Science Diver

International Conference

SCIENCEDIVER in the BLUE ECONOMY ERA

educational approaches - operational challenges - occupational modes

20-21 April 2023, Valletta, Malta

BOOK OF ABSTRACTS

With the contribution of the European Maritime and Fisheries Fund of the European Union.

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Hybrid International Conference

"ScienceDIVER in the BLUE ECONOMY ERA"

Educational Approaches – Operational Challenges – Occupational Modes

held on

20 & 21 April 2023

at the Mediterranean Conference Centre, Valletta, Malta

organised by

Science Diver

With the contribution of the European Maritime and Fisheries Fund of the European Union.

Contents

With contribution of the European Maritime and Fisheries Fund of the European Union (Project id: 863674 - EMFF Blue Economy 2018 - Blue Careers

INTRODUCTION

ScienceDIVER: Cross-sectoral skills for the blue economy market (Project id: 863674 – EMFF Blue Economy 2018 – Blue Careers) for its final event organized an international conference about the current challenges and future of scientific diving, with a focus on the educational approaches, operational challenges and occupational modes of scientific diving. The goal was to raise awareness about the training standards, professional recognition and mobility of scientific divers and the need for the establishment of a common framework for scientific diving, presenting initiatives and proposals, including the ScienceDIVER roadmap towards the establishment of a common framework for scientific diving.

The International Conference "ScienceDIVER in the Blue Economy Era" was organized as a two-day hybrid event on 20th and 21st April 2023 and was held at the Mediterranean Conference Center in Valletta, Malta.

29 speakers from different parts of the world shared their experience and exchanged views, covering specific techniques in scientific diving and showcasing practical examples from the fields of biology, archaeology and geology. The conference topics covered training courses, experiences performed in the field of scientific diving in Europe and worldwide, the use of new technologies and the development of digital skills as well as bridging the skill gap in the Blue Economy, Scientific Diving and Blue Technology sectors. Participants discussed existing training gaps and future steps towards the elaboration of a unified training methodology in scientific diving, and the stage of adoption of guidelines, regulations and standards as well as the challenges of scientific diving in the absence of a common legal framework.

The event gathered more than 100 participants - researchers, scholars, practitioners, students, government officials and stakeholders and representatives of the scientific diving community in Europe and worldwide.

The conference concluded with the adoption of the Common Declaration introduced by ScienceDIVER for the establishment of a common framework of Scientific Diving in Europe.

This book includes the abstracts of all contributions in the 4 sessions of the two-day conference and the Common Declaration about Scientific Diving. The videos of the sessions are available through the links below:

April 20, part I: https://attendee.gotowebinar.com/register/8961702993733343580
April 20, part II: https://attendee.gotowebinar.com/register/1070745535696583007
April 21, part I: https://attendee.gotowebinar.com/register/5319523447725440854
April 21, part II: https://attendee.gotowebinar.com/register/7857853792585888348

The Organizing Committee

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CONFERENCE AGENDA

DAY 1 – Thursday April 20, 2023

09:00 – 09:30 REGISTRATION

09:30 – 10:10 WELCOME

Moderator: Alessandro Marroni, DAN Europe

09:30 – 09:35 Welcome by **Pierre Fenech**, CEO Mediterranean Conference Centre

09:35 – 09:40 Welcome by **Simon Sciberras**, President of PDSA Malta

09:40 – 10:10 Academic Diving Educational program in Malta (**Alessandro Marroni**, DAN Europe)

10:10 – 11:10 SESSION 1: CHALLENGES AND IMPLICATIONS OF SCIENTIFIC DIVING (first part)

Moderator: Kimon Papadimitriou, Aristotle University of Thessaloniki

10:10 – 10:40 Keynote Speech: **Scientific diving as part of UCH management in Greece. The Ephorate of Underwater Antiquities, new challenges, and perspectives** (Dimitrios Kourkoumelis, Hellenic Ministry of Culture and Sports)

10:40 – 10:55 **Surveying as a common reference for underwater science** (Konstantinos Tokmakidis, Aristotle University of Thessaloniki)

10:55 – 11:10 **An interdisciplinary underwater research project: the case of Early Neolithic settlement of Agios Petros** (Panagiotis Tokmakidis, Aristotle University of Thessaloniki)

11:10 – 11:30 COFFEE BREAK

11:30 – 12:45 SESSION 1: CHALLENGES AND IMPLICATIONS OF SCIENTIFIC DIVING (second part)

Moderator: Kimon Papadimitriou, Aristotle University of Thessaloniki

11:30 – 11:45 **Building a new scientific diving framework from scratch. The Greek case** (Alex Tourtas, Aristotle University of Thessaloniki)

11:45 – 12:00 **First amphibalanus amphitrite adhesion strength data on the self-polishing coatings off the Aegean Sea** (Ibrahim Kirkiz, Levent Cavas, Dokuz Eylül University)

12:00 – 12:15 **Divers can have a role to protect underwater cultural heritage: the new CMAS program** (Hakan Oniz, Akdeniz University)

12:15 – 12:30 **Marine weather forecasts and their significance for the design of scientific diving operations** (Dr. Georgia Kalantzi, Aristotle University of Thessaloniki)

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12:30 – 12:45 **Q&A for SESSION 1**

12:45 – 14:00 LUNCH BREAK

14:00 – 15:00 SESSION 2: EDUCATION AND TRAINING FOR THE NEXT GENERATION OF SCIENTIFIC DIVERS (first part)

Moderator: Fabio Bruno, University of Calabria

14:00 – 14:30 Keynote Speech: **International Standards for Scientific Divers** (Mark Caney, PADI Worldwide)

14:30 – 14:45 **More than 20 years of training in Occupational Scientific Diving at work in Europe, The European Scientific Diving Panel (ESDP) model** (Alain Norro, Royal Belgian Institute of Natural Sciences)

14:45 – 15:00 **Hazard Identification, Risk assessment and First Aid training for Science Divers** (Guy Thomas, DAN Europe)

15:00 – 15:15 COFFEE BREAK

15:15 – 16:00 SESSION 2: EDUCATION AND TRAINING FOR THE NEXT GENERATION OF SCIENTIFIC DIVERS (second part)

Moderator: Fabio Bruno, University of Calabria

15:15 – 15:30 **The pilot courses of the ScienceDIVER project, overview and focus on the Italian case study** (Fabio Bruno, University of Calabria)

15:30 – 15:45 **About benefits of courses for scientific divers in Bulgaria, topic trends, consecutive methodology changes, social demand and investigations of water habitats by scientific diving methods** (Dimitar Kozhuharov, University of Sofia St. Kliment Ohridski)

15:45 – 16:00 **Scientific diving training in Greece. Before and after ScienceDiver project** (Kimon Papadimitriou, Aristotle University of Thessaloniki)

16:00 – 16:15 **Q&A for SESSION 2**

16:15 – 17:00 COMMON DECLARATION OF SCIENCEDIVER & CONCLUSIONS OF THE CONFERENCE FIRST DAY

Moderator: Angelos Manglis, Atlantis Consulting S.A.

16:15 – 16:30 **Common Declaration of ScienceDIVER project** (Yana Popova, Marine Cluster Bulgaria)

16:30 – 17:00 Discussion panel with all moderators

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DAY 2 – Friday April 21, 2023

09:00 – 09:40 REGISTRATION

09:40 – 09:45 WELCOME

Moderator: Alessandro Marroni, DAN Europe (tbc)

09:45 – 11:30 SESSION 3: OPERATIONAL CHALLENGES (first part)

Moderator: Ralph O. Schill, envirocom

09:45 – 10:15 Keynote Speech: **Scientific Diving - extended range** (Steffen Scholz, Institute for Automation and Applied Informatics)

10:15 – 10:30 **Operational challenges in biological sampling underwater - A case study from the Red Sea** (Jennifer Tersteegen, Aalto University)

10:30 – 10:45 **Geological sampling technics for scientific divers** (Richard Stanulla, CMAS Scientific Diving

Center Freiberg; Judy Adamek, GeoWissenschaftliche Dienste GmbH)

10:45 – 11:00 **Research and protection of shallow water archaeological sites around the Alps** (Hellena Seidl da Fonseca, Naturhistorisches Museum Wien)

11:00 – 11:15 **Doing research underwater: academic education, diving skills or commercial certification?** (Paulo Costa, NOVA FSCH)

11:15 – 11:30 COFFEE BREAK

11:30 – 12:45 SESSION 3: OPERATIONAL CHALLENGES (second part)

Moderator: Ralph O. Schill, envirocom

11:30 – 11:45 **Overcoming challenges to conducting underwater behavioural research on coral reefs** (Claire Dell, State University of New York)

11:45 – 12:00 **Molecular and skeletal fingerprints of scleractinian coral biomineralization: From the sea surface to mesophotic depths** (Tali Mass, University of Haifa)

12:00 – 12:15 The deepest Spot in the northern Adriatic Sea; a deep-sea experience in an overall shallow sea (**Rouven Metternich**, MareMundi, Verein zur Förderung der Meereswissenschaften)

12:15 – 12:30 **Challenges in researching the deep sea cultural heritage in the Bulgarian Black Sea** (Pavel Georgiev, Center of Underwater Archeology)

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12:30 – 12:45 **When Neither Commercial or Recreational Diving are Solutions: Navigating the Challenges of Scientific Diving in Underwater Archaeology** (Alexandre Monteiro, HTCCFE FCSH/UNL, Lisbon Nova University)

12:45 – 13:00 **Q&A for SESSION 3**

13:00 – 14:00 LUNCH BREAK

14:00 – 15:30 SESSION 4: TOWARDS A COMMON OCCUPATIONAL FRAMEWORK FOR SCIENTIFIC DIVING

Moderator: Angelos Manglis, Atlantis Consulting S.A.

14:00 – 14:30 Keynote Speech: **Challenges of scientific diving in the absence of a legal framework. From the experience of the FRI scientific diving team in Greece** (Vasillis Papathanasiou, Fisheries Research Institute in Greece)

14:30 – 14:50 **Towards a common legal framework for Scientific Diving. Lessons learnt and future steps** (Themistoklis Ioannidis, Atlantis Consulting S.A.)

14:50 – 15:10 **Lessons learnt from the ScienceDIVER project** (Angelos Manglis, Atlantis Consulting S.A.)

15:10 – 15:30 **Sciencediver.jobs - bridging the skill gap in the Blue Economy, Scientific Diving and Blue Technologies sectors.** (Vasiliki Drouga, Atlantis Consulting S.A.)

15:30 – 16:00 CONFERENCE CONCLUSIONS & CLOSING REMARKS

Discussion panel with all moderators

16:00 – 16:30 COFFEE CORNER & NETWORKING

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CONFERENCE SESSIONS

SESSION 1. Education and training for the next generation of scientific divers

The session aims to present the currently existing panorama regarding the training and education offer in the field of scientific diving at European and worldwide level. The session has the goal to analyze both the current context with the training offers available and the future development perspectives with a broad approach linked to the continuous evolution of new digital technologies used in scientific diving, also considering the ever-increasing attention paid to the study and conservation of the marine environment as well as the ocean protection. Furthermore, in this environmental-change epoch, the need to follow a holistic approach to the diversified studies and research on the climate change and ocean acidification is greater. The scientific diving training programmes can play a crucial role in supporting the field research providing new approaches and skills to explore the marine environment.

Questions to be answered:
- Which is the current training and education offer in Europe and worldwide?
- Are there any gaps in the existing training programmes?
- How could the training of scientific divers support the evolving needs of marine research?
- How new technologies should be taught in the scientific diving training courses?

SPECIFIC TOPICS

1. Describing training courses experiences performed in the field of scientific diving in Europe and worldwide.
2. Analyzing the state of the art of training courses currently adopted and/or implemented in Europe and worldwide, at both academic and non-academic level, and assessing the effectiveness of the training methodologies and programmes adopted.
3. Discussing the training gaps (topics to be covered in the future, also considering the ever increasing use of new technologies and digital skills).
4. Discussing the possible scientific diving training courses paths to be differentiated for different students' backgrounds.

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Building a new scientific diving framework from scratch. The Greek case.

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Keywords: Scientific Diving, national framework, Greece

ABSTRACT

Greece is a country with a long tradition in underwater scientific projects. Since the first extensive underwater archaeological research at Antikythera in 1900, there has been important activity in various fields of underwater scientific work that spans from biology, ecology and other natural science disciplines to engineering and of course humanities. For more than a century, scientists from Greece, Europe and other parts of the world gather almost every year to dive in the clear waters of the Mediterranean and collect samples, excavate archaeological sites, test new scientific equipment, supervise underwater technical works etc. Nonetheless, Greece does not have a solid scientific diving framework neither in legal terms nor in training and practice terms. This gap is partially covered by recreational and commercial diving frameworks that, albeit better than naught, cannot address the specific needs of scientific diving. In the past, there have been efforts to regulate scientific diving by either individuals or organizations that have been focusing on their special needs. Alas, these attempts have not produced a unifying framework or at least some stepping stones in order to promote this effort closer to fruition. There is, however, nowadays an ongoing process that brings together scientists from various backgrounds, who work in Greece, aiming at the design of a common national framework – bottom-up – that will provide a stable training and occupational environment for the promotion of scientific diving in the country. This presentation will provide a timeline of the developments on scientific diving in Greece focusing on legal, occupational, and training matters and the implications that have been tantalizing this procedure so far. Moreover, it will present the major stakeholders, the areas of potential development, as well as the threats that lurk in the shadows of political and financial interests.

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Scientific diving as part of UCH management in Greece. The Ephorate of Underwater Antiquities, new challenges, and perspectives.

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Keywords: Underwater Cultural Heritage, Maritime Archaeology, Scientific Diving

ABSTRACT

The protection of Cultural Heritage in Greece is a Constitutional Obligation. Underwater Cultural Heritage (UCH) since the last decades of the 19th c. has been an important field of interest, as well as a concern, for archaeologists even in times when accessibility was extremely limited. Since 1976, and the creation of the Ephorate of Underwater Antiquities (EUA) of the Hellenic Ministry of Culture the management of UCH became the primary goal of the agency. Underwater archaeologists, conservators, engineers, technicians and other professionals have been organizing and taking part in various research endeavours focusing on discovery, excavation, conservation and communication of the underwater archaeological archive. The EUA is the competent authority on research, protection, promotion, and accessibility of UCH in Greece and has been regulating and supervising all relevant underwater activity regarding the safety of the people involved and the preservation of the underwater cultural landscape as the basic principles of UCH management. However, a lot is still to be done in Greece. The potential in UCH management that derives from the country's ancient and recent history is substantial and the need for more well trained and skilful diving scientist that will engage this field is imminent. Greece does not have a concrete scientific diving framework. Thus, it is extremely important to work towards the creation of a national framework that will support UCH management and will give to Greek scientific divers the opportunity to collaborate with other UCH professionals in Europe and the rest of the world.

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MARINE CONDITIONS AND THEIR SIGNIFICANCE FOR THE DESIGN OF SCIENTIFIC DINVING OPERATIONS

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Keywords: marine conditions; marine weather forecasts; scientific diving; diving operations; scientific diving safety

ABSTRACT

Currently, the planning of diving operations, including scientific diving, when it comes to expected marine weather conditions is based mostly on generic weather bulletins, observations and experience from the involved stakeholders. However, it is known that weather is unpredictable and can be a factor of misplanning in the best case scenario or safety incidents, in the worst. In this work we aim to highlight the importance of knowledge of future marine weather conditions when planning scientific diving operations. These activities demand precision in their post-operation design, so as to secure best possible outcome of the research, experiment, sampling, mapping etc, as well as to ensure safety of the divers and their equipment. More specifically, knowledge of future conditions at sea plays a crucial role for (a) the planning/ design of the underwater research (i.e. site assessment, description of conditions, evaluation of risks, “smart” mission planning, optimum conditions-based planning), (b) the scientific diving methods (i.e. ground trothing, weather/ sea state model calibration, monitoring of conditions), and (c) the related technology (i.e. web services. Dive computers, other sensors such as monitoring buoys, remote sensors such as satellites). Marine weather parameters that are useful to be known prior to planning of scientific diving operations are the wind, the wave, the currents, the sea temperature, the air temperature, the tides and others. For some of them such as the currents and the sea temperature it is useful to know their future values on the sea surface but also in various depths. Nevertheless, there are several sources of this information, several forecast models and several data provision types. These are all notions that will be overviewed in the present work, as well as options regarding the optimum sources and formats of information. Finally, the accuracy of existing numerical forecasts models will be commented on and state-of-the-art alternatives that are gaining ground nowadays will also be mentioned. These include new and disruptive Artificial Intelligence models that by using good quality reanalysis data that are already available, can actually “learn” how ocean physics works and can provide marine weather forecasts of enhanced accuracy and spatial/ temporal resolution. This game-changing accuracy can benefit several operations within the maritime industry such as transportation, fishing etc but can also find ground in the planning of high-demand operations such as the scientific diving operations.

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DIVERS CAN HAVE A ROLE TO PROTECT UNDERWATER CULTURAL HERITAGE: THE NEW CMAS PROGRAM

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Keywords: cultural heritage, shipwrecks, UNESCO, ICOMOS, CMAS

ABSTRACT

An essential part of modern life with industrial and commercial activity has become increasingly entwined with the shores of oceans, seas, lakes, and rivers [1]. All of them have astrong potential to create a variety of problems that impact both natural and cultural heritage. Some of the fishing methods, Illicit traffic of historical artifacts, treasure hunting, and looting are also serious risks to underwater cultural heritage. Discovering and documenting many underwater heritage sites and shipwrecks by specialists, providing protective legal policies which aim at preventing illicit trade, and promoting public awareness have to have priority toprotect underwater cultural heritage. Significant steps have been already taken by both UNESCO and ICOMOS. The UNESCO UniTwin Network of Underwater Archaeology, which wasestablished in 2012, is actively promoting inter-university collaboration between many universities around the world in the frame of academic standards. However, the most essential step to protect these values can be taken by 6 million active divers in the recreational diving community. CMAS (World Underwater Federation) with more than 130 member countries from 5 continents is encouraging divers to take unified steps in raising awareness, promoting the preservation, and participating in sharing information from the underwater world. The new program of CMAS will be presented in this symposium program.

[1] Öniz, H. (2020). Underwater Cultural Heritage At Risk: Problems Related to Urbanization. Editors: Hafner Albert – Öniz Hakan–Semaan Lucy –Underwood J. Christopher. Heritage Underwater at Risk Threats – Challenges – Solution. The International Council on Monuments and Sites (ICOMOS)- International Committee on The Underwater Cultural Heritage (ICUCH),Edition Number: 1, Page: 218, ISBN:978-2-918086-37-6, English, (Publishing No:6821286)

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FIRST AMPHIBALANUS AMPHITRITE ADHESION STRENGTH DATA ON THE SELF-POLISHING COATINGS OFF THE AEGEAN SEA

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Keywords: Biofouling; Self polishing; *Amphibalanus amphitrite*; Pseudobarnacle adhesion strength; Marine coating

ABSTRACT

Marine vessels are used in scientific diving activities. The underwater parts of these vehicles are coatedwith antifouling paints to protect them from fouling organisms [1,2]. Some of these antifouling paints contain toxic biocides and the release of these biocides into the environment is a major threat to the marine world. The aim of this study is to introduce current antifouling technology to the scientific divers and provide a laboratory test in the development of antifouling paints. With this laboratory test, adhesionstrength of *Amphibalanus amphitrite* in İzmir Bay were studied and the results were compared with the pseudobarnacle adhesion test. Normally, adhesion tests are performed to evaluate the performance of the antifouling coatings, but the test results can also be used on the biofouling cleaning processes to causeminimal or no damage to the coatings [3-5]. The biofouling process is highly dependent on climatic conditions. For this reason, laboratory tests are required to perform the performance tests of self- polishing coatings in cases where living organisms cannot be reached. For this purpose, different self-polishing antifouling coatings have been formulated. Field tests for the coatings were carried out in the Aegean Sea for 10 weeks. After 10 weeks, scoring system was used to evaluate the field test [6,7]. Then barnacle and pseudobarnacle adhesion tests were conducted on coatings. When the results were compared, a similarity was observed between the adhesion strengths of barnacle and pseudobarnacle with 10 mm diameter in coating 12 (40:40:20 (w/w%), rosin:xylene:BaSO4). Adhesion strength of barnacles and pseudobarnacles on coating 12 were found as 0.46 MPa and 0.45 MPa, respectively. In conclusion, the present study exhibits first data related to adhesion strength of *A. amphitrite* on rosin- based self-polishing coatings in the Aegean Sea. Moreover, based on field tests, a pseudobarnacle adhesion methodology was developed to mimic barnacles and the correlation between barnacle and pseudobarnacle tests was examined.

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An interdisciplinary underwater research project: The case of Early Neolithic settlement ofAgios Petros.

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Keywords: Scientific Diving, interdisciplinary research, 3D survey, photogrammetry, LiDAR, Greece

ABSTRACT

This paper presents the planning, the on-site operations and the results of a 3D survey conductedduring a recent interdisciplinary expedition to the prehistoric settlement on Agios Petros islet, located in a gulf off the island of Kyra Panagia in the Northern Aegean. Led by Professor N. Efstratiou and the Ephorate of UW Antiquities, the expedition aimed to gain new insights into the settlement's history and evolution through three distinct scientific domains.

Archaeologists surveyed the site for new data on land and underwater, while geologists evaluatedthe islet's geomorphology and gathered seabed cores to estimate past conditions. Surveyor engineers implemented a georeferenced underwater grid and conducted an aerial LiDAR and photogrammetric survey of the islet and the surrounding shoreline of Kyra Panagia. The logisticsand safety concerns of the mission were very critical, since more than 15 persons with their respective scuba and scientific equipment involved.

The result of the expedition is a detailed 3D reconstruction of the area, including the underwatersite, and a masterplan of the settlement and surrounding area. This includes georeferenced ortho-rectified images of the shoreline and islet, ground contour lines, and ortho-rectified images of theunderwater area where the grid has been implemented and a future excavation might take place. These resources not only provided a valuable foundation for future expeditions to the area and offer new insights into the settlement's history and relationship to its environment, but also yieldedsolid experiences on how to plan, co-operate and conduct interdisciplinary scientific diving research, with safety and minimum cost.

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Surveying as a common reference for underwater science

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Keywords: Underwater surveying, Scientific Diving, ScienceDiver

ABSTRACT

Having an experience of more than forty years in surveying monuments and archaeological sites in Greece and abroad, we had a challenge to start diving and surveying also the underwater findings. And ifyou are wondering now, what a surveyor can do in the bottom of the sea, in this paper will be presentedto you a few cases in order to explain the issue. First of all, it will be clear to everyone in this audience that if someone wants to study or build anything, then there is a necessity for a detailed mapping of the existing setting of the space on which they have to study or intervene on. This requirement is becoming more imperative in recent years as the international community focuses on the blue economy and the ocean management. However, it is equally important to record, preserve, highlight and utilize the culturalwealth that is hidden in the depths of the seas. Therefore several research programs have been successfully developed like the ScienceDiver, which we conclude successfully today and tomorrow. This project started three years ago and it was aiming to establish a common framework for scientific diving nationally, internationally and even globally. And as far as I can observe it has reach its goals to the maximum. Therefore, other projects have already started towards an extension of it. Here I will also referthose projects and present to you some more details about them.

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SESSION 2. Challenges and Implications of Scientific Diving

Facing the challenges of UN's "Decade of Ocean Science for Sustainable Development" and the needs of the Blue Economy Market, scientists and stakeholders around the world develop new tools and new methodologies in order to promote innovative and effective research projects. In this framework Scientific Diving has to adapt to a wider and more complex environment of interaction that brings together scientists, supporting crew, stakeholders, administrators, policy makers, entrepreneurs and of course the public. Moreover, the advancement of digital technologies, the endorsement of sustainability and "greener" policies, the promotion of Ocean Literacy and the publicization of underwater knowledge form the milieu, on which new multidisciplinary approaches and consensual practices are being currently developed and new channels of interdisciplinary collaborations are being structured. All the above highlight the need for the adoption of common Guidelines, Regulations and Standards in Scientific Diving, in order to facilitate international mobility, to effectively incorporate state-of-the-art technologies or follow new trends in research methodology, to emerge discussions on ethics and the interaction between science and the community and finally, to deliver a stable educational and occupational framework for Scientific Divers. This session will address these matters focusing on their challenges and their implications, either through the study of already established structures or through the proposal of new ideas on how to provide a modern Scientific Diving framework.

SPECIFIC TOPICS

1. The advancement of Scientific Diving through Digital Technologies
2. Green Scientific Diving and sustainability in the Blue Economy era
3. Adoption of Guidelines, Regulations and Standards in Scientific Diving (at various scales)
4. Ocean Literacy and the Politicization of the Underwater Knowledge
5. Multidisciplinary approaches and Consensual practices
6. Regional implementations and local frameworks

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More than 20 years of training in Occupational Scientific Diving at work in Europe, The European Scientific Diving Panel (ESDP) model

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ABSTRACT

Starting in the 1970s, from an administrative point of view, it became increasingly complicated to use scuba diving forscientific research. This affected the mobility of European scientists and scientific collaborations, even for those funded by the European Union, like the MArine Science and Technology (MAST) program. To reduce this growing handicap, initiatives were taken, in the early 1980s, at the European level to manage the occupational scientific diving sector and to move towards an equivalence system based on a common minimum training standard. After years of discussions, in 2000, the first training standard agreed upon by 15 European countries was endorsed. It included two levels, namely the European Scientific Diver and the Advanced European Scientific Diver (ESD & AESD). Following the European Commission recommendation, training has been organised at the national level and within the existing national legal framework (occupational training); however, occupational scientific diving was recognised by law (currently in only eight member states). Scientists and other employees of scientific institutions, mainly from oceanography, biology, ecology and archaeology, and students, were trained. Nowadays, Germany, Sweden and Finland co-organise a common framework for occupational scientific diving (OSD) training, including common training sessions that end with examinations conducted by the national authority of the applicant country. The details of a Nationally organised training will be illustrated by the training session organised by the Royal Belgian Institute for Natural Sciences (RBINS) for the Belgian Science Policy Federal Public Service (Belspo). From the recruitment criteria for the scientific diver candidates to the issuance of the certificate of competence and its validity period, we will illustrate the process followed in Belgium. Today's minimum common training includes the theoretical session for 3 ETCS and 21 h framed by a University 2nd cycle course given at the Free University of Brussels (VUB) Brussels before the practical sessions are organised from a marine research station in the Mediterranean Sea. Practical training is made of three sessions per day for 14 days. it includes twenty scientific dives organised from boat and shore according to the weather.

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ABOUT BENEFITS OF COURSES FOR SCIENTIFIC DIVERS IN BULGARIA, TOPIC TRENDS, CONSECUTIVE METHODOLOGY CHANGES, SOCIAL DEMAND AND INVESTIGATIONS OF WATER HABITATS BY SCIENTIFIC DIVING METHODS

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Keywords: scientific diving, training, qualification, application

ABSTRACT

Teaching in regular scientific diving courses in Bulgaria started nine years ago. First such course was carried out in August 2014, based on CMAS standards. The motivation was called forth by the local social demand, arising parallel to the global interest. The initial efforts were aided by descent traditions in the subject.
The courses were organized by Bulgarian Association for Under Water Activities, Bulgarian under water scientific panel and Institute of Oceanology – Bulgarian Academy of Science (IO-BAS). Several lecturers were from Sofia University (SU), Institute of Biodiversity and Ecosystem Research – BAS (IBER-BAS), Centre for Underwater Archaeology (CUA) and Military Medical Academy (MMA) participated.
The classes were provided at cape Maslen nos – (Black sea) at the field base of the institute of Oceanology.
Initially the main goals of the scientific diving courses were:

- To teach the participants to work safety during different types of underwater scientific activities.
- To highlight some of the specifics problems, and to upgrade constantly level of the teaching in the courses. Also to insert some new ideas for the next courses.

The main scientific area and levels in what participants have lectures and practical exercises were Hydrobiology, Underwater Archeology, Hydrology and Hydrochemistry, Underwater photography, Underwater scientific investigations in caves, very important parts were on Medical aspects and potential problems and threats for scientific SCUBA divers.
Hydrobiological lectures and exercises were separate on several topics:

- Types of classification of the water basins and the inhabiting communities.
- Pelagic communities and types of investigations.
- Benthic communities and types of investigations.
- Typical examples of invasive organisms in Black sea and main environmental problems in the Black Sea.
- Some equipment and methods for underwater scientific Biological work – their advantages and disadvantages.

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- Archeological lectures and exercises were focused on two topics

– The specific methods of under water work on ship wrecks,

- Specifics of work to submerge settlements, buildings, etc.

Hydrology and Hydrochemistry classes were focused on specifics of the water in different parts of Black Sea.

In the Underwater photography classes the focus was pointed on the document scientific photography during the scientific diving activities in Hydrobiology, Archeology, Cave diving investigations, and documentation of different type of underwater objects.

The topics of cave science classes were on the ways for formation of different type of caves and especially on the marine karst and volcanic caves and caverns at the Black sea coast. The exercises were provide in two under water caves situated nearby.

The medical under water activities classes were carried out at the same place and the practical part was provided in the bay of Maslen nos.

During the courses' implementation, of the topics were specified, developed and the methodology was improved. Recently, the Science DIVER Project initiative, coordinated locally by Marine Cluster – Bulgaria, provided a chance for producing universal training divers' qualification at EU level. BNAUA and IO-BAS's efforts were allowed to associate to the Project' pilot training programme. Additional topics were included to the material, and methodics were restructured according to upcoming trends in standartisation.

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THE PILOT COURSES OF THE SCIENCE DIVER PROJECT, OVERVIEW AND FOCUS ON THE ITALIAN CASE STUDY

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Keywords: Science Diver Project, Scientific diving training, Underwater technologies

ABSTRACT

The present paper describes the experiences conducted in the framework of the Science Diver Project (Cross-sectoral skills for the blue economy market - Project id: 863674 – EMFF Blue Economy 2018 – Blue Careers) related to the implementation of four Scientific Diving Pilot Training Courses organized in Italy, France, Greece and Bulgaria in 2022 to train new and experienced divers about scientific diving.

The courses capitalize on the experiences and information retrieved in the first two phases of the project, intending to harmonize training courses and understand the best practice to teach scientific diving skills.

In this contribution, the organization process, the selection criteria, the contents of the courses, and analysis of the students' evaluations and the gaps are described with a focus on the course organized in Italy. The results highlighted that the interest in scientific diving is on the rise and new young students, researchers and professionals are increasingly interested in acquiring new skills in this field, even because the scientific diving training programmes can play a crucial role in supporting the field research, providing new approaches and skills to explore the marine environment and to support the evolving needs of marine research. Several hints have been collected and these could guide a review of the programme more focused on the students' specific skills and scientific background.

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Hazard Identification, Risk assessment and First Aid training for Science Divers

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Keywords: Diving Safety, underwater activities, First Aid, Risk Assessment

ABSTRACT

Scuba Diving is not without risks and Scientific Diving is no exception. We can however easily mitigate these risk by performing an appropriate Hazard Identification ad Risk Assessment, not only focusing on what happens in the water, but by looking also at the operations done outside the water or in preparation of dive operations.

Scientific Divers might be scientists that started diving to perform scientific diving operations or might be divers that studied to become scientists. In both cases, it is important that the scientific divers have the needed skills and experience to perform their dives in a safe way. This includes a good knowledge and level of experience of basic diving skills or specific scientific diver skills, but also includes being prepared to react in case of emergencies.

In order to establish a safe dive environment and operation, an appointed Diving Safety officer should not only identify the different hazards that might be present during the dive, but also in the areas, such as for example on the boat or even in a compressor area. Once Hazards are identified, it becomes important to develop appropriate Standard Operational Procedures (SOPs), taking into account the different tasks that can be performed in the many areas that were assessed during a Hazard Identification and Risk Assessment. Scientific Divers should then be fully aware of these procedures and respect them in order to avoid accidents.

It is also understood that a Hazard Identification and Risk Assessment, or the use of SOPs are not a guarantee accidents will not happen, but will reduce them to a minimum. If accidents happen, it becomes important for the divers to react in a uniform way to avoid confusion and improvisation. The use of Emergency Action Plans are crucial in avoiding precious time getting lost or wrong decisions are taken and should be known by all the team members. Some actions will need to be taken immediately by the Scientific divers before professional rescue services or healthcare providers arrive at the site of the accent. This means that not only the different members of the team should be trained to perform the basic rescue skills to make sure a diver is removed from the water, or even from a certain depth, to a boat or shore, but also include appropriate First Aid training according to international accepted guidelines.

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"Scientific diving training in Greece. Before and after the ScienceDIVER project".

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Keywords: national framework , underwater activities, transfer of knowledge, higher education

ABSTRACT

The ScienceDIVER project promotes the development of official national frameworks for scientific diving, in countries that currently do not have one in place. Such is the case of Greece, both in terms of legislation and education. Generally, the need for personnel being able to perform activities underwater by means of diving is covered by training schemes that provide the required competencies and are dedicated to any specific kind of operations.

The Greek territory, although small in extend (130647 sq.km), includes one of the longest coastlines globally (13676 km), while the surrounding maritime territorial area (108335 sq.km) accommodates a wealthy Mediterranean ecosystem, grafted with the roots of Western civilization. The same features of this unique natural and cultural niche are perceived as economic assets in the context of the so-called Blue Growth. Regarding the role of the state for a comprehensive, yet sustainable, stewardship of those assets, the absence of an official framework on scientific diving is translated into lack of knowledge, which in turn means an inability to adequately manage them. Nevertheless, scientists in Greece, having the ethical responsibility to develop the underwater knowledge and transfer it to the society, have been either (re-)inventing or replicating (already established to other countries) ways to practice diving as a means for accessing their field of study. So far, improvision and self-regulation of operational matters for scientific diving projects, appears to have produced some remarkable results from archaeological, biological, or ecological research at the Greek seas. Many of those project-oriented practices became trends among the Greek scientific diving communities and formed diverse "schools" for the way of diving. Nowadays, the most common prerequisite for a scientist willing to work underwater is to have been certified as a recreational diver. Another approach, deriving from a requirement for commercial diving, is asking the scientists to have a contract with (or own) a company for underwater technical works. Worth mentioning that till some years ago, it was asked from the navy (or the coast guard) to provide the diving personnel for the performance of scientific diving research. As a consequence of the absence of a legal framework for scientific diving in Greece, which has been leading to the above-mentioned variations, the educational approaches have been oriented either on recreational dive training (e.g. through touristic diving providers and certifications), or on commercial diving traineeships (without any other prerequisite than the basic recreational or military dive training). Moreover, the role (and purpose) of the higher education institutions to provide specialized training on a topic, such is diving, highly associated with a wide range of scientific disciplines, is hindered. Worth also mentioning the lack of graduate or post graduate courses that incorpor-

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-ate dive training. The recent years, some initiatives from Greek universities, started flirting with diving in the context of training activities. Among those cases, the best achievement in terms of combining the theory with practical application underwater, was the development of a hybrid training course (featuring academic lessons and scuba diving in parallel) for surveys performed by divers. A major success last summer, was the implementation of the ScienceDIVER pilot training, as a complete course for the training for this particular purpose of diving.

The scope of this work is to present what preceded of and what is expected to follow this first Scientific Diving Training course in Greece. Additionally, through the case described here, it is provided an insight of the factors having fragmented the "landscape" of scientific diving globally.

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SESSION 3. Operational Challenges

This session aims to discuss the challenges of scientific diving as well as presenting relevant practical examples. The session focuses on different aspects of underwater scientific field work, in particular: a) biological work involving the sampling of organisms or behavioral studies underwater, b) scientific work on archaeological and/or underwater cultural heritage sites, and c) geological work underwater.

SPECIFIC TOPICS

1. Discussing the challenges of biological work involving the sampling of organisms or behavioral studies underwater with various practical examples.
2. Discussing the challenges of scientific work on archaeological and/or underwater cultural heritage sites with various practical examples.
3. Discussing of the challenges of geological work underwater with various practical examples.

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When Neither Commercial or Recreational Diving are Solutions: Navigating the Challenges of Scientific Diving in Underwater Archaeology

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Keywords: underwater cultural heritage; commercial diving; recreational diving, shipwrecks, blue economy

ABSTRACT

This presentation will focus on the regulation of underwater archaeology projects conducted by the author in Europe, Africa and the Middle East, and how the different aspects of diving - scientific, commercial, and recreational - intersect with existing regulation. The speaker will examine the legal frameworks in place for the protection and preservation of underwater cultural heritage sites and artefacts, as well as the role of the 2001 UNESCO Convention on the Protection of the Underwater Cultural Heritage in shaping these frameworks.

Through case studies and examples, the speaker will explore the challenges and opportunities that arise when balancing the interests of different stakeholders in the regulation of underwater archaeology, including divers, archaeologists, and commercial operators. The presentation will highlight the importance of responsible diving practices and effective regulation in order to ensure the long-term preservation of underwater cultural heritage.

The presentation will conclude with a discussion of the benefits of a collaborative and interdisciplinary approach to underwater archaeology scientific diving regulation, and how this approach can help ensure the sustainable use and enjoyment of Europe's underwater cultural heritage for generations to come.

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OVERCOMING CHALLENGES TO CONDUCTING UNDERWATER BEHAVIOURAL RESEARCH ONCORAL REEFS

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Keywords: Fish feeding preference; SCUBA

ABSTRACT

Coral reefs are currently facing a range of threats, so it is imperative that we identify and protect the species that are critical to promoting reef health and persistence. My research in the Cayman Islands focused on elucidating the key herbivores that remove the most abundant and problematic macroalgae in that region. Accomplishing this objective involved many hours underwater and many different survey methodologies and experimental protocols. For example, it was necessary that I conduct surveys of the benthos, population estimates, observational studies of fish feeding behavior, and feeding assays to determine fish feeding preference (termed food behavior). There are a host of obstacles specific to conducting research underwater. From the limited time available when on SCUBA, to the issues using equipment in salt water, to the increased health risks of the participants and likelihood of inclement weather interrupting work schedules. Furthermore, conducting behavioural studies underwater also necessitates accounting for the potential impact an observer on SCUBA may have on the species being observed. Navigating such obstacles requires careful planning, efficiency, and an imaginative use of resources. It is also vital that such research is undertaken by divers who are comfortable with the environment, efficient in their air consumption, and who can conduct research with good buoyancy so as not to damage or disturb the environment and species under investigation. In this presentation I will discuss the challenges inherent in conducting research, specifically food behavior studies, on coral reefs. I will also present a range of solutions to these issues so that a researcher can collect reliable data in a safe and timely manner.

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www.sciencediver.eu

Research and protection of shallow water archaeological sites around the Alps

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Keywords: underwater cultural heritage, prehistory, underwater-heritage protection, underwater-archaeology, diving-surveys, UNESCO-World Heritage,

ABSTRACT

Since 2011 there has been a UNESCO World Heritage Site "Prehistoric Pile Dwellings around the Alps" in six European countries around the Alps. 111 sites have been selected to represent the approximately 1000 known prehistoric lake and moorland settlements. But with the World Heritage designation comes responsibility. In Austria there are five sites of this serial UNESCO World Heritage Site and they are all located under water in shallow water zones. Located on the shores of Lake Attersee and Lake Mondsee in Upper Austria and on a former island in Lake Keutschachersee in Carinthia, they face different threats and require different forms of monument preservation. [1] The task of the Kuratorium Pfahlbauten is to take care of the mediation, research and protection of this underwater cultural heritage in Austria. A team of research divers, not only regularly checks the condition of the sites, but also installs under water protection measures. Regular diving activities includesurface surveys, the placement and reading of erosion markers, documentation, measurements and sed-iment coring, as well as the installation of underwater erosion protection mats. [2] But communication with the authorities, communities, lake owners, residents, fishermen and regional associations is also animportant key to protecting the lakes' monuments. [3]
In addition to the diving work for the preservation of monuments, the diving team's annual program includes research work at various sites. Various research projects require skills in underwater excavation, sampling and retrieval and handling of artifacts. Specialists trained in archaeology with additional training in scientific diving can accompany this work. [4]

To date, around 30 prehistoric pile-dwelling settlements have been identified in Austria, but many more undiscovered sites are slumbering in our waters. Archaeology has always benefited from reports of finds from the general public. The discovery of some lakeside settlements also goes back to reports ofobjects collected on the shore or finds by divers. In cooperation with interested Austrian diving bases the Kuratorium Pfahlbauten also offers special courses to sensitize the diving community to the under- water cultural heritage. Because only those who recognize an object are capable to pin down its significance. This is important as we know, a cultural monument never stands alone, it is always part of a community and a specific context, even if it is submerged in a lake.

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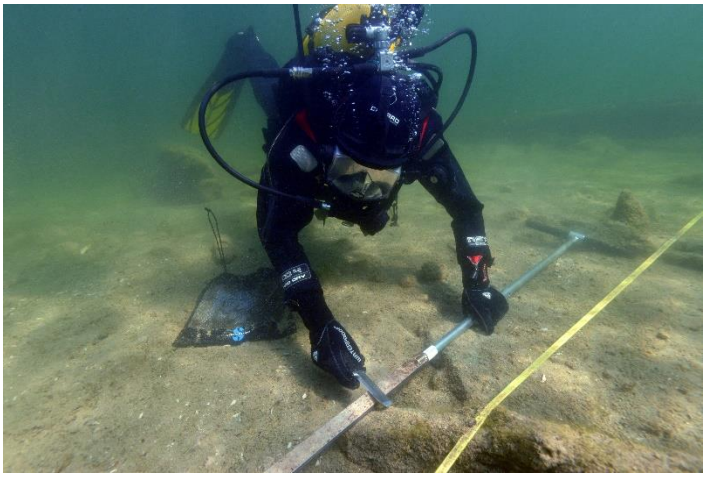
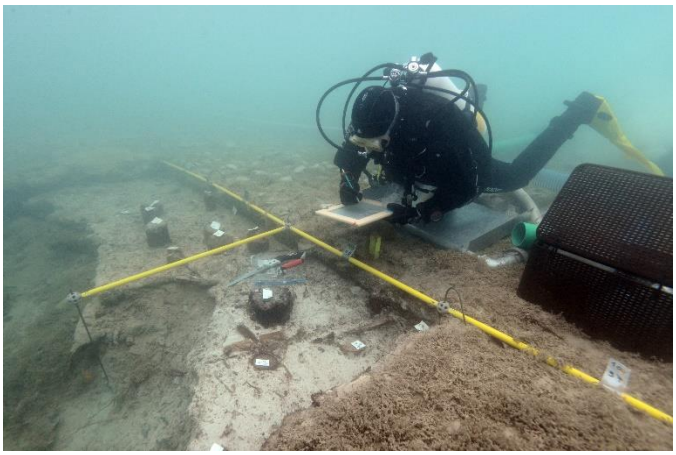


1. *Underwater coring at the UNESCO World Heritage site Keutschachersee at Carinthia ©Kuratorium Pfahlbauten*



2. Underwater excavation at the Neolithic lakeshore settlement Seewalchen at Lake Attersee ©Kuratorium Pfahlbauten

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Operational challenges in biological sampling underwater - A case study from the Red Sea

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Keywords: Bioactive substances, dolphins, marine invertebrates, underwater sampling, scientific diving

ABSTRACT

Biological sampling underwater opposes different challenges compared to terrestrial sampling. This becomes clear by looking at a case study from the Red Sea, Egypt. Behavioral studies showed that Indo- Pacific bottlenose dolphins in the Red Sea (Hurghada, Egypt) rub themselves on specific soft corals and sponges. These soft-corals and sponges were examined for bioactive substances to see whether there could be a connection between the rubbing behavior and possible bioactive substances that could influence the dolphin´s skin condition. [1]

Sampling of the sponges and soft corals brings different challenges up. To make sure that only organ - isms are sampled that are also accessed by the dolphins a great knowledge on the local area is needed. This is especially since behavioral studies are carried out long term which makes permanent underwater markers difficult to use. Additionally, the study area is frequently visited by divers which doesn´t guaran-tee that markings or organism won´t be affected by them.

Another aspect to consider is that how the sampling process affects the biochemical composition of the sponges and soft corals. From cutting of the sample until they are processed on the surface some time elapses which might cause differences in the metabolic pattern of the organisms.

Furthermore, taking samples from remote places such as specific reefs in the Red Sea makes it difficult to carry out all sample processing steps. E.g., usually, you won´t have a -80° C freezer or liquid nitro - gen available on the boat. This requires compromises in the sample processing as well taking of e.g., control samples.

This case study shows that biological sampling underwater requires thorough planning and that specific tasks can only be carried out by means of scientific diving.

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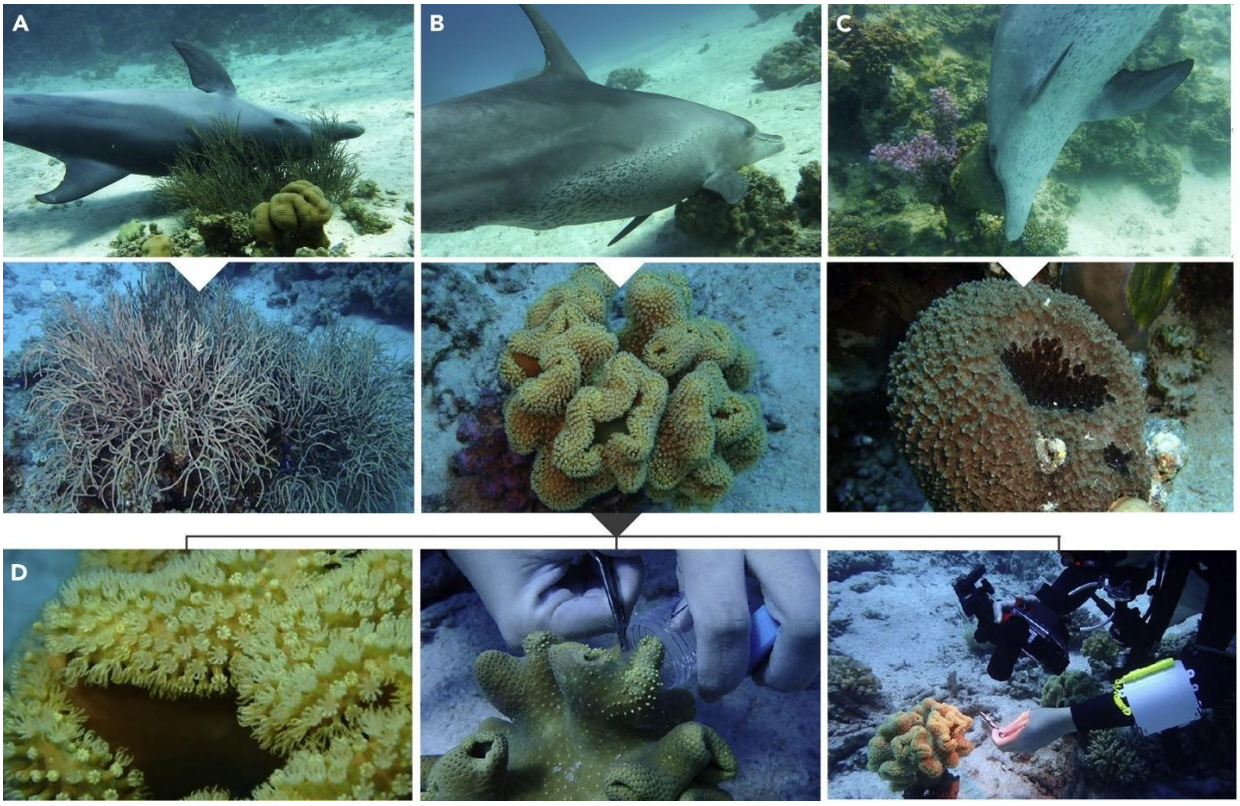

Figure 1: Observed rubbing behavior and sampled organisms: A) *Rumphella aggregata*, B) *Sarcophyton* sp., C) *Ircinia* sp.; D) Sampling process on the example of *Sarcophyton* sp. [1]

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DOING RESEARCH UNDERWATER: ACADEMIC EDUCATION, DIVING SKILLS OR COMMERCIAL CERTIFICATION?

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Keywords: underwater cultural heritage; scuba-diving; scientific diving; underwater works.

ABSTRACT

In Portugal, the existence of a vague legislation and the lack of agreement about what "underwater work" actually is has subjected researchers to the arbitrariness of the authorities responsible for authorizing work in an aquatic environment and created doubts about who can do what underwater.

The survey and study of underwater cultural heritage find itself in a particularly ambiguous position where scientists must resort to volunteer scuba-divers without academic education in order not to be sanctioned or are imposed commercial divers, giving rise to a collaboration between those who have scientific knowledge and those who have diving skills.

Based on our experience, we share some examples of underwater work where researchers sought a balance between complying with legislation and, at the same time, finding an answer to their scientific questions, highlighting why diving is important for underwater research.

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Challenges in researching the deep sea cultural heritage in the Bulgarian Black Sea

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Keywords: shipwrecks, bottom-trawling, sea pollution,

ABSTRACT

The Centre for Underwater Archaeology is a national cultural institute of the Bulgarian Ministry of Culture. Founded in 1978, it is one of the oldest such institutions in Eastern Europe and the first to activelywork in the Black Sea. It's responsible for the research, documentation and preservation of all the underwater cultural heritage of the Republik of Bulgaria regardless of its environment whether in rivers, lakes, dams or the Black Sea. Because of this and the strategic territorial location, the range of sites is vastthat includes but is not at all limited to: submerged prehistoric settlements and necropoleis, ancient harbours and structures and a wide variety of shipwrecks from different ages and periods [1].

The unique environment of the Black Sea makes it very favourable for the preservation of underwatercultural heritage. It has very low salinity due to many large European rivers supplying it with fresh water which creates a positive outflow through the Turkish Straits and into the Aegean sea. Furthermore, salinewater flows into the Black Sea which due to the difference in density of both types of water, creates a permanent anoxic layer. This hydrogen sulfide layer below 150 - 200 m of depth creates superb conditionsfor the conservation of organic artefacts and especially for wooden shipwrecks.

It has long been speculated and theorized that this anoxic environment must have very well-preservedthe ancient shipwrecks but giving hard evidence was not easy. Because of the large depth and hostile environment research was done mostly with remote sensing techniques and equipment. Those sporadic and expensive explorations gave encouraging indications of the presence of shipwrecks on the Black Sea seabed. Even though on most wrecks further detailed information such as date or type could not be gathered [2], [3].

It wasn't until the international "Black Sea Maritime Archaeology Project" conducted from 2015 to 2017 that a breakthrough was made. Using large research vessels, more than 1200 sq. km. were surveyedwith state-of-the-art equipment that led to the detailed documentation of 65 shipwrecks. They are at a depth from 40 m to 2200 m and documentation was done using the "Supporter" ROV. It was equipped with high-end recording sensors that produced more than 250 000 high-definition (HD) photographs andhundreds of hours of ultra-high-definition (UHD) video. Those were used to create accurate photogrammetric recordings. The oldest shipwreck is from the 5th or the beginning of the 4th c. BC and was discovered at a depth of 2021m. It is almost identical to the depiction of a ship on a red-figure Stamnos from Vulci c. 480-450 BC [4].

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The project revealed that despite the good preservation of organic the shipwrecks are being endangered by other threats. Even at a depth of more than 2000 m, there is modern plastic garbage accumulating around the wrecks which have turned into islands of trash on the sea floor. But on the shallower shipwrecks, a more destructive threat came to light. That is the sea-bottom trawling used by fishing ships that have destroyed many wooden shipwrecks down to 100m in depth. Hitting a shipwreck while bottom trawling would usually damage the net as well. That is why fishermen tend to avoid those areas but others intentionally go there to “fish” amphoras and other artefacts in the hopes of selling themon the black market. In addition, sonar scanning has documented numerous tracks lefts by bottom trawling on the seabed. The method is a major fishing practice for decades in Bulgaria, although it has notbeen legalized or regulated by legislation [5].

Those threats to the underwater cultural heritage in depths down to 100 m need to be addressed withthe utmost urgency. It is necessary that those shipwrecks be located, researched and documented. Although small-scale ROVs have become more affordable and widely used they do not remove the need for a researcher to go down to see, touch and analyze the site. Another challenge is that the use of rebreather systems for scientific dives in Bulgaria is non-existent. That requires the development of best practices and methods for the research and protection of the Black Sea’s deep sea cultural heritage. “Theworld’s largest underwater museum.” – Prof. Jonathan Adams

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The deepest Spot in the northern adriatic sea; a deep-sea experience in an overall shallow sea

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Keywords: biodiversity, sample-collection, diving methods, deep-sea trench

ABSTRACT

Mare-Mundi is an Austrian non-governmental organization dedicated to marine research and protection, our main place of action is the Croatian island of Krk. Exactly here, between the islandsof Cres and Plavnik, lies the deepest point of the Northern Adriatic Sea in the Krusija Channel, a "deep sea" trench with a depth of 125 meters. This trench is the focus of our project *go-deep*, which has been running since the beginning of the year. We have set ourselves the goal of investigating the particularities of these still largely unknown ecosystems within this trench, in particular the biodiversity and species composition, but also the pollutant load within the living organisms there. A special feature of this project will be that we will investigate the existing ecosystems at different sea depths, which means that we will work with different diving methods(snorkeling, TecDiving, ROV). A special challenge for our diving teams will be the correct collectionof biological samples by remote operated underwater vehicle (ROV). By means of these ROVs, wecan not only take high-resolution images of the different habitats (steep walls, rocky and muddy seabeds, etc.), but also collect meaningful samples with the help of special manipulation tools, which can be scientifically studied at a later stage. Our samples will include both organic and inorganic samples, mainly sediment, detritus, seagrass remains and also living organisms such as mussels, sponges, fish or crustaceans. Apart from the ecological relevance of these samples, we also want to screen them for residues of certain biologically active contaminants (for example the dirty dozen). Especially the comparison to reference samples from shallower marine areas will give us some information about the threats to these still unknown ecosystems. Finally, our overall goalis to be able to declare areas like these as marine protected areas (MPAs) in the long term, throughprojects like *go-deep*.

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Molecular and skeletal fingerprints of scleractinian coral biomineralization: From the sea surface to mesophotic depths

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Keywords: Biomineralization, Mesophotic reef, Morphology plasticity

ABSTRACT

Reef-building corals, the major producers of biogenic calcium carbonate, form skeletons in a plethora of morphological forms [1]. Here we studied skeletal modifications of Stylophora pistillata (clade 4) colonies that adapt to increasing depths with decreasing ambient light. Understanding the reef coral physiological plasticity under a rapidly changing climate is of crucial importance for the protection of coral reef ecosystems. Most of the reef corals operate near their upper limit of heat tolerance. A possible rescue for some coral species is migration to deeper, cooler mesophotic depths [2]. However, gradually changing environmental parameters (especially light) along the depth grdient pose new adaptative stress on corals with largely unknown influences on the various biological molecular pathways.

S. pistillata show characteristic transitions from spherical morphologies (shallow depths, 5 m deep) to flat and branching geometries (mesophotic depths, 60 m deep) [3]. Such changes are typically ascribed to the algal photosymbiont physiological feed- back with the coral that host them. We find specific fine-scale skeletal variability in accretion of structure at shallow- and mesophotic depth morphotypes that suggest underlying genomic regulation of biomineralization pathways of the coral host. To explain this, we conducted comparative morphology-based analyses, including optical and electron microscopy, tomography and X-ray diffraction analysis coupled with a comprehensive transcriptomic analysis of S. pistillata . The samples originated from Gulf of Eilat in the Red Sea collected along a depth gradient from shallow to mesophotic depths (5 to 60 m). Additional samples were experimentally transplanted from 5 m to 60 m and from 60 m to 5 m. Interestingly, both morphologically and functionally, transplanted corals partly adapt by exhibiting typical depth-specific properties. In mesophotic depths, we find that the organic matrix fraction is enriched in the coralla, well matching the over representation of transcripts encoding biomineralization “toolkit" structural extracellular proteins that was observed. These results provide insights into the molecular mechanisms of calcification and skeletal adaptation that repeatedly allowed this coral group to adapt to a range of environments presumably with a rich geological past.

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Digital Formats: Any image file format that can be imported into this file will be acceptable for publication; to avoid technical problems, we suggest using TIFF (.tif) or GIF (.gif) files for photographs, and encapsulated PostScript (.eps) or Windows metafiles (.wmf) for line drawings.

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Geological sampling techniques for Scientific Divers

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ABSTRACT

Geological investigations deliver fundamental knowledge on subaquatic environments and are the basis for many further studies concerning ecological and biological fields of science. They require sample material of high significance and as much complementary information as possible. Findings on the in-situ situation at the sampling site is crucial for a meaningful analysis and subsequent interpretation. The sampling methods and transportation procedures enormously affect the gained data. Therefore, different sampling-methods are reviewed to facilitate international exchange and enhance data usage and comparability of sample material from different locations worldwide.

The sampling of hard-rock samples can be realized by simple methods, such as the use of hammer and chisle. Such surface-near samples deliver general information on the prevailing lithology and are used for chemical and petrological analysis. To gain oriented rock samples the application of core-drilling-devices might be necessary. The drilling cores can be applied for a variety of geological and mineralogical investigations (e. g. structural analysis). Such devices are available with hydraulic power supply providing a comparably high torque. However, they need on-board technique and may raise ecological problems in case of leakage. The use of biologically degradable lubricants is mandatory in any case. Alternatively, pneumatic versions can be applied using scuba air-tanks what makes the system highly mobile (transport by lifting bags). However, also electric systems are available. The key challenge for them is a continuous power supply during the whole drilling process. Core-drilling by scientific divers always is a surface-near sampling technique (~ 1 m) and may not be compared to classical pontoon-supplied core-drilling (> 10's - 100s m). Nevertheless, it delivers lots of geological and geotechnical parameters and allows distinct sampling of small-scaled structural features.

The choice of an appropriate sampling technique depends in the first order on the intended information and the planned scope of investigation. For bulk chemical analysis, mixed samples, taken in plastic bags or by the use of airlift-pumps, are sufficient. However, they don't deliver data on stratigraphic issues. Sediment-corer or liner are applied to gain almost undisturbed samples (cf. DIN ISO 22475-1), allowing a subsequent lab-analysis on geotechnical parameters (e. g. slope stability).

In combination with underwater mapping grids quantitative investigations on selected areas can be realized by methods of digital image analysis and thus enable statistical data-evaluation.

Generally, every sampling-location should be comprehensively documented. A significant visual documentation as well as proper documentations in sampling protocols are mandatory.

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Structural and geological mapping of subrecent small-scaled subrosion structures in Panarea, Italy

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ABSTRACT

Detailed structural mapping campaigns of recent small-scaled subrosion structures were conducted during scientific diving fieldwork campaigns off Panarea Island. A complex of three connected structures is situated 7.0 m ENE (65°) of the main buoy of Area 26 (coordinates: UTM 33S 509386/4276235). Due to the negative relief and the general appearance of the structures, they are referred to as bowls (cf. Stanulla, 2021). Thus, the complex neotectonic pattern in the central part of the submergent volcano was named “Three bowls”-structure. Typically, the seafloor is covered by recent sands, leading to the necessity to excavate the rocks using a mobile airlift pump. The structure in the north (Bowl A) is the smallest one in the complex with 1.0 x 0.6 x 0.25 m (LWD). It is connected to the largest structure (Bowl B) by a number of small fractures (main: 030-210/80 E; minor: 060-240/86 W) which shows dimensions of 1.5 x 0.7-1.0 x > 0.25 m and is located in the south of the complex (11 m, 85 ° from main buoy). Bowl C is situated in the north-west of the complex (7.0 m, 65 ° from main buoy). With dimensions of 1,5 x 1,3 x > 0.3 m it seems to be the deepest of the three bowls. The distance between the bowls is about 3.5 m. All structures show constant, mostly water dominated hot fluid discharges. Geologically, the bowls are build up of medium grained sandstone to fanglomerate. They are cemented by sulfuric mineral precipitates. Commonly, single large clasts are included (mass flow deposit). Additionally, the hydrothermal fluids cause recent small-scaled formations of massive sulfide ore aggregates. A whitish finegrained sediment (?Alunite) was discovered in the deepest parts of the bowls. The bowl structures are formed by a continuous process of leaching and subrosion due to highly aggressive hydrothermal fluids. This periodic process leads to the formation of centimetre thick laminae within the sidewalls of the bowls. A collapse of parts of the sidewalls is caused by an ongoing destabilization of these laminae while the bowls keep growing in all directions. In contrast, the process becomes decelerated by mineral precipitation.

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SESSION 4. Towards a common Occupational Framework for Scientific Diving

Considering there is not yet a common legal framework for scientific diving in Europe and globally, will introducing ISO standards for scientific diving help solve this problem? Following the establishment of new ISO standards, will the introduction of an EU Directive contribute to bridge the gaps? What is the way for the creation of a common occupational framework for scientific diving in Europe and what are the challenges for scientific divers? When working in scientific diving projects, still today all participant divers are not recognised as scientific divers but rather as recreational, commercial, or professional divers. What should change and how can we achieve that divers working in such projects are recognised as scientific divers? What are the open issues regarding the recognition of the professional rights of scientific divers in Europe, including safety, health insurance, salary etc.? Are there currently career opportunities for young scientific divers and which factors define any career paths? How can we connect academia and scientific diving to enhance this possibility? How can young scientific divers and students acquire skills, and how could they be supported to have the necessary equipment, given the high cost involved in scientific diving training and gaining experience?

SPECIFIC TOPICS

1. A legal framework for Scientific Diving in EU and globally. Identifying challenges & bridging the gaps.
2. Recognizing scientific divers among recreational, commercial, and professional divers when working together.
3. Connecting academia and marine industry. Career paths for young scientific divers.
4. How to support young scientific divers and academic students to gain skills and experience in scientific diving.

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Lessons Learnt from the ScienceDIVER project

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Keywords: scientific diving, professional recognition, ISO Standards, funding

ABSTRACT

The ScienceDIVER project, aiming to highlight the important role of scientific diving in underwater re- search and blue growth, copes with the challenges towards the professional recognition of scientific divers. These include the mobility of scientific divers in the blue economy job market, as well as the inconsistencies among EU countries in training and the legislative framework. In addition, while education in scientific diving is rarely included in the university curricula in Europe and the provision of the required diving equipment for that kind of training courses is not affordable for students, more barriers arise and less career opportunities are offered for young scientists. Those challenges are addressed by proposing the development of ISO standards towards the establishment of a common training framework for scientific diving. In this way, it is expected that EU states will obtain a technical tool for mutual recognition of competencies in scientific diving, higher education institutions will be facilitated in developing of high standards curricula and the diving training organizations, such as CMAS, DAN and PADI, will be able to support global recognition of related qualifications. Furthermore, the skills acquired through that kind ofstandardized training will be easier matched with the job market needs. Funding solutions can further support training and the enhancement of scientific diving. The European Commission encourages the competent stakeholders at a national level to take up the necessary initiatives. To support these goals andthe professional recognition of scientific diving, an independent organization as a legal entity with the involvement of key stakeholders in underwater science is also highlighted as a necessity. This paper presents the initiatives by the ScienceDIVER consortium and discusses how the proposed solutions could be implemented in practice.

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Towards a common legal framework for Scientific Diving. Lessons learnt and futuresteps.

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Keywords: Legal Framework, ISO Standards, Legal Identity

ABSTRACT

In EU, the fragmented legal framework for diving has been a thorn for the seamless transformation ofunderwater scientific knowledge into driving force for the development of the blue economy. This problematic issue burdens the scientific diving community for decades. Although important steps have been taken place, especially the last 2 decades, there are still many barriers to overcome so that Science Divers,especially the younger ones, should not be obliged to attend and purchase expensive certifications related to commercial diving nor be misoriented with collecting recreational diving qualifications not associated with scientific purposes. ScienceDIVER project took the initiative as part of its implementation plan to bring to light the grey zones, evaluate the current situation globally - although the initial plan emphasizedin very few EU countries - communicate the findings, and finally propose the next steps to allow the just transition for a better legal framework for Scientific Diving.

The communication/dissemination strategy and implementation regarding the legal framework (i.e.dedicated open workshops with the participation of experts in Scientific Diving, presentation in ScientificDiving conferences, personal communications and questionaries among others) proved to be positivelyimpactful. Colleagues from different countries (i.e. from EU but the rest of the world as well) offered tosupport the research for the legal framework in their countries and the initial database was revised andupdated with data and legal documents that cannot be found easily through desk research. An additionalbarrier for this specific research was that in many cases, legislation framework was in different languages.A recent advancement, that encompasses the previous among others and it is expected to eliminate the respective barriers, is the release of the new ISO standards. Members of the ScienceDIVER project participated in the development of the standards, adopted the principles of those standards during theimplementation of the project activities and shared the lessons learnt from the consortium efforts as wellas important own experience. Through the global application of ISO Standards, Scientific Divers will beable to have a “legal identity”. Additionally, in time, issues like the professional acknowledgement andrights will be also in line with the true operational needs that significantly support the “first a Scientist and then a Diver” principal. These issues are examined and presented in the present study.

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Sciencediver.jobs - bridging the skill gap in the Blue Economy, Scientific Diving and Blue Technologies sectors.

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Keywords: scientific diving, recruitment, job platform, matchmaking algorithm, skill gap,

ABSTRACT

The Sciencediver.jobs concept integrates the innovative approach of ScienceDIVER project in an online tool for addressing the demand and supply for jobs, facilitating both job seekers and employers to bridge the gap in the Blue Economy, Scientific Diving and Blue Technologies sectors. By incorporating advanced techniques for job matchmaking and using ranking algorithms, this online platform meets multiple objectives at once; from connecting the diving market with students, calculating their skills gaps, providing data for policy makers and diving stakeholders, to covering the skill gap of each candidate by linking it with e-learning courses. This paper presents the functionalities of a job matchmaking tool, designed to increase visibility of scientific diving as a high-quality well-paid profession, create links between academia and maritime/diving Industry, collect data and provide insights on market demands in terms of diving skills.

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COMMON DECLARATION

for the establishment of a common framework of Scientific Diving in Europe

Adopted in the context of the ScienceDIVER International Conference in Valletta, Malta, April 20th -21st 2023

The Common Declaration aims to promote the discussion for the establishment of a common framework in Scientific Diving in Europe and the enhancement of mobility of scientific divers. It is based on activities and studies carried out in the framework of ScienceDIVER project and the feedback collected from key stakeholdersand target audiences. The Common Declaration was adopted in the context of the ScienceDIVER International Conference held in Valletta, Malta, April 20th -21st 2023, during which it was open to public consultation with the goal to reflect the needs of scientific divers.

We Science Divers,

Recalling

- the United Nations declaration of the decade 2021-2030 as the Decade of Ocean Science for Sustainable Development and an opportunity “to generate the global ocean science needed to support the sustainable development of our shared ocean”;
- the UNESCO Convention on the Protection of the Underwater Cultural Heritage (Paris, 2001), suggesting in situ preservation of Underwater Cultural Heritage as first option;
- the EC Communication COM/2014/0254 about science as a key of Blue Economy and the transition from thelab to the market and the need for “scientists, engineers and skilled workers to apply new technologies and scientific knowledge in the marine environment”;
- the European Marine Board suggestion about the need for an established standardized methodology to define scientific diving qualifications in all European countries;
- the ESDP Consultation Document No.1 (Common Practices for Recognition of European Competency levels for Scientific Diving at work) proposing that “harmonization of scientific diving competencies has to be recognized within the legal framework of the respective member states and has to be represented by authorities with a clearly defined national status”.

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Highlighting the need for

- the protection of the marine environment, biodiversity and underwater cultural heritage;
- considering the safety of divers during Scientific Diving projects;
- recognizing the particularity and the interdisciplinarity character of Scientific Diving and encouraging the collaboration among public and private organizations from different sectors;
- skillful and qualified underwater scientists in marine related scientific fields and industry sectors (including biology, geology, ecology, chemistry, archaeology, engineering, aquaculture and fisheries, environmental protection, oceanography, ocean renewable energy, blue biotechnology, maritime monitoring & surveillance, marine technology, topography etc.) and to recognize their contribution to innovation in blue economy;
- recognizing the contribution of non-scientists (technicians, citizen scientists etc.) participating in Scientific Diving projects with different roles;
- a definition of the Scientific Diver term according to the forthcoming ISO Standards for Scientific Diving;
- a harmonized framework and regulations for the required qualifications of scientific divers in the Blue Economy market to enhance mobility across EU countries;
- structured cooperation among actors (universities, ministries, diving associations, etc.) for the promotion, support and professional recognition of Scientific Diving at both national and EU level;
- supporting university students and young divers to cover the high costs in training and equipment required to become a scientific diver.

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We believe that further steps shall include:

- the adoption of common ISO standards and of a unified training framework in Scientific Diving by international diving organizations and actors related to underwater science, diving regulations and safety, and Blue Economy industry sectors;
- the establishment of a European Board for Scientific Diving as a legal entity, autonomous and acknowledged by organizations and competent bodies across Europe, to promote Scientific Diving at EU policy level and issues related to the professional recognition of scientific divers;
- university departments to play an active role in the training of scientific divers and include training and practice courses in their curricula, so that students and young divers acquire the necessary skills and certification in Scientific Diving;
- an EU Directive to promote a unified regulation in Scientific Diving across EU to be implemented at national level, which will address training, operational and occupational aspects of Scientific Diving in order to support mobility of scientific divers across Europe in joint international scientific diving research projects;
- the creation of a Funding Mechanism to support scientific divers' skills acquisition, especially for young scientific divers, to have access to underwater equipment, certification and gaining experience.

We commit to support the goals and proposals included in the Common Declaration in our capacity.

About ScienceDIVER

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A group photo after the successful completion of the International Conference "ScienceDIVER in the Blue Economy Era"

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