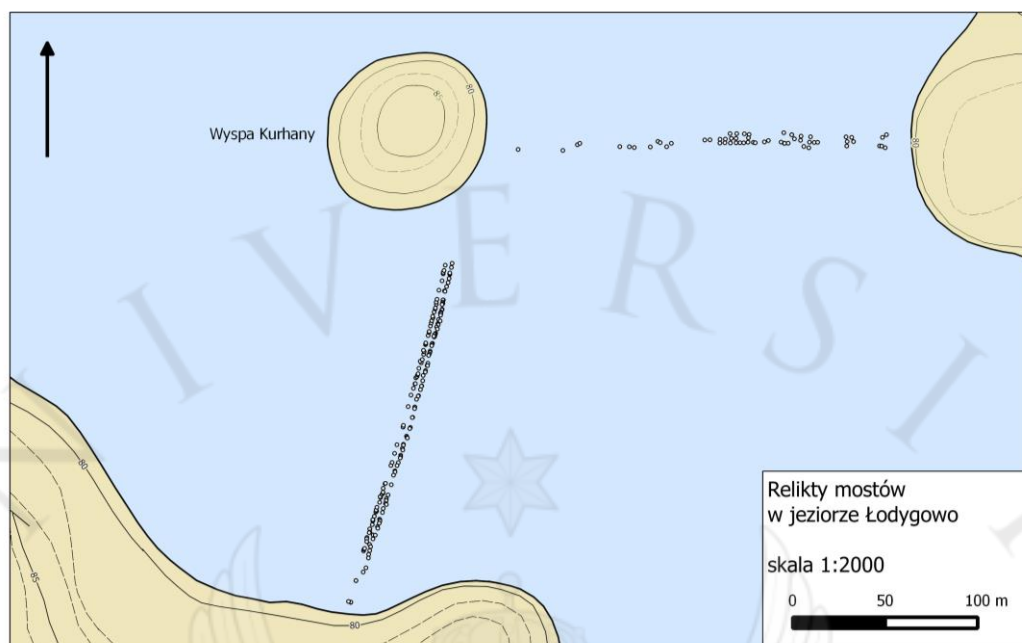


Fig. 5 – Plan of medieval bridges in Lake Łodygowo (elaborated by: P. Stencel)

DIGITAL
ARCHAEOLOGY
www.digital-archaeology.eu



Fig. 6 – Ortophotomosaic of a fish trap from Lake Lednica (elaborated by: P. Stencel)

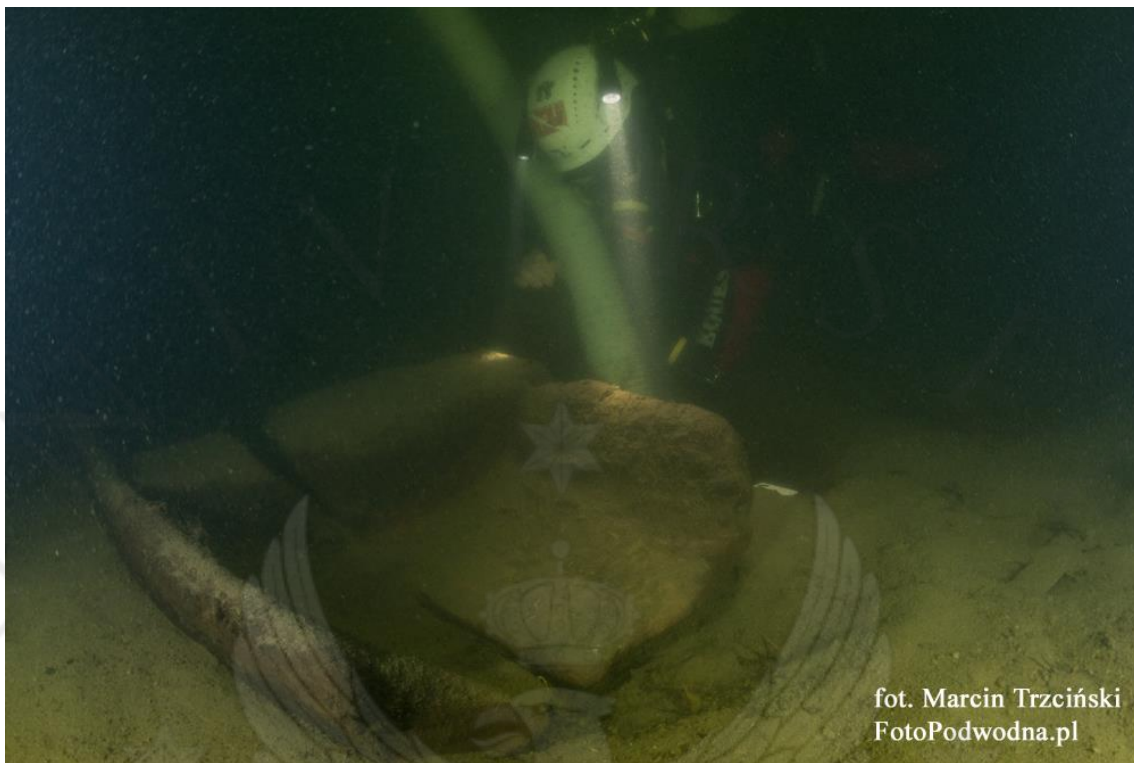


Fig. 7 – Large logboat from Lednica Lake (photo by: M. Trzcíński)



Fig. 8 – Diver with a medieval axe in Lake Lednica (photo by: M. Popek)



Fig. 9 – 3D model of trenches with remains of the medieval bridge on the island of Ledniczka, Lake Lednica (elaborated by: P. Stencel)

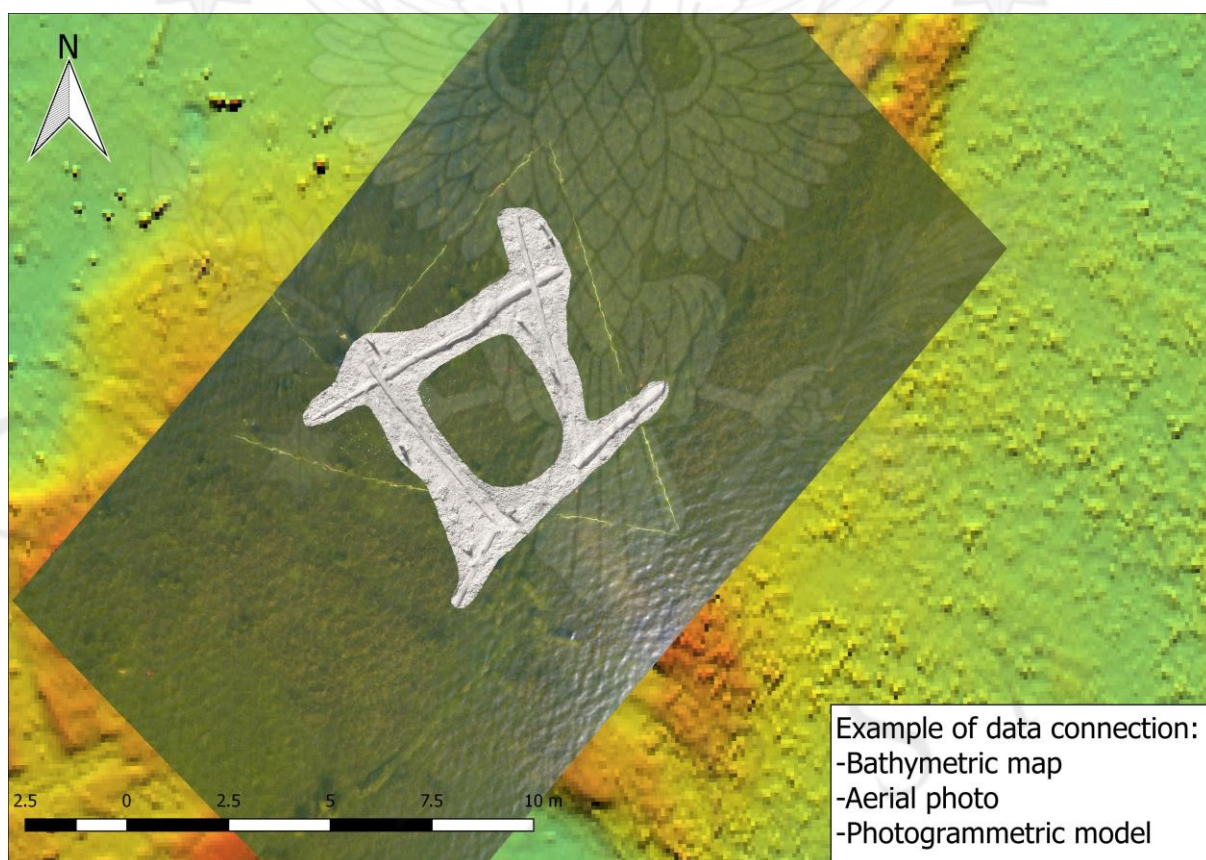


Fig. 10 – An example of different data connection – bathymetry, aerial photo and a photogrammetry model at the Puck Bay (elaborated by: P. Stencel, M. Popek)



Ministerstwo Nauki
i Szkolnictwa Wyższego



United Nations
Educational, Scientific and
Cultural Organization



Unitwin Network
for Underwater
Archaeology

