BOOK OF ABSTRACTS

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9TH EUROPEAN CONFERENCE ON SCIENTIFIC DIVING
15 | 19 JUNE 2026
AZORES, PONTA DELGADA

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Underwater Videographer and Photographer

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9TH EUROPEAN CONFERENCE ON SCIENTIFIC DIVING | **AZORES,** PONTA DELGADA

PROGRAMME

15 – 16 JUNE 2026

WELCOME DAY & CONFERENCE DAY 1

15 JUNE 2026	**WELCOME DAY**	
17:30–19:30	**REGISTRATION & ICEBREAKER**	
16 JUNE 2026	**CONFERENCE DAY 1**	
08:30–09:00	**CHECK-IN/REGISTRATION**	
09:00–09:30	**OPENING SESSION**	
09:30–10:10	Keynote lecture	Diving in the Mesophotic Forests: Ecology and Conservation of Black Corals in the Canary Island **Francisco Otero-ferrer** – University of Las Palmas de Gran Canaria
10:10– 12:30	**SESSION**	**MARINE BIOLOGY & ECOLOGY**
	Talk 1 10:10–10:25	Forests Beneath Arctic Water: Benthic Ecosystem Functioning in a Warming Fiord **Marta Ronowicz** – Institute of Oceanology Polish Academy of Sciences
	Talk 2 10:25–10:40	Antagonistic Effects of Epibiota on Chronic Experimental Artificial Light at Night (ALAN) Exposure in *Cymodocea nodosa* **Davide De Battisti** – University of Padova
	Talk 3 10:40–10:55	Climate-driven Community Shifts Reshape Productivity and Carbon Uptake in Marine Forests **Bianca Reis** – Interdisciplinary Centre of Marine and Environmental Research (Porto)
10:55–11:15	Coffee Break	
	Talk 4 11:15–11:30	Role of Underwater Kelp Forests and Seabird-derived Subsidies in Shaping Benthic Communities **Piotr Balazy** – Institute of Oceanology Polish Academy of Sciences
	Talk 5 11:30–11:45	Assessing Shallow Reef Resilience in a Changing Environment **Leda Liyue Cai** – Cyprus Marine & Maritime Institute - CMMI
	Talk 6 11:45–12:00	Long-term Trends in *Eudendrium Racemosum* (Cavolini 1785) in the Adriatic Sea **Veronica Marchesi** – Polytechnic University of Marche
	Talk 7 12:00–12:15	Standardized *in situ* Assessments Reveal Spatial Patterns of Sponge Assemblages in the Greek Seas **Thanos Dailianis** – Hellenic Centre for Marine Research
	Talk 8 12:15–12:30	Early Stages in the Formation of Mesophotic Bryo-constructions (MBC) **Cristina Di Camillo** – Marche Polytechnic University
12:30–13:30	Lunch Break	
13:30–14:10	Keynote lecture	Into the Dark: Scientific Diving as a Window into the Biodiversity, Ecology, and Conservation of Yucatan's Anchialine Cenotes **Nuno Simões** – UMDI-Sisal, Facultad de Ciencias, UNAM
14:10– 15:40	**SESSION**	**METHODS & TECHNOLOGY I**
	Talk 1 14:10–14:25	Automation of Underwater Population Assessment of the Protected Species *Lobelia dortmanna* Using Neural Networks and Diving-based Survey Methods **Mateusz Draga** – Department of Hydrobiology, Institute of Environmental Biology, Faculty of Biology, Adam Mickiewicz University
	Talk 2 14:25–14:40	Combining Scientific Diving, eDNA and Metabolism to Assess Coastal Urbanization Impacts on Benthic Communities **Giada Riva** – University of Padova
	Talk 3 14:40–14:55	Determining the True Depth Limits of Benthic Vegetation Using Experimental Substrate Deployment in the NE Baltic Sea **Hanna-eliisa Luts** – Estonian Marine Institute
	Talk 4 14:55–15:10	From Fins to Findings: Microsent as a Platform for Diving-based Microbial M **Clara Loureiro** – Institute of Marine Sciences OKEANOS
	Talk 5 15:10–15:25	Automated Species Identification and Metric Length Estimation from Monocular Underwater Video **Pietro Piancatelli** – University of Padova
	Talk 6 15:25–15:40	Characterizing Underwater Soundscapes in a Large Lake: First Results from the ACOULAC Project **Stephan Jacquet** – National Research Institute for Agriculture, Food and Environment
16:00–16:30	Coffee Break	
16:30–17:30	**POSTER SESSION**	

9TH EUROPEAN CONFERENCE ON SCIENTIFIC DIVING | **AZORES,** PONTA DELGADA

PROGRAMME

17 JUNE 2026

CONFERENCE DAY 2

17 JUNE 2026	CONFERENCE DAY 2	
09:00–09:40	Keynote lecture	A Professional Scientific Dive Centre in a Recreational Diving Legislation **Diogo Paulo** – Scientific Dive Centre, Centre of Marine Sciences (Algarve)
09:40–12:15	**SESSION**	**METHODS & TECHNOLOGY II**
	Talk 1 09:40–09:55	Scaling Up Seagrass Mapping in Ria Formosa: Hybrid Methodology for Subtidal Seagrass Mapping: Combining Scientific Diving and Aerial Drones **Guilherme Contente Rosado** – Centre of Marine Sciences (Algarve)
	Talk 2 09:55–10:10	An Integrated Stereophotogrammetric and Colorbalanced 3D Reconstruction for Coralreef Investigation **Alessandro Capra** – University of Modena and Reggio Emilia
	Talk 3 10:10–10:25	A New Monitoring Technique for Protected Species **Georgios Chatzigeorgiou** – Hellenic Centre for Marine Research - Institute of Oceanography
10:25–10:45	Coffee Break	
	Talk 4 10:45–11:00	Upscaling Transplant Methods of Subtidal Seagrass in Southern Portugal **João Pedro Da Silva Encarnacao** – CCMAR, University of Algarve
	Talk 5 11:00–11:15	Integrating Remote Sensing and Diver-based Ground-truthing to Assess Native Oyster (*Ostrea edulis*) Reef Condition for Conservation and Restoration **Tiffany Monfort** – ATU - Atlantic Technological University - Galway
	Talk 6 11:15–11:30	Underwater Infrastructure Inspection: the Cooperation Between Scientific Divers and Autonomous Robots **Richard Vinzenz Gruhn** – Scientific Diving Center, TU Bergakademie Freiberg
	Talk 7 11:30–11:45	Cross-realm Canopy Science: Translating Terrestrial Forest Methods to Marine Animal Forests **Torcuato Pulido Mantas** – Universit Politecnica delle Marche
	Talk 8 11:45–12:00	Methods to Monitor Native Oyster Reef Restoration in the Mediterranean Sea **Massimo Ponti** – University of Bologna
	Talk 9 12:00–12:15	From Visual Census to Virtual Reality: a Decade of Surveys, Studies and Innovation in Mare-Madeira Scientific Diving Program **Susanne Schafer** – MARE Madeira/Arditi
12:30–13:30	Lunch Break	
13:30–14:10	Keynote lecture	Using Volcanic CO2 Vents and Warming Hotspots to Study the Effects of Climate Change on Fishes and Marine Ecosystems in situ **Ivan Nagelkerken** – School of Biological Sciences, Adelaide University
14:10–15:40	**SESSION**	**GEOLOGICAL, VOLCANIC AND SUBTERRANEAN SYSTEMS**
	Talk 1 14:25–14:40	Environmental Inventory of Mercury (Hg) for Three Marine Shallow Water Hydrothermal Systems **Thomas Pichler** – Universitt Bremen
	Talk 2 14:10–14:25	Underwater Geomorphological Formation Research in the Eastern Baltic Sea **Ieva Barda** – Latvian Institute of Aquatic Ecology
	Talk 3 14:40–14:55	Charting the Macaronesian Void: a Baseline for the Volcanic Marine Caves of the Canary Islands **Yeray Gonzalez-marrero** – University of La Laguna
	Talk 4 14:55–15:10	Scientific Diving Survey of the Biological and Hydrological Features of Sinkholes in the Salento Peninsula (southern Italy) **Michele Onorato** – Universit degli Studi di Bari Aldo Moro - Dipartimento di Scienze della Terra e Geoambientali
	Talk 5 15:10–15:25	From the Deep to the Cave: Unexpected Strongholds of Rock Sponges **Vasilis Gerovasileiou** – Ionian University
	Talk 6 15:25–15:40	The Use of Biodegradable Mats in Lake Restoration: Divers Saving Lakes **Nadia Golinska** – Adam Mickiewicz University
16:00–16:30	Coffee Break	

9TH EUROPEAN CONFERENCE ON SCIENTIFIC DIVING | **AZORES,** PONTA DELGADA

PROGRAMME

18 - 19 JUNE 2026

CONFERENCE DAY 3 & FIELD ACTIVITIES AND OPEN DAY

18 JUNE 2026	**CONFERENCE DAY 3**	
09:00–09:40	Keynote lecture	Visual Documentation in Scientific Diving: an Essential Tool for Marine Biodiversity Research and Conservation **Sylvie Dias** – Underwater Videographer and Photographer
09:40–14:55	**SESSION**	**CITIZEN SCIENCE, HUMAN FACTORS & SAFETY**
	Talk 1 09:40–09:55	Elasmobase Azores Project: Integrating Underwater Visual Census on Recreational Diving to Monitor Elasmobranch Populations **Fatima Perez Neira** – Elasmobase Azores - Independent Research Project
	Talk 2 09:55–10:10	Fear or Fascination? a Close Eye on Sharks and Rays Encounters in Their Migratory Pathways Across the Globe **Martina Gaglioti** – IUCN/ Sharkvoice
	Talk 3 10:10–10:25	Impact of Recreational Diving on Marine Ecosystems: Contributions Towards Sustainable Management **Claudia Luisa Salvador Hipólito** – University of Algarve
10:25–10:45	Coffee Break	
	Talk 4 10:45–11:00	25 Years of Occupational Scientific Diving at the Institute of Natural Sciences of Brussels **Alain Norro** – Royal Belgian Institute of Natural Sciences
	Talk 5 11:00–11:15	Equipping the Diver, Empowering the Science: How the Dive-reporter Digital Platform Is Enhancing Marine Biodiversity Monitoring **João Gama Monteiro** – Universidade da Madeira, Faculdade de Ciencias da Vida, MAREMadeira/ ARDIT
	Talk 6 11:15–11:30	Integrating Reef Check Underwater Visual Census and Video-based Transects: Methodological Implications for Long-term Reef Monitoring **Eva Turicchia** – University of Bologna
	Talk 7 11:30–11:45	Interdisciplinary Research as a Key Driver of Innovation in Scientific Diving **Thomas Grab** – TU Bergakademie Freiberg
	Talk 8 11:45–12:00	Take It or Leave It: a Science-based Tool to Guide Ghost Gear Removal **Camilla Roveta** – Universit Politecnica delle Marche
12:30–13:30	Lunch Break	
13:30–14:10	Keynote lecture	Diving Accident Referral Pathway (Green Way) of Hospital do Divino Espírito Santo (HDES) **Paula Ferreira** – Hyperbaric and Underwater Medicine Unit, Hospital do Divino Espírito Santo, Ponta Delgada, Azores, Portugal
	Talk 9 14:10–14:25	Building a University Scientific Diving Training Scheme in Greece: the Case of the Science Diver: Introduction to Scientific Diving Training Program in the Aristotle University of Thessaloniki **Kimon Papadimitriou** – Aristotle Univeristy of Thessaloniki
	Talk 10 14:25–14:40	Risk Analysis, Human Factors and Other Components of a Work Method Statement Document Applied to In-situ Sampling of an Offshore North Sea Wind Park **Alain Norro** – Royal Belgian Institute of Natural Sciences
	Talk 11 14:40–14:55	(Re)breathing Forests: Using Closed Circuit Rebreathers to Study Mesophotic Kelp in the Azores **David Milla Figueras** – Institute of Marine Sciences OKEANOS
15:00–16:30	**ROUND TABLE DISCUSSION - "SCIENTIFIC DIVING, SAFETY AND CERTIFICATION"**	
16:30–17:00	Coffee Break	
17:00	**MOVIE SESSION**	**"THE ISLAND OF GIANTS"** – Nuno Sá
19 JUNE 2026	**FIELD ACTIVITIES AND OPEN DAY**	
09:00–17:00	**FIELD DEMONSTRATION (VALTAMER TABLET)/OPEN DAY**	

Keynote speakers

Ivan Nagelkerken

Full Professor at The University of Adelaide, Australia

Using volcanic CO_2 vents and warming hotspots to study the effectsof climate change on fishes and marine ecosystems in situ.

Nuno Simões

UMDI-Sisal, University of Sciences, UNAM, Mexico

Into the dark: scientific diving as a window into the biodiversity, ecology, and conservation of Yucatán's anchialine cenotes.

Diogo Paulo

PhD Marine Biology – Ecology and Conservation

A Professional Scientific Dive Centre in a non Recreational Diving Legislation.

Francisco Otero-Ferrer

Professor and Researcher at the University of Las Palmas de Gran Canaria, Spain

Diving in the mesophotic forests: ecology and conservation of black corals in the Canary Islands

Sylvie Dias

Underwater Videographer and Photographer

Visual documentation in Scientific Diving: an essencial tool for Marine Biodiversity reasearch and conservation

ABSTRACTS

Underwater Geological Heritage of the Baltic Sea as Habitat for Benthic Fauna

PRESENTATION: Oral

AUTHORS: Marta Ronowicz*[1], Piotr Kuklinski[1], Adrian Zwolicki[2], Maria Włodarska-Kowalczuk[1]

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2. University of Gdańsk, Poland

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Arctic kelp forests are key components of coastal ecosystems, supporting high biodiversity and providing habitat for numerous associated organisms. In Arctic fjords, progressing deglaciation is altering underwater light conditions and sediment regimes, potentially reshaping macroalgal assemblages and the communities they host. In this study, we examined how glacier-derived disturbances influence kelp-dominated habitats and their associated fauna in the Arctic fjord of Hornsund (Svalbard). Three sites located at different distances from glacier fronts were sampled. A total of 403 kelps were collected by divers, measured, weighed, and aged, and all associated fauna were identified to the lowest possible taxonomic level. We assessed kelp standing stock, macroalgal community composition, biomass and density patterns, as well as the diversity and successional patterns of fauna inhabiting kelp holdfasts. Macroalgal community composition differed between glacier-exposed and clearer sites, revealing a strong influence of glacier proximity. At glacial sites, macroalgal biomass shifted toward shallower depths, likely as a consequence of reduced water transparency. Kelp holdfasts emerged as true hotspots of life, hosting 200 species dominated by colonial Bryozoa, Hydrozoa, and Polychaeta. Even high sedimentation did not reduce species richness but reshaped which groups were dominant. Across an age gradient of kelp holdfasts, species richness and abundance increased with age, reflecting progressive habitat development. However, community composition remained highly variable, suggesting that stochastic processes play a major role in shaping these assemblages. Older holdfasts showed slightly lower β-diversity and more frequent positive species associations, indicating a gradual shift toward more structured communities. Kelps themselves proved remarkably adaptable. Their morphological traits varied among sites, highlighting their phenotypic plasticity—a survival toolkit in the face of harsh and changing conditions. By shaping the physical and biological environment, kelps act as underwater engineers, supporting rich communities and demonstrating resilience in a rapidly changing Arctic. These findings highlight the role of Arctic kelp forests as biodiversity hotspots and emphasize their importance for maintaining ecosystem functioning in glacier-influenced fjord ecosystems.

KEYWORDS: BIODIVERSITY, SUCCESSION, KELP-ASSOCIATED MACROFAUNA, CLIMATE CHANGE

Antagonistic effects of epibiota on chronic experimental Artificial Light At Night (ALAN) exposure in *Cymodocea nodosa*

PRESENTATION: Oral

AUTHORS: Joana A. Riedel, Davide De Battisti[1*], Laura Airoldi, Giada Riva, Yuvarani Selvam, Robin P. M. Gauff

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Artificial Light At Night (ALAN) is an emerging anthropogenic stressor in coastal ecosystems, particularly in urbanised areas. ALAN can disrupt the natural diel cycles of light-sensitive foundation species, such as seagrasses, altering key physiological processes. In urban coasts, seagrass physiology is also impacted by other anthropogenic stressors, leading to an excess growth of epibionts which alters impact availability. Yet, the combined effects of ALAN and epibionts on seagrasses remain largely unexplored. This study assessed the combined effects of ALAN and epibiota on the seagrass *Cymodocea nodosa* in an in-situ field experiment (Venice Lagoon, Italy). Experimental plots were exposed to ALAN, and epibiota presence was manipulated via biweekly leaf cleaning. Oxygen fluxes and photosynthetic performance were measured at night to observe immediate physiological responses. Further, photosynthetic efficiency (ΦPSII) under standardised daylight and morphological traits, including leaf length and specific leaf area, were quantified to evaluate longer-term functional responses. Our results show that ALAN and epibionts had no direct impact on seagrass physiology at night. However, ΦPSII under standardised daylight was significantly higher and leaf length was reduced in ALAN-exposed seagrass compared to unexposed controls, but only in the epibionts-free treatment. This study demonstrate that ALAN alters seagrass long-term physiology and morphology, but this effect can be modulated by epibionts.

KEYWORDS: SEAGRASS, LIGHT POLLUTION, EPIBIOTA, VENICE LAGOON, RESISTANCE, PHOTOSYNTHESIS, INCUBATION CHAMBER, SPECIFIC LEAF AREA (SLA)

Climate-driven community shifts reshape productivity and carbon uptake potential in marine forests

PRESENTATION: Oral

AUTHORS: Bianca Reis[1,2,3], Francisco Arenas[1], Hugo Sainz-Meyer[1], Óscar Babé-Gómez[1], Isabel Sousa-Pinto[1,2], Jonas de Azevedo[1], Pieter van der Linden[1], Álvaro Sánchez-Gallego[3], Marta Martins[1], João N. Franco[3]

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2. Faculty of Sciences, Department of Biology – University of Porto, Rua do Campo Alegre 1021 1055, 4169-007 Porto, Portugal;
3. MARE-Marine and Environmental Sciences Centre & ARNET – Aquatic Research Network Associated Laboratory – ESTM, Polytechnic of Leiria, 2520-630 Peniche, Portugal

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Shifts in marine ecosystems, driven by rising seawater temperatures in cold-temperate regions, are becoming increasingly frequent worldwide. This phenomenon, known as tropicalisation, is altering community structure and ecosystem function in temperate marine forests globally, and understanding these changes is critical for predicting the future of blue carbon systems and ecosystem services in temperate coastal zones. Canopy-forming macroalgae, which play a crucial role in ecosystem productivity and carbon cycling, are being replaced by less productive, warm-affinity species. Despite the growing concern, there is a critical lack of in-situ measurements quantifying the direct impact of these community shifts on ecosystem primary productivity and carbon uptake in transitional zones. Here, for the first time, in-situ measurements of community productivity were conducted using benthic incubations across contrasting habitat types: canopy-forming (cold-affinity) and low-canopy (warm-affinity) assemblages composed of different algal species. These measurements were carried out along an ocean climate gradient spanning a biogeographical transition zone on the western coast of the Iberian Peninsula. Net Community Productivity (NCP) and its carbon-based equivalent (NCP_C) were calculated to quantify differences in productivity and carbon uptake potential between habitats and species. Productivity in canopy habitats was significantly higher than in low-canopy habitats, with NCP and NCP_C values being 104.5% and 86.4% greater, respectively. Within habitats, productivity was species-specific, with Laminaria hyperborea-dominant forests showing the highest values and forests of turf\/foliose species the lowest. Our findings provide empirical evidence that climate-driven shifts from kelp-dominated to warm-affinity-dominated communities have the potential to significantly reduce coastal productivity and carbon uptake. These changes could have far-reaching consequences for ecosystem functioning and services. As similar transitions are occurring in temperate marine forests globally, conservation and management strategies must adapt to address these widespread climate-driven ecosystem shifts.

KEYWORDS: PRIMARY PRODUCTIVITY, KELP, TURF; TROPICALISATION

Role of underwater kelp forests and seabird-derived subsidies in shaping benthic communities

PRESENTATION: Oral

AUTHORS: Piotr Balazy[1], Maria Bagur[2], Maria Włodarska-Kowalczuk[1], Klaudia Kosek[1], Wojciech Artichowicz[3], Bernabe Moreno[1], Maciej Chełchowski[1], Piotr Kukliński[1], Zuzanna Opalińska[4], Katarzyna Zmudczyńska-Skarbek[4]

1. Institute of Oceanology Polish Academy of Sciences, Sopot, Poland
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4. University of Gdańsk, Gdańsk, Poland

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Kelp forests create a unique environment representing one of the most productive, structurally complex, and biologically diverse coastal ecosystems on earth. Their ecological role extends beyond habitat provisioning, as they function as refuges, breeding grounds, and nurseries for a wide range of marine taxa. Kelps also act as ecosystem engineers by modifying hydrodynamic conditions, attenuating wave energy and currents, and influencing the retention of organic matter and nutrients within benthic habitats. Here, we present studies examining the influence of kelp forests on benthic communities spanning sub-Antarctic regions of the Beagle Channel (Chile–Argentina) and Arctic coastal systems of Spitsbergen (Svalbard, Norway). Using photo- and video-transects, we document the diversity, abundance, and spatial structure of benthic assemblages associated with giant kelp (*Macrocystis pyrifera*) along a fjord meltwater gradient extending from the Pacific to the Atlantic sector of the Beagle Channel, highlighting changes in community composition along gradients of salinity, turbidity, and freshwater influence. In the Arctic, a set of environmental loggers measuring near-bottom current velocity, flow direction, and tidal water levels was used to assess how kelp species, including winged kelp (*Alaria esculenta*), sugar kelp (*Saccharina latissima*), and oarweed (*Laminaria digitata*), modify hydrodynamic conditions at four sites in Isfjorden (west Spitsbergen). Two of these sites were located beneath large seabird colonies that subsidize adjacent coastal ecosystems with ornithogenic nutrients derived from guano deposition. Benthic communities beneath seabird cliffs, studied with phot-quadrats and stable isotopes, at Isfjorden as well as Bellsund and Bjornoya differed markedly from reference areas, exhibiting higher diversity and increased abundance of e.g. benthic filter feeders, as well as elevated δ^{15}n values in selected taxa, indicating assimilation of seabird-derived nitrogen. However, these effects were spatially heterogeneous. The presence of kelp forests modified the expression of ornithogenic fertilization by structuring the nearshore environment and mediating where and how benthic consumers accessed and incorporated seabird-derived nutrients, thereby additionally shaping benthic community structure.

KEYWORDS: KELP FORESTS, BENTHIC COMMUNITIES, ECOSYSTEM ENGINEERING, ORNITHOGENIC NUTRIENT SUBSIDIES, POLAR COASTAL ECOSYSTEMS

Assessing shallow reef resilience in a changing environment

PRESENTATION: Oral

AUTHORS: Leda L. Cai1*, Nikhil Thomas[1], Andromachi Gkoulia[1], Eleni Christoforou[1], Genna-Leigh Geldenhuys[1], Gil Rilov[2], Guy Raanan[2], Shai Ziberman[2], Louis Hadjioannou[1]

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Over the last decade the Eastern Mediterranean and Middle East have experienced warming rates significantly higher than the global average, characterized by an increase in the duration and severity of marine heatwaves (MHWs). While MHWs are primary drivers of biodiversity loss, they act in synergy with other stressors, including bioinvasions, anthropogenic pressures, and marine pollutants. Effective conservation of regional biota and ecological services requires a localized understanding of these impacts to inform management and policy. The PUREEF-Y project addresses this need by assessing the status of shallow reef biodiversity, reconstructing paleo-ecological and paleo-oceanographic conditions, and utilizing experimental frameworks (i.e., mesocosms) to predict future ecological shifts. This study presents results from seasonal sampling across four subtidal sites, including two in Marine Protected Areas (MPAs), as well as preliminary results from incubation chamber experiments used to evaluate species-specific metabolic rates. To quantify fish abundance and richness, visual census methodology was conducted using scuba diving. To evaluate benthic community composition, photoquadrats were collected from each transect and analysed on CoralNet software. Preliminary results from seasonal sampling indicate slightly higher species richness of native organisms within MPAs. However, the ratio of native to non-native species remained consistent across both protected and non-protected areas, regardless of season. Overall, communities exhibited significant spatial and seasonal variation. In addition, despite abundance of native species being mostly higher than alien species, alien species had a higher biomass. This is likely due to alien species being larger than the native species present within our transects. Moving forward, the project will utilize results from incubation chamber experiments and subsequently conduct mesocosm experiments to test responses to multi-stressor scenarios. These data will be integrated into predictive models to forecast the ecological state of shallow reefs under changing environmental conditions, ultimately providing evidence-based recommendations for regional marine policy and management.

KEYWORDS: BIODIVERSITY ASSESSMENT, VISUAL CENSUS, NON-INDIGENOUS SPECIES, CLIMATE CHANGE, INCUBATION EXPERIMENTS

Long-term Trends in *Eudendrium Racemosum* (Cavolini 1785) in the Adriatic Sea

PRESENTATION: Oral

AUTHORS: Veronica Marchesi1*, Camilla Roveta[1,2], Torcuato Pulido Mantas[1,2], Teo Marrocco[1], Stefania Puce[1], Elisa Rostirolla[1], Carlo Cerrano[1,2,3,4], Cristina Gioia Di Camillo[1,2]

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Hydroids are key components of shallow-water hard-bottom assemblages and are particularly common in the Mediterranean Sea. Their abundance, diversity, and reproductive activity show strong seasonal variability driven by environmental factors such as temperature, irradiance, and food availability. Sexual reproduction is typically restricted to short periods, with male gametes often maturing at lower temperatures than female ones. Owing to their high sensitivity and phenotypic plasticity, hydrozoans can rapidly respond to environmental changes through dormancy, colony regression, or shifts in reproductive timing, making them valuable indicators of global change in benthic ecosystems. This study investigates the population dynamics of *Eudendrium racemosum* (Cavolini 1785) (Anthoathecata, Filifera) living in shallow waters in the northern Adriatic Sea, focusing on seasonal variations in community structure, reproduction and diet. Colony density was assessed through scuba diving using frames and photoquadrats, while polyp density, sex ratio, associated fauna and gut contents were analyzed from randomly collected colonies. Plankton samples were collected monthly to relate prey availability to gut contents composition. Data from May 2025 to May 2026 were compared with those collected between 2007 and 2011 and with temporal variations in sea water temperature. Our results document community composition and reproductive patterns of *E. racemosum* over a 15-year interval. These findings reinforce the role of hydroids as sensitive indicators of environmental change and highlight the importance of long-term monitoring for understanding hydrozoan phenology in a warming Adriatic Sea.

KEYWORDS: HYDROIDS, CLIMATE CHANGE, PHENOLOGY, ADRIATIC SEA

Standardized in situ assessments reveal spatial patterns of sponge assemblages in the Greek Seas

PRESENTATION: Oral

AUTHORS: Thanos Dailianis*[1], Vasilis Gerovasileiou[2], Ioannis Rallis[2], Markos Digenis[2], Grigorios Skouradakis[1], Emmanouela Vernadou[1]

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Sponges are dominant components of Mediterranean reef habitats, exhibiting high biodiversity and playing major ecological roles in benthic ecosystem functioning. Although substantial progress has been made towards inventorying sponge biodiversity, knowledge of their community structure remains limited. This gap constrains marine conservation planning and the detection of habitat change in the rapidly shifting Mediterranean environment. This study presents a comparative analysis of sponge assemblages across three biogeographic sectors of the Greek Seas — the Ionian Sea, Central Aegean, and Crete. A total of 45 locations were investigated, encompassing key sponge habitats including exposed and shaded reefs, as well as marine caves, with priority given to MPAs. Assessments of sponge abundance and diversity were conducted along two depth zones (10 & 20 m) using two complementary, non-destructive methods: (i) visual census along belt transects with two independent observers, and (ii) high-resolution photographic quadrats. The produced data enabled robust cross-site and cross-region comparisons of sponge density and community structure, revealing marked regional variation in taxonomic composition and abundance, with certain taxa showing habitat-specific dominance patterns. Photophilic and sciaphilic habitats hosted distinctly different assemblages, underscoring the importance of accounting for light regime and microhabitat structure in biodiversity assessments. Habitat type emerged as the primary driver of community structure, while subregional differentiation and depth-related effects were moderate but significant. This integrated approach highlights the complementarity of visual and photographic methods in detecting both conspicuous and cryptic sponge taxa. Quantitative outcomes are significantly enhancing regional checklists, with spatially referenced abundance metrics providing a foundation for mapping biogeographic trends. The resulting baseline is particularly relevant given the under-representation of Porifera in ecological indicators despite their ecological prominence. Overall, the study delivers a standardized, habitat-structured baseline dataset for sponge biodiversity, supporting long-term monitoring and future research on spatial ecology, biogeographic boundaries, and community shifts driven by ongoing environmental change. This study was funded by Biodiversa+, the European Biodiversity Partnership under the 2021-2022 BiodivProtect joint call for research proposals, co-funded by the European Commission (GA N°101052342) and the funding organisation General Secretariat for Research and Innovation (GSRI) Grant No ΓΓΒΙΟ-0559429.

KEYWORDS: PORIFERA, BIODIVERSITY, MONITORING, PHOTOQUADRATS, VISUAL CENSUS, MEDITERRANEAN

Early stages in the formation of Mesophotic Bryo-Constructions (MBC)

PRESENTATION: Oral

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Crustose Coralline Algae (CCA) are considered primary frame builders of coralligenous outcrops, while invertebrates with calcareous skeletons are generally secondary contributors to the bioconstructions. However, animal bioherms developing in dim-light conditions have been observed in several Mediterranean localities, dominated by different frame-builders, such as the Mesophotic Coral Bioconstructions (MCB) and the Mesophotic Oyster Bioconstructions (MOB) observed in Apulia, the bio-stalactites of the serpulid *Protula tubularia* (Montagu, 1803) in marine caves, and the *Dendrophyllia ramea* (Linnaeus, 1758) banks in Sicily. Habitat-forming bryozoans can generate 'faciès' and durable carbonate structures, which enhance habitat complexity and support biodiversity. Despite their role as both primary and secondary frame-builders, bryozoans have been protected only indirectly, through their inclusion in broad habitat categories such as Reefs (Habitat Directive), coralligenous formations (Marine Strategy and Habitat Directive), and bioconstructions (Barcelona Convention). Here, we describe the initial phases in the formation of Mesophotic Bryo-Constructions (MBC) at Vis Island (Croatia), where huge bryozoan colonies grow beneath and among gorgonian assemblages, acting as key coralligenous builders. Non-destructive samplings (i. e., photo-surveys) were conducted by scuba diving at a depth of 25-40 m between 2019 and 2025 to monitor the evolution of the bryozoan forest over time. Analysis of the collected images enabled us to investigate the relationship among bryozoans, CCA, secondary builders (serpulids, foraminifers and encrusting bryozoans), and binders (sponges, seaweeds), as well as to assess the roles of both living colonies and entire or fragmented dead bryozoans in the coralligenous dynamics of the area.

KEYWORDS: ANIMAL CORALLIGENOUS, BIOCONCRECTIONS, PENTAPORA

Automation of Underwater Population Assessment of the Protected Species *Lobelia dortmanna* Using Neural Networks and Diving-based Survey Methods

PRESENTATION: Oral

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Lobelia dortmanna is a key indicator species characteristic of lobelia lakes: softwater, oligotrophic water bodies traditionally described as nutrient-poor and occurring across Europe. In Poland, the species is strictly protected, and the lakes it inhabits are designated under the Natura 2000 network as habitat type 3110: "Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*)". In accordance with the EU Habitats Directive, this habitat type requires regular ecological monitoring. Currently, lobelia lakes are subject to multiple pressures, including anthropogenic impacts, climate change, and declining water levels. Given the dynamic nature of these stressors, frequent and reliable monitoring of key indicator species such as *L. dortmanna* is essential for effective conservation management. At the same time, increasing monitoring demands create logistical challenges that may be addressed through the integration of trained citizen science divers and emerging machine learning tools. The aim of this study was to develop a prototype convolutional neural network (CNN) object detection model capable of recognizing and counting *L. dortmanna rosettes* in underwater imagery. The dataset consisted of several thousand selected underwater photographs collected by scientific divers and underwater drones in four lobelia lakes. The trained model's performance was evaluated by comparing automated counts with population assessments conducted using traditional in situ diver-based survey methods. The results demonstrate a high potential for applying neural networks to assess population density of key species in lobelia lakes. Automated image analysis significantly reduced processing time while maintaining strong agreement with expert-based evaluations. The integration of diver-acquired imagery with machine learning driven analysis offers a scalable and efficient approach to habitat monitoring, supporting conservation obligations under Natura 2000 and enhancing the long-term protection of vulnerable oligotrophic lake ecosystems.

KEYWORDS: FRESHWATER, NEURAL NETWORK, COMPUTER VISION, MACROPHYTES, DIVING

Combining Scientific Diving, eDNA and Metabolism to Assess Coastal Urbanization Impacts on Benthic Communities

PRESENTATION: Oral

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Coastal marine ecosystems have substantial social, ecological, and economic value, providing critical goods and services. However, the extensive development of coastal infrastructure is altering coastal habitats (e.g., hydrodynamics, nutrient regimes, and contamination), thereby affecting community dynamics and ecosystem functioning. Therefore, understanding what ecological processes shape biodiversity in increasingly urbanized marine systems is fundamental to guide better planning and management solutions. This research addresses a critical gap in our understanding of the ecological consequences of marine urbanization considering regional-scale dynamics. The study focuses on assessing biodiversity across urbanized marine areas, highlighting changes in community composition, structure, and ecosystem functions by combining taxonomic and molecular approaches. Between September and October 2023, through scuba diving we sampled urban (artificial rocks inside the marina), periurban (breakwaters), and natural rocky habitats across seven biogeographical sectors spanning ~2000 km of the Italian coastline. Community composition and structure were evaluated by combining environmental DNA (eDNA), non-destructive photographic and destructive sampling of sessile assemblages, as well as in situ measurements of benthic metabolism. Morphological identifications and eDNA revealed a loss in taxonomic, functional, and phylogenetic richness from natural to urban habitats, indicating strong environmental filtering. However, multivariate analyses showed that urban communities were distinct from natural ones and did not represent a subsample of the species regional pool, suggesting multiple processes shape community structure, such as connectivity patterns driven by human activities (i.e., ship traffic) or different biotic interactions in artificial habitats. A large-scale standardized survey across biogeographic sectors revealed consistent biodiversity declines in urban habitats together with reductions in key ecosystem functions. This research emphasizes the need for integrative biodiversity monitoring programs that combine scientific diving with molecular tools and measurements of ecosystem processes, improving our understanding of ecosystem responses to anthropogenic drivers and supporting successful restoration and conservation plans.

KEYWORDS: COASTAL DEVELOPMENT, BENTHOS, EDNA, ARTIFICIAL STRUCTURES

Determining the true depth limits of benthic vegetation using experimental substrate deployment in the NE Baltic Sea

PRESENTATION: Oral

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Decreasing underwater light conditions caused by eutrophication have reduced the depth distribution of benthic macrovegetation in the Baltic Sea. Because maximum vegetation depth is commonly used as an indicator of ecological status in coastal waters, accurate determination of this limit is important. However, in many areas of the NE Baltic Sea, soft sediments dominate below 8–10 m, and the lack of hard substrate may prevent macroalgae from growing at their true light-defined depth limit. As a result, observed depth limits may underestimate the actual potential distribution of benthic vegetation. This study aimed to assess the true vertical distribution potential of benthic macroalgae by providing suitable natural substrate in areas where hard bottom is absent. The study was conducted along six monitoring transects in the Gulf of Finland and the Estonian coastal sea. SCUBA divers deployed vegetation-free granite boulders (40-50 cm in diameter) starting from the deepest occurrence of natural hard substrate and continuing down to 15 m depth. At each 1 m depth interval, three boulders were placed together at a single point along the transect. Colonization was monitored through non-destructive visual assessments by divers, estimating species presence and percent cover to maintain compatibility with long-term monitoring practices. Previous monitoring data indicated that vegetation extended to depths of 9–11 m in these transects. However, the experimental substrates were colonized at greater depths. The perennial red algae species Vertebrata fucoides was recorded at depths between 12 and 15 m, and the perennial brown algae species *Battersia arctica* was found down to 15 m. These results show that substrate availability can limit observed vegetation depth. The study highlights the value of diver-assisted substrate deployment as a practical and cost-effective approach for refining ecological status assessments.

KEYWORDS: BALTIC SEA, BENTHIC MACROALGAE, ECOLOGICAL STATUS ASSESSMENT, SUBSTRATE LIMITATION

From Fins to Findings: MicroSent as a Platform for Diving-Based Microbial Monitoring

PRESENTATION: Oral

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Coastal ecosystems are increasingly exposed to climate-driven stressors, pollution, and biodiversity loss, yet microbial communities — which underpin nutrient cycling, primary productivity, and carbon sequestration — remain largely absent from routine monitoring frameworks. Microbial plankton drive marine biogeochemical cycles and regulate ecosystem resilience. But their spatial and temporal dynamics are rarely integrated into operational coastal management. MicroSent (Microbial Sentinels) addresses this gap by combining scientific diving, DNA metabarcoding, in situ biosensing, and machine learning to develop a scalable microbial monitoring framework for Azorean coastal ecosystems. Building upon previous regional research on microbial biogeography and oceanographic drivers (c.f. Loureiro 2022, PhD thesis), the project deploys diver-assisted sampling to collect planktonic microbial samples across environmental gradients. Trained scuba divers perform standardized sampling, deploy sensors, and document ecological variables, expanding spatial coverage beyond traditional vessel-based surveys restricted to fixed stations and discrete depth intervals. Microbial community composition is assessed through high-throughput sequencing, enabling detection of shifts in functional groups associated with nitrogen cycling, carbon flux, and ecosystem stress responses. These datasets are integrated with environmental parameters (e.g., temperature, salinity,) and analyzed using predictive models to identify early-warning indicators of ecosystem change. A central innovation of MicroSent is the integration of Sentinel Divers (SDs — trained recreational or professional scuba divers contributing to standardized, science-based monitoring). SDs collect environmental and biological data, including microbial and DNA samples, during routine dives, expanding observation capacity. Acting as mobile in-water sentinels, they enhance early detection of ecological shifts while promoting community ocean stewardship. In the regional context, this model can generate thousands of additional sampling points per year, strengthening coastal observation networks. The Azores, characterized by mesoscale variability, seamount influence, and oligotrophic waters, provide a strategic natural laboratory. By positioning microbes as bioindicators within coastal monitoring systems, MicroSent contributes to Marine Strategy Framework Directive objectives and ecosystem-based management. MicroSent advances a paradigm shift: recognizing microbial communities as sentinels of ocean health and divers as key actors in sustainable coastal management.

KEYWORDS: MARINE MICROBIOME, SCIENTIFIC DIVING, CITIZEN SCIENCE, COASTAL MONITORING

Automated species identification and metric length estimation from monocular underwater video

PRESENTATION: Oral

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Underwater visual census techniques conducted by SCUBA divers provide rapid, low-cost, and non-destructive assessments of fish assemblages. Despite their effectiveness, these methods suffer from limited repeatability, observer bias, and potential disturbance to organisms. Accurate underwater size estimation also requires highly trained specialists, making measurements challenging. Therefore, SCUBA-aided stereo-video systems (often referred to as Stereo-DOV) are widely used for identifying fish species and estimating body length in underwater surveys. However, their cost, calibration requirements, and deployment constraints can limit their adoption in routine monitoring. This work evaluates the feasibility of a fully monocular vision workflow that jointly performs automated species identification and length estimation from underwater video, aiming to provide a more straightforward and cost-effective alternative for research visual census applications, with a future focus on juvenile fishes in nursery areas. Given the limited availability of pretrained models for the target coastal Mediterranean species, we trained a dedicated model for species detection. Training images were downloaded from the citizen-science platform iNaturalist and filtered to include only Creative Commons licenses compatible with AI training. We manually labelled the pictures to the species level and trained an object detection model under YOLOv11 architecture. The detection pipeline was then integrated with a monocular depth estimation model (Depth Anything V2) to enable metric size estimation from a single camera. The depth model was calibrated using multiple reference markers of known length positioned at various distances from the action camera. Both calibration and test videos, acquired in natural underwater conditions, were corrected for fisheye lens distortion. The calibrated model was subsequently evaluated on a marker-free video to assess performance under operational conditions, with fish typically observed within 0–1.5 m from the camera. For each detected individual, the workflow returns a species label and an estimated length. Preliminary results indicate that monocular systems can jointly automate species detection and size estimation in natural settings. Once validated against stereo-video reference measurements or, through direct length measurements obtained after capture, this approach could become a practical, cost-effective tool for monitoring and quantifying juvenile fish dynamics in nursery areas while reducing the logistical barriers associated with stereo-video deployments.

KEYWORDS: MONOCULAR VISION, FISH SPECIES IDENTIFICATION, LENGTH ESTIMATION, OBJECT DETECTION (YOLO), NURSERY HABITAT MONITORING

Characterizing underwater soundscapes in a large lake: First results from the ACOULAC project

PRESENTATION: Oral

AUTHORS: Stéphan Jacquet[1*], Lucille Chapuis[2], Marylin Beauchaud[3], Sarah Berthomieu[3], Jonathan Grimond[4], Vincent Medoc[3]

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The ACOULAC project aims to characterize and monitor underwater soundscapes in large perialpine lakes, using Lake Geneva as a reference system. By integrating innovative approaches in passive acoustic monitoring with machine learning, the project seeks to disentangle the respective contributions of biophony (biological sounds produced by aquatic fauna), geophony (physical environmental sounds such as wind, waves, or rainfall), and anthropophony (human-generated noise) to underwater soundscapes. Acoustic diversity is assessed in relation to biodiversity patterns and levels of anthropogenic pressure. This contribution presents an intermediate overview of the project, with a focus on the methodological framework and field operations conducted since spring 2025. Two study sites were selected for initial deployments based on their ecological interest. These sites encompass a range of submerged microhabitats, including shipwrecks, submerged tree trunks, macrophyte beds, and culvert structures, which are expected to support biological and acoustic heterogeneity. Both sites are also subject to intense human activity during the summer season. At each site, three to four representative microhabitats were instrumented using stand-alone underwater acoustic recorders to enable long-term passive acoustic monitoring. A total of eight recorders (three HydroMoths and one SoundTrap per site) have been deployed and programmed to record 10 minutes per hour. Preliminary spectrogram analyses reveal a clear presence of biophonic signals, including characteristic sounds produced by fish and invertebrates. To our knowledge, these observations constitute some of the first documented evidence of underwater biophony in large perialpine lakes. Recordings also indicate a strong anthropogenic acoustic footprint linked to navigation, recreational boating, and shoreline activities. These initial results highlight the potential of passive acoustic monitoring, supported by scientific diving operations, as a powerful tool for assessing ecological dynamics and human pressures in large freshwater lake ecosystems.

KEYWORDS: LAKE; SURVEY; DIVING; NOISE; SENSOR

Scaling up Seagrass Mapping in Ria Formosa: Hybrid Methodology for Subtidal Seagrass Mapping: Combining Scientific Diving and Aerial Drones

PRESENTATION: Oral

AUTHORS: Guilherme Contente Rosado*[1], Diogo Paulo[1], João Encarnação[1]

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The monitoring of subtidal seagrass meadows is crucial for coastal management. However, traditional diver-based surveys often face limitations in spatial coverage and efficiency when dealing with large-scale ecosystems. This study presents the methodology developed within the Restore Seagrass Project to map seagrass distribution across the Ria Formosa lagoon in southern Portugal, a vast system covering approximately 18,000 hectares. To address the logistical challenges of such an extensive area, a hybrid approach was implemented, combining UAV remote sensing with specialized scientific diving techniques. While aerial imagery provided the necessary landscape scale, the diving operations were essential for high-resolution ground-truthing and characterization. To maximize efficiency underwater, we dove utilizing DPVs, commonly known as scooters, to cover large distances rapidly and navigate against the current of the area. The divers were equipped with surface-towed buoys integrated with GPS systems, allowing for the precise georeferencing of seagrass boundaries as the divers moved along the meadow edges. Beyond mapping the perimeter, scientific divers performed in-situ assessments within each meadow. This included counting shoot density using quadrats, measuring canopy height, and identifying species composition, as well as the presence of invasive species. This \hands-on\" approach allowed for the validation of seagrass presence in turbid or deeper areas where aerial sensors often struggle with light penetration. Through this integrated technique a total of 48 distinct seagrass meadows were successfully mapped. The synergy between UAVs and DPV-supported scientific diving significantly accelerated the mapping process.

KEYWORDS: SUBTIDAL MONITORING, RESTORESEAGRASS PROJECT, COASTAL MANAGEMENT, SCIENTIFIC DIVING

An integrated stereo-photogrammetric and color-balanced 3D reconstruction for coral-reef investigation

PRESENTATION: Oral

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Coral reefs are rapidly degrading under the combined impacts of climate change and local anthropogenic pressures. Effective health assessment of these structurally complex ecosystems requires non-invasive, high-resolution mapping approaches capable of capturing fine-scale morphological and ecological changes. This study presents a scientific diving-based workflow for acquiring and processing repeated underwater stereo photogrammetric datasets along transects of a few tens of meters, intending to produce accurate 3D reconstructions and color-balanced orthomosaics for detecting variations in colony condition, benthic composition, and reef structural complexity. Stereo image acquisition was performed by scientific divers using pre calibrated GoPro camera pair mounted on a rigid bar to ensure stable geometries and synchronized triggering. Divers followed highly overlapping (~90%) acquisition paths at constant height above the reef, maximizing redundancy and feature coverage. The imagery was processed through a dedicated pipeline including: (i) definition of intrinsic and extrinsic camera parameters; (ii) automated frame orientation and point cloud reconstruction via Structure from Motion (SfM) and Multi View Stereo (MVS) methods; and (iii) advanced color correction routines to compensate for depth-dependent light attenuation and spectral distortion. Artificial intelligence–based color restoration algorithms were applied in parallel with image orientation and dense cloud generation in Agisoft Metashape Pro. Derived products included 3D metrics such as rugosity, slope, and fractal dimension, alongside orthomosaics for benthic cover assessment. The integrated approach produced centimeter-scale 3D reconstructions with acceptable geometric deviation. Pre-calibration improved overall accuracy, reducing the need for external ground references and limiting diving effort. AI-based color correction enhanced feature detection even in low contrast areas, using exclusively photogrammetric data and intermediate outputs. Orthomosaics exhibited improved spectral balance, facilitating rapid visual assessment of bleaching and disease patches. This scientific diving photogrammetric approach provides an efficient, scalable, and cost-effective tool for coral reef monitoring at relevant ecological scales. Its compatibility with UAV and ROV-based mapping platforms supports integration into broader multi-sensor monitoring frameworks, enabling long-term ecosystem health assessments. Field tests were carried out in Indonesia and Vietnam as part of joint projects involving the University of Bologna, the University of Manado, and the Vietnam Institute of Oceanography in Nha Trang.

KEYWORDS: BIODIVERSITY, SUCCESSION, KELP-ASSOCIATED MACROFAUNA, CLIMATE CHANGE

A new monitoring technique for protected species

PRESENTATION: Oral

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The Aquaculture Stewardship Council (ASC) Principle 2 aims to conserve natural habitats, biodiversity and ecosystem function around aquaculture sites. We implemented a scientific-diving baseline assessment to support ASC Criterion 2.3 (Interaction with critical or sensitive habitats and species) in the North Euboean Gulf (Oreoi Strait, Greece). Within a buffer zone of 500m around the fish farm, two stations were selected to be monitored (near and far). Into the survey two protected sponge taxa (Porifera) — *Axinella cannabina* (Barcelona Convention SPA\/BD Annex II) and *Aplysina aerophoba* (genus-level protection under SPA\/BD Annex II) were identified as they considered as sensitive indicator species because they are conspicuous, sessile filter-feeders potentially responsive to chronic farm-related pressures (sedimentation\/organic enrichment, increased suspended solids\/turbidity and indirect habitat alteration). Scientific divers applied two complementary, non-destructive methods to quantify individual condition and enable trend detection. (1) Underwater photogrammetry: divers executed standardized orbits with time-lapse imaging (295–480 photos per specimen), followed by colour correction and processing in Agisoft Metashape to produce whole-organism 3D models and baseline volume estimates. (2) Marked-branch morphometrics: five branches per specimen were tagged for relocation and repeated measurement of branch length and thickness at fixed positions (bottom\/middle\/top), capturing localized breakage, necrosis or thinning that may not be evident in coarse volume change. This dataset establishes reference conditions for protected sponge individuals within the buffer zone of aquaculture facilities. Continued monitoring of the same individuals using consistent sampling protocols will support adaptive management, with sustained volume loss and\/or systematic branch deterioration acting as alert triggers for expanded monitoring along exposure gradients and integration with benthic deposition metrics. While a single survey cannot confirm impacts, the implementation of species-specific monitoring provides a defensible framework aligned with ASC Criterion 2.3

KEYWORDS: PHOTOGRAMMETRY, SPONGES, AQUACULTURES

Upscaling transplant methods of subtidal seagrass in southern Portugal

PRESENTATION: Oral

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Seagrass meadows are highly biodiverse marine ecosystems that sustain local fisheries, provide coastal protection, increase water and sediment quality, and function as important blue carbon stocks. Southwestern Europe contains the most diverse seagrass populations of Atlantic mainland Europe, including species such as *Zostera marina*, *Cymodocea nodosa*, several *Ruppia spp.*, and *Zostera noltei*. But seagrass meadows are an endangered habitat, as the sustainable cohabitation between human activities and such coastal biodiversity hotspots is not straightforward. The Ria Formosa (south Portugal) is a shallow coastal lagoon subject to a diverse and high level of human stressors, such as local fishing and shellfish exploration, heavy boat traffic, or tourism-related activities. Over the last decades, this have resulted in a decrease of over 40 ha of infralittoral seagrass meadows within the Ria Formosa lagoon. The objective of this study is to demonstrate the large-scale effectiveness of seagrass transplantation, including subtidal species such as Cymodocea nodosa, using scientific diving transplant methods. Transplantation methods include the collection of runners and sods from healthy seagrass meadows. Receiving sites will be subject to threats-mitigation measures, such as relocation of boat moorings or invasive species removal campaigns. In total, we aim at restoring up to 7 ha of seagrass meadows in Ria Formosa lagoon over the period of 7 years, both between traditional lagoonal zones currently more degraded, but also by restoring and planting abandoned salt pans. This process will have profound implications on how we manage wetlands and the respective human uses that may be permitted towards a more sustainable use of environmental resources.

KEYWORDS: HABITAT RESTORATION, SEAGRASS MEADOWS, CYMODOCEA NODOSA, TRANSPLANTATION METHODS, RESTORE SEAGRASS

Integrating remote sensing and diver-based ground-truthing to assess native oyster (*Ostrea edulis*) reef condition for conservation and restoration

PRESENTATION: Oral

AUTHORS: Tiffany Monfort*[1], Mateja Svonja[1], José Maria Fariñas-Franco[1]

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The native oyster (*Ostrea edulis*) is a reef-forming species that creates complex biogenic habitats essential for the survival of many marine organisms, providing refuge, feeding grounds, and nursery areas. Historically, its distribution was widespread across European waters, including the Eastern Atlantic, the North Sea, and the Mediterranean Sea. Today, however, native oyster reefs have become rare. Since the early 1900s, repeated mortality events—driven by disease outbreaks and anthropogenic pressures such as trawling and overfishing—have drastically reduced populations throughout Europe. Connemara (western Ireland), a collaborative initiative between a consortium of fishermen and scientists was established to monitor and map the remaining native oyster reefs and to test restoration strategies. This effort focuses on two bays in the region. In 2025, a mortality event was recorded in one of these bays, prompting further investigation. The aim of this study was to identify the cause of the mortality event and to characterise the remaining oyster beds in the affected area. A multidisciplinary approach was used to reconstruct the timeline of the mortality event and to map the bay. The monitoring programme employed a suite of seabed habitat mapping approaches that combined remote acoustic sensing with high resolution imaging, both remote and in situ, the latter conducted by scientific divers. Divers carried out direct seabed assessments, collected oyster samples for disease screening, and captured detailed photoquadrats used to quantify mortality rates and validate remotely sensed data. This integrated diving supported methodology provides the fine scale resolution necessary for robust ecological interpretation to inform restoration approaches. Preliminary results indicate that Ostrea edulis was infected by Bonamia edulis, a parasitic pathogen, and that the bay experienced significant oyster loss as a result. This study highlights the value of interdisciplinary collaboration and underscores the importance of integrating local ecological knowledge from fishermen, whose field-based expertise is indispensable. Further research is required to refine restoration strategies, and additional trials will be necessary to support the potential recovery and expansion of native oyster reefs.

KEYWORDS: OSTREA EDULIS, CONNEMARA, IRELAND, MORTALITY EVENT, MULTIDISCIPLINARY APPROACH

Underwater Infrastructure Inspection: The cooperation between scientific divers and autonomous robots

PRESENTATION: Oral

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Water-related infrastructures such as dams play a crucial role in drinking water supply, industrial water provision, energy production, and mitigating the effects of extreme weather events such as floods and droughts. In addition to dams, many other submerged structures, including bridge piers, harbour facilities, locks and shore protections, require regular inspections to ensure operational safety. Currently, underwater inspections in Germany are mainly conducted through manual surveys according to the DIN 1076 standard, involving either reservoir drawdowns or the deployment of qualified divers. Both options are cost- and time-consuming. As a result, inspections are too rare, leading to delayed damage detection and increased maintenance costs. The research project SUBmarIne aims to overcome these challenges and facilitate the work of scientific divers. The approach focuses on developing a cost-effective system for underwater infrastructure inspection, which enables regular and complete investigations without interrupting the use of the facility. The preliminary inspection of the structures is to be carried out by autonomous underwater vehicles equipped with optical sensor systems, which capture high-resolution images of submerged structures. The recorded data is processed using photogrammetry to generate detailed three-dimensional models of the whole inspected objects. Based on the recorded images and videos, automated algorithms are applied to detect potential damages. The basis for reliable image evaluation is the training of artificial intelligence with underwater image data sets that are as comprehensive and diverse as possible. These should reflect different damage classes and sizes as well as varying environmental conditions and recording settings. In particular, images captured under poor visibility conditions represent a key challenge for underwater photogrammetry and automated image analysis. Within the project, different methods were developed and implemented to reduce these effects and improve data quality. The combined visualization of AI-detected damages within the corresponding 3D model enables precise localization of relevant inspection areas for scientific divers. This approach allows divers to focus on critical sections, increasing the efficiency of underwater surveys and enabling larger areas to be inspected within the same time. As a result, inspection intervals can be shortened, more structures can be monitored regularly, and the water supply security is guaranteed.

KEYWORDS: UNDERWATER BUILDING INSPECTION, DIVER-ROBOT INTERACTION, AUTONOMOUS UNDERWATER VEHICLES, 3D-PHOTOGRAMMETRY, AI-DEFECT DETECTION

Cross-realm canopy science: translating terrestrial forest methods to marine forest canopies.

PRESENTATION: Oral

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Marine animal forests (MAFs) are structurally complex benthic ecosystems dominated by canopy-forming filter- and suspension-feeders. Like terrestrial forests, they act as biodiversity hotspots, providing habitat, nursery grounds, and feeding and reproductive shelters for numerous species. Despite their ecological importance, quantitative monitoring of MAFs at medium to large spatial scales remains challenging for scientific diving operations. This study presents an innovative, semi-automated workflow for assessing canopy-forming organisms (CFOs) using diver-acquired imagery and Structure-from-Motion (SfM) photogrammetry. High-resolution underwater surveys were conducted across five Mediterranean MAFs sites to generate three-dimensional (3D) reconstructions of benthic assemblages. The resulting point clouds were processed through a five-step pipeline adapted from terrestrial LiDAR forest analysis: (i) denoising, (ii) ground-point classification and filtering, (iii) height normalization to correct for substrate irregularities, (iv) individual CFO detection and height estimation, and (v) canopy volume and occupancy quantification. Semi-automated outputs were compared with manual measurements derived from 3D models. CFO detection showed strong agreement (mean F1-score = 0.77 ± 0.12), indicating robust performance in identifying canopy elements. Height estimation, however, revealed moderate accuracy (mean R^2 = 0.55 ± 0.29), with systematic overestimation in areas characterized by highly irregular substrates. Although direct transfer of terrestrial forest-processing methods to underwater environments presents limitations, this study represents the first semi-automatic quantitative assessment of MAFs canopy structure derived from diver-based photogrammetry. The proposed workflow supports a shift from species-level assessments toward structurally explicit ecosystem monitoring, offering a cost-effective and scalable tool for scientific diving programs aimed at habitat integrity evaluation and long-term conservation management.

KEYWORDS: HABITAT ENGINEERS, 3D PHOTOGRAMMETRY, SCIENTIFIC DIVING, 3D CANOPY STRUCTURE, BENTHIC MONITORING

Monitoring the effects of native oyster reef restoration in the Mediterranean Sea

PRESENTATION: Oral

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Native oyster reef restoration projects, well developed in northern Europe, America and Australia, are increasingly being implemented in the Mediterranean Sea, from shallow coastal habitats to offshore waters often characterized by low visibility. Assessing the ecological effects of newly established oyster reefs requires robust monitoring frameworks capable of capturing structural development, population dynamics, biodiversity enhancement, and ecosystem functioning across multiple spatial scales. Effective and successful oyster reef monitoring program usually combines five groups of indicators: oyster population status (health, density and age structure), oyster recruitment (natural spat settlement and beyond), structure (growing reef height\/complexity, bioconstruction\/bioerosion processes), associate biodiversity (higher fish and invertebrate abundance), and ecosystem functioning (measurable filtration and nutrient cycling). No single survey method can adequately capture this complexity. Instead, monitoring programs must combine complementary underwater methodologies ranging from direct sampling of oyster populations to benthic and nektonic community assessments, manipulative in situ experiments, and acoustic or optical surveys. In the Mediterranean Sea, limited visibility and highly heterogeneous three-dimensional reef structures pose operational challenges for diver-based assessments. Standard visual census approaches are often insufficient, requiring the integration of high-sensitivity photographic and video systems alongside traditional sampling. Multi-scale approaches, spanning centimeter-level structural measurements to hectare-scale habitat mapping, are therefore essential. Drawing on restoration case studies from the Adriatic Sea conducted under varying environmental conditions, this contribution outlines an integrated methodological framework tailored to Mediterranean oyster reef restoration. The proposed approach emphasizes the need for adaptive, multi-method monitoring strategies to ensure reliable assessment of ecological recovery and long-term ecosystem service provision.

KEYWORDS: OSTREA EDULIS, HABITAT RESTORATION, UNDERWATER SURVEY

From Visual Census to Virtual Reality: A Decade of Surveys, Studies, and Innovation in MARE-Madeira's Scientific Diving Program

PRESENTATION: Oral

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Over the last decade, MARE-Madeira has developed a comprehensive scientific diving program that integrates classical diver-based methods with a broad and evolving suite of underwater technologies to address ecological, methodological, and operational challenges in the Madeira Archipelago. This presentation provides an overview of a decade of activity, highlighting how scientific diving is embedded in multiple research domains, rather than a stand-alone technique. At MARE-Madeira, a major focus of the scientific diving work lies on long-term ecological monitoring, based on standardized underwater visual census surveys used to assess biodiversity patterns and temporal trends along the coast, including marine protected areas and restoration sites, as well as to detect and track non-indigenous species. Scientific divers also contribute directly to habitat characterization and mapping by collecting detailed biological observations that serve as ground-truth data for remotely acquired imagery and acoustic products. Underwater experimentation represents another area of activity. Divers aid in the installation, maintenance, and monitoring of experimental systems designed to investigate ecological processes in situ, such as species interactions, resource use, and biofouling dynamics. In parallel, scientific diving is essential for the deployment, maintenance, and recovery of underwater sensors, including hydrophones for passive acoustic monitoring and environmental loggers used in long-term observation programs. Finally, scientific divers play a key role in testing and validating newly developed or adapted underwater equipment, particularly low-cost and prototype systems intended for deeper or more remote deployments. These controlled field trials enable early identification of technical and operational limitations and directly contribute to refining emerging technologies. This presentation showcases studies from the Madeira Archipelago ranging from underwater visual censuses and complex in situ experimentation to more innovative approaches, including the integration of AUVs for underwater photogrammetry during surveys, custom-designed camera setups, and VR immersive experiences. Through a set of representative case studies, we highlight how a flexible and technology-aware scientific diving capability supports both scientific discovery and methodological development. Drawing on 10 years of experience, this contribution illustrates how an integrated scientific diving program can strengthen multidisciplinary marine research and enhance institutional capacity to respond to evolving environmental and technological challenges.

KEYWORDS: MULTIDISCIPLINARY MARINE RESEARCH, MADEIRA ARCHIPELAGO, COASTAL MARINE ECOSYSTEMS, TECHNOLOGY AND INNOVATION, TECHNOLOGY-INTEGRATED FIELD RESEARCH

Environmental Inventory of Mercury (Hg) for three Marine Shallow Water Hydrothermal Systems

PRESENTATION: Oral

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Mercury (Hg) is a globally significant environmental toxin and an important tracer element in hydrothermal systems, yet its behavior in coastal, marine shallow-water hydrothermal systems (MSWHS) remains poorly constrained. While deep-sea hydrothermal venting is widely considered a major natural source of Hg to the ocean–atmosphere system, Hg emissions from shallow, nearshore hydrothermal systems—often located in biologically sensitive coastal environments—are largely overlooked. This study investigates Hg concentrations in three prominent MSWHS in the Mediterranean Sea: Milos (Greece), Panarea, and Vulcano (Italy), to identify controls on Hg variability and transfer processes. A novel gas sampling and analytical approach using SCUBA diving was employed to quantify gaseous Hg reliably, assumed to be predominantly elemental Hg, using permanganate trapping followed by cold-vapor atomic fluorescence spectrometry. Mercury concentrations in hydrothermal gases span several orders of magnitude, ranging from 1 to nearly 3000 nmol m^{-3}, both between sites and within individual systems. Notably, no systematic relationship was observed between Hg concentrations in gases and those in associated hydrothermal fluids or porewaters. Instead, Hg abundances in hydrothermal gases are primarily controlled by venting style and near-surface processes. Gases discharging directly from bedrock without a sediment cover consistently exhibit significantly higher Hg concentrations than gases migrating through seafloor sediments before release. This pattern is observed across all three study areas and is particularly pronounced at Panarea. Interaction with sediment porewaters promotes the transfer of Hg from the gas phase into the aqueous phase, facilitating cinnabar (HgS) precipitation and effectively scavenging Hg from ascending gases. High H_2S concentrations further enhance Hg removal, whereas elevated CH_4 concentrations appear to favor Hg transport and partially counteract sediment-related losses. These findings demonstrate that shallow subsurface processes exert a dominant control on Hg emissions from MSWHS, overprinting signals inherited from deeper hydrothermal reservoirs. Consequently, Hg fluxes from shallow-water hydrothermal venting cannot be extrapolated from deep-sea systems alone. Given their proximity to coastal ecosystems, MSWHS represent a potentially important yet underappreciated component of the marine Hg cycle and warrant inclusion in future regional and global Hg budgets.

KEYWORDS: MARINE SHALLOW-WATER HYDROTHERMAL SYSTEM, MERCURY, SEDIMENT, ENVIRONMENT, TOXIC

Underwater Geomorphological Formation Research in the Eastern Baltic Sea

PRESENTATION: Oral

AUTHORS: Ieva Barda*[1], Anete Fedorovska[1], Gustavs Ruskuls[1], Ingrida Andersone[1], Kristaps Rendinieks[1], Sandijs Meskis[2,3], Sandra Sprukta[1]

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Geomorphologically significant underwater formations in the eastern Baltic region, particularly within Latvian territorial waters of the Baltic Sea, are subject to increasing anthropogenic pressure, fragmented management frameworks, and limited integration of geological and ecological data. Poor underwater visibility, sediment disturbance, and uneven documentation of seafloor features further constrain effective conservation and marine spatial planning. This study aimed to improve the protection, management, and sustainable use of submarine geological heritage through an integrated research approach combining hydroacoustic mapping, scientific diving, underwater photogrammetry, geomorphological assessment, and biological sampling. Scientific diving played a central role by enabling direct in situ observation, substrate characterization, and validation of remotely sensed data. Diving surveys were guided by hydroacoustic datasets, allowing targeted investigation of geomorphologically significant submerged formations and their associated ecological features. The integration of in situ observations with geospatial analyses significantly improved the interpretation of acoustic data and enabled detailed documentation of complex seabed landforms that are difficult to characterize using remote methods alone. Combined geological and biological mapping outputs enhanced understanding of the relationships between seafloor morphology, habitat distribution, and conservation priorities. The results demonstrate that coupling scientific diving with geospatial analysis provides a robust framework for documenting and managing significant underwater geomorphological formations in the Baltic marine environment. This approach highlights the expanding role of scientific diving in multidisciplinary marine research and supports its application as a key method for evidence-based environmental management and marine spatial planning in coastal systems. The research was financed by the Interreg VI-A Latvia–Lithuania Programme project LL-00244 GEOSITES \Enhancing protection and conservation of geological structures in Latvia and Lithuania\”"

KEYWORDS: BALTIC SEA, GEOMORPHOLOGICAL FORMATIONS, BIODIVERSITY

Charting the Macaronesian Void: A Baseline for the Volcanic Marine Caves of the Canary Islands

PRESENTATION: Oral

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Marine caves of Macaronesia represent a largely unexplored component of Atlantic biodiversity. In the Canary Islands, a volcanic archipelago, prior investigations had generated fragmentary knowledge of these ecosystems, lacking a systematic baseline for research or conservation management. To address this gap, we implemented the first large-scale, comprehensive monitoring programme for marine caves in the region, driven by the dual objective of fulfilling the EU Marine Strategy Framework Directive (MSFD) and generating scientific knowledge. Over two years, an extensive field campaign using scientific diving techniques surveyed 54 caves across five islands for rapid assessment, from which nine were selected for intensive, long-term monitoring. All dives were conducted following rigorous operational protocols to maximise safety and efficiency. We deployed a holistic methodological toolkit including: (1) semi-permanent spatial referencing systems for repeatable surveys; (2) high-resolution 3D topographic mapping and photogrammetric mosaics to characterise habitat structure; (3) photo-quadrats, fish censuses, and biological sampling to quantify sessile and mobile communities; (4) multiparametric sonde profiling for physicochemical characterisation; and (5) water sampling for nutrient and organic matter analysis to assess trophic conditions. This integrated approach allowed us to establish the first robust baseline for marine caves in the Canary Islands. Our findings revealed a unique ecosystem identity. Communities were structurally similar to other oligotrophic regions, such as the Aegean Islands, with a high prevalence of sponges. However, their species composition shows a distinct Atlantic biogeographic signature. Furthermore, our results uncovered a critical vulnerability paradox, despite high diversity.

KEYWORDS: MARINE CAVES, MACARONESIA, BIODIVERSITY BASELINE, MONITORING, VULNERABILITY

Scientific Diving Survey of the biological and hydrological features of sinkholes in the Salento peninsula (Southern Italy)

PRESENTATION: Oral

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Salento peninsula (SE Italy) has approximately 220 km of coastline bordered by the Ionian and Adriatic Seas, with high development of coastal karst due to widespread presence of carbonate rocks. This contribution presents the preliminary results of a research focused on flooded sinkholes along the Ionian coast. These collapse phenomena occur along the coastline, up to a few hundred meters from the sea, at depths ranging from 0.5 to 6 m above sea level. They contain a mixing of freshwater and sea water, with further addition from sulphur springs. Waters have a constant temperature of around 18°C and host a rich biodiversity. The aim of the activities is the hydrogeological and biological characterization of the site and the evaluation of the effects of water mixing on carbonate dissolution rates. To this end 40 dives have been conducted so far, with a maximum of two divers at a time (for mutual assistance) equipped with speleo-diving equipment in A.R.A. Biological sampling is being conducted using plankton nets (200 µm mesh) and a sorbona. At least 20 taxa have been identified so far, including amphipods, isopods, mysids, tanaids, copepods, gastropods, polychaetes, some possible parasites, as well as different euryhaline fish species. In addition, samples of the algal component have been collected and analyzed. Multi-parameter probes have also been deployed to monitor conductivity, temperature, and pressure. These are combined with periodic measurements of pH values, chemical and microbiological analyses, and meteorological parameters. Finally, to evaluate the rate of water dissolution in the rock, a series of tablets were established using two local lithotypes: these are collected and checked periodically in the laboratory in order to evaluate their weight over time. All diving operations were entirely filmed using video cameras mounted on the divers' helmets and each dive was recorded in an Excel spreadsheet.

KEYWORDS: SINKHOLE, KARST, BIODIVERSITY, HYDROGEOLOGY, SCIENTIFIC DIVE.

From the Deep to the Cave: Unexpected Strongholds of Rock Sponges

PRESENTATION: Oral

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Marine caves are widely recognized as biodiversity hotspots, with sponges among the dominant and most diverse taxa. Often described as "sponge biodiversity reservoirs", marine caves host high species richness, including rare and previously undescribed taxa. In recent years, scientific diving expeditions conducted within the framework of various research projects and coordinated sampling campaigns have systematically explored marine caves across the Eastern Mediterranean, expanding our understanding of these understudied ecosystems. Several noteworthy records emerged, including rare taxa, potentially new species, and extensive sponge aggregations of considerable size. Among the most remarkable findings is the discovery of rock sponge formations, particularly in cave sectors with higher freshwater input. These sponges, typically known from deep-water environments and rarely recorded in shallow marine caves, benefit from silicate-enriched conditions that facilitate the development of heavily silicified skeletons and allow these sponges to construct rigid frameworks and often large bioconstructions. In caves with lower freshwater input, rock sponges were present but showed smaller growth or malformed skeletal elements, highlighting the role of silicate availability in skeletal development. Morphological examination revealed at least ten taxa, some likely new to science, demonstrating that targeted sampling combined with careful spicule-based taxonomy is essential to avoid underestimations of diversity. These discoveries support the recognition of a distinct marine cave community associated with freshwater input, dominated by rock sponges forming complex bioconstructions that enhance local biodiversity. This community highlights the ecological uniqueness of marine caves as refugia for deep-water lineages and supports rare taxa. Recognition of this habitat has contributed to recent conservation actions, including the listing of key bioconstruction-forming genera as endangered or threatened under regional and international frameworks. These findings emphasize the need for continued monitoring, habitat management, and protection of marine caves, which also hold significant scientific and heritage value and serve as popular locations for recreational diving. This work was supported by "SponBIODIV – Marine sponge biodiversity from genes to ecosystems: delivering knowledge and tools for sustainable management and conservation," funded by Biodiversa+, the European Biodiversity Partnership under the 2021–2022 BiodivProtect joint call, co-funded by the European Commission (GA N°101052342) and the funding organisation GSRI (ΓΤΒΙΟ-0559429).

KEYWORDS: MARINE CAVES, SPONGES, BIODIVERSITY HOTSPOTS, BIOCONSTRUCTIONS

The use of biodegradable mats in lake restoration: divers saving lakes

PRESENTATION: Oral

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Shading is widely recognized as one of the most effective large-area methods for controlling expansive stands of predominantly vegetatively reproducing aquatic plants, as is the case with many invasive macrophytes. By reducing light availability at the sediment surface, shading limits photosynthesis and weakens invasive populations without the need for mechanical harvesting or chemical treatments. Biodegradable mats made from natural fibers are particularly promising, as they provide temporary light exclusion and subsequently decompose, creating conditions favourable for the recovery of native aquatic vegetation from the sediment seed bank. We conducted a pilot study to assess the effectiveness of underwater jute fiber mats installed manually by divers in four lakes in Poland. The study focused on two invasive species, *Elodea nuttallii* and *Cabomba caroliniana*, which form dense monospecific stands and pose a serious threat to European biodiversity. Mats were placed directly over invasive plant stands in affected areas, ensuring full coverage and close contact with the substrate to maximize shading efficiency. The results indicate a complete reduction in the occurrence and biomass of invasive species within treated plots. Importantly, the biodegradable mats proved to be an excellent substrate for the development of native plant species, including *Potamogeton* and *Ceratophyllum*, as well as rare and habitat-forming green algae (charophytes). Notably, charophytes were observed emerging only a few weeks after mat installation. These findings suggest that biodegradable shading can function both as an effective control method and as a tool supporting ecological restoration and the recovery of structurally diverse macrophyte assemblages. However, treatment effectiveness depended strongly on precise installation. Proper positioning, tight adherence to the sediment, and secure anchoring were essential to maintain consistent light limitation and prevent displacement. This highlights the critical role of trained divers, who ensure accurate deployment and provide ongoing monitoring and maintenance. The project demonstrates the value of integrating scientific research with local diving organizations in lake conservation, offering an environmentally responsible and targeted approach to invasive species management and biodiversity restoration.

KEYWORDS: FRESHWATER BIODIVERSITY, INVASIVE SPECIES, ECOLOGICAL RESTORATION, SHADING, BIODEGRADABLE MATS

Fear or Fascination? A Close Eye on Sharks and Rays Encounters in Their Migratory Pathways Across the Globe

PRESENTATION: Oral

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Sharks and rays are considered among the most threatened groups of vertebrates. Traditionally, the narrative has depicted them more as scary predators rather than as keystone species with crucial roles for overall marine ecosystem functioning. In the last few years, significant advancements have been made both in terms of awareness raising and targeted research to support policy implementation for marine and migratory species. This contribution is inspired by recent scientific diving fieldwork and expeditions, including shark and ray encounters, and recent policy milestones aimed at increasing their protection across the globe. This study investigates the primary anthropogenic challenges facing migratory elasmobranchs by connecting field observations and satellite telemetry data on movement with public sentiment analysis. Findings reveal critical spatial bottlenecks where migration routes overlap with industrial activities. They suggest that while public perception is shifting from fear to fascination, increased political commitment is required for legal protection, along with the need for more structured observation protocols and fit-on purpose dissemination resources to conduct safe fieldwork and interactions with these animals.

KEYWORDS: SHARKS, CITIZEN SCIENCE, ENDANGERED

Impact of recreational diving on marine ecosystems: contributions towards sustainable management

PRESENTATION: Oral

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The literature on dive tourism has grown at a pace comparable to the increase in the number of tourists and destinations. Globally, scientific studies addressing the environmental impacts of dive tourism, as well as diver behaviour and satisfaction, are available; however, they predominantly focus on tropical regions. In temperate regions, which have specific ecological characteristics, research in this field remains scarce. In Portugal, information and scientific studies concerning the characteristics and management of diving activities, as well as acceptable limits of change in marine ecosystems, are limited. Providing an innovative contribution to this field, this doctoral project applies adapted methodologies, using the Azores and the Algarve as case studies. The project aims to support future improvements in the management and understanding of this activity, which is regarded as strategic for the tourism development of both regions. The research included: (i) an analysis of different approaches to the management of recreational dive tourism at a global scale; (ii) the identification of the characteristics of dive sites in the two case studies, including an assessment of the species most affected by the activity; and (iii) the proposal of a methodology for calculating the ecological carrying capacity of dive sites.

KEYWORDS: DIVE TOURISM; IMPACTS; CARRYING CAPACITY; SUSTAINABILITY

25 Years of Occupational Scientific Diving at the Institute of Natural Sciences of Brussels

PRESENTATION: Oral

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Over the last 25 years, occupational scientific diving has been developed at the Institute of Natural Science in Brussels, Belgium. The institute that also operates the Belgian oceanographic vessel R\/V Belgica did not permit civilian diving for safety reasons before 2000. Following an initiative by a scientist, also an expert in diving, and with the support of the Institute, the first cruise featuring scientific diving was organised to begin a faunal inventory of one of the wrecks on the seafloor of the Belgian continental plate. At the same time, involvement in scientific diving at the EU level from the late 1980s. First, for the Liege University, and then from the Institute, Belgium was one of the countries that founded the ESDC, which later became the ESDP. National funding was secured to study the biodiversity of the Belgian North Sea Wrecks (BEWREMABI project). At the end of 2003, a new Royal Decree was published in the Belgian Official Bulletin, underscoring the need to establish a sector for occupational scientific diving. Following this structured training, based on the ESDP competency levels for scientific diving at work, was organised. In 2009, the Belgian Working Group on scientific diving, hosted by the Belgian Science Policy Federal Public Service (FPS), obtained authorisation from the Labour FPS to issue the legal Belgian certificate of professional competency for diving. This year, we will organise the 18th edition of our core training fully compliant with the ESD competency level for scientific diving at work (ESDP). The theoretical part of the course is offered at Brussels University as a 3 ECTS course, followed by a 2-week intensive internship for the practical component, covering all skills required by the Belgian BSD standard. The institute's occupational scientific diving team conducted more than 2,500 man dives in the Belgian North Sea, supporting a major project to monitor newly constructed offshore wind parks, including about 400 wind turbines. During this talk, we will discuss the key aspects of legally compliant scientific diving sampling and illustrate this with the sampling and scientific outputs from many funded projects in which the occupational scientific diving team was involved.

KEYWORDS: OCCUPATIONAL SCIENTIFIC DIVING, LEGAL CERTIFICATION, IN-SITU SAMPLING

Equipping the diver, empowering the science: how the Dive-Reporter digital platform is enhancing marine biodiversity monitoring

PRESENTATION: Oral

AUTHORS: João Gama Monteiro[1,2*], André Almeida[1,2], Ruben Freitas[1,2], Susanne Schäfer[1,2], Rodrigo Silva[1,2], Paola Parretti[1,2], Matej Buzinkai[1], Mark Radeta[1,2], João Canning-Clode[1,2,3]

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Scientific diving remains the gold standard for subtidal ecological monitoring, enabling high-resolution data collection and complex experimental interventions. However, the operational constraints of scientific diving—specifically depth-time limits, logistical costs, and restricted spatial coverage—often result in spatiotemporal data deficits. This limitation is particularly acute in coastal ecosystems undergoing rapid phase shifts, such as the proliferation of urchin barrens or the establishment of non-indigenous species (NIS), where continuous, broad-scale surveillance is critical for effective management. This presentation outlines how the Dive Reporter mobile application and web platform addresses these limitations by bridging the gap between rigorous scientific protocols and opportunistic citizen science. Developed and validated within the EU Horizon Europe CLIMAREST project, the Dive Reporter platform and monitoring program utilizes a semi-standardized protocol that engages recreational dive centres as long-term monitoring stations.

KEYWORDS: CROWD SOURCING, STAKEHOLDER ENGAGEMENT, MSFD, MOBILE APP, INTERREG-MAC, DIVEREPORTER_MAC PROJECT

Integrating Reef Check underwater visual census and video-based transects: methodological implications for long-term reef monitoring

PRESENTATION: Oral

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Long-term monitoring is essential for documenting ecological change and counteracting shifting baselines in coral reef ecosystems. Standardized protocols such as Reef Check (RC) have enabled global-scale citizen-science monitoring through underwater visual census (UVC), yet comparative evaluations with video-based approaches remain limited. The RC protocol relies on indicator-based surveys of fish, invertebrates, substrate categories, and anthropogenic impacts. With the increasing use of underwater video systems, evaluating the transferability of RC indicators to image-based analyses is essential for methodological integration and data archiving. Surveys were conducted annually at six reef sites around Bangka Island (North Sulawesi, Indonesia) between 2013 and 2023 (excluding 2020–2022), at 6 and 12 m depth. At each site and depth, four 20 × 5 m belt transects were surveyed following the RC protocol, recording fish (eight indicator families), invertebrates (nine indicator groups), substrate composition (ten categories via point-intercept transects), and anthropogenic impacts. The same transects were simultaneously recorded using forward- and downward-facing cameras. Video analyses replicated RC procedures: fish and invertebrates were counted from forward-facing footage, while substrate categories were assigned from systematically extracted frames simulating 0.5 m point intercepts. Permutational ANOVAs revealed significant method effects for specific indicators rather than uniformly across categories. Within substrate components, hard coral and nutrient indicator algae differed significantly between methods, with video generally yielding lower estimates. A significant site × depth interaction across substrate categories indicated that both approaches effectively discriminated spatial variability. For invertebrates, method effects were significant for banded shrimp and small clams (0–10 cm), while a significant method × site interaction emerged for Diadema. Among fish, method effects were detected for parrotfish and groupers (30–40 cm), and a significant method × year interaction occurred for butterflyfish. These results indicate that while video-based surveys capture spatial patterns comparable to UVC, not all RC indicators are equally transferable to image-based methods. Careful indicator selection and calibration are therefore required when integrating video transects into standardized scientific diving programmes. Combining both methods strengthens long-term monitoring frameworks and provides a robust archival record for future reassessment of coral reef ecosystems.

KEYWORDS: CORAL REEF, CITIZEN SCIENCE, LONG-TERM MONITORING

Interdisciplinary Research as a Key Driver of Innovation in Scientific Diving

PRESENTATION: Oral

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Scientific diving is a highly specialized field of research that combines expertise from the natural sciences, engineering, and medicine under real underwater conditions. In view of increasingly complex research questions—ranging from environmental monitoring and material development to structural inspection—the importance of interdisciplinary collaboration continues to grow. The aim of this contribution is to highlight the role of interdisciplinary research approaches in scientific diving and to demonstrate their added value through selected projects. The analysis is based on interdisciplinary research and development projects conducted at the Scientific Diving Center of TU Bergakademie Freiberg. These include initiatives in materials science, such as the development of materials for underwater 3D printing and phosphate-absorbing materials for water remediation in lakes, as well as projects in robotics and engineering, including software applications for the automated detection of structural damage in underwater constructions using robotic systems and scientific divers. In addition, environmental chemical studies on the underwater monitoring of chemical parameters and the impact of aquathermal systems are considered. Diving medical research also plays a central role, particularly the investigation of divers' bubble load to assess physiological stress. The results demonstrate that scientific diving functions as an integrative research platform in which different disciplines interact synergistically. Technological innovations in sensor technology, robotics, and material development enhance efficiency, data accuracy, and operational safety. At the same time, the direct implementation of experiments and measurements under real environmental conditions ensures a high degree of practical relevance of the collected data. Medical accompanying research contributes significantly to the further development of safety standards and operational profiles. The ISO 8804-1\/2-certified training program, offered by the Scientific Diving Center of TU Bergakademie Freiberg as the world's first certified training institution in this field, ensures international comparability, quality, and safety. Overall, it becomes evident that interdisciplinarity represents a key prerequisite for innovation, safety, and scientific excellence in the field of scientific diving and opens new perspectives for applied environmental, materials, and engineering sciences.

KEYWORDS: SCIENTIFIC DIVING, INTERDISCIPLINARY RESEARCH, UNDERWATER TECHNOLOGY, ENVIRONMENTAL MONITORING

Take it or leave it: a science-based tool to guide ghost gear removal

PRESENTATION: Oral

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Abandoned, lost, or otherwise discarded fishing gear (ALDFG) poses a significant threat to marine ecosystems worldwide, causing physical damage, entanglement, and long-term degradation of benthic habitats. However, removal interventions itself may cause additional harm to fragile habitat/communities. This study introduces a standardized marine citizen science (MCS) protocol, the "Reef Alert Network (RAN) – Assessment of lost fishing gear", together with a new decision-support tool, the Gear Removal–Biological (GRaB) index, developed to evaluate the ecological risks associated with ALDFG removal. An extensive application of the RAN protocol occurred in April 2024, during which 11 trained volunteer divers surveyed coralligenous habitats at depths of 29–51 m within the Portofino Marine Protected Area (Italy). Divers recorded environmental conditions, gear characteristics, colonization levels, and the taxa affected. Across a surveyed area of 350 m^2, 91 items of lost gear were documented, entangling nearly 1,000 organisms. The red gorgonian Paramuricea clavata emerged as the most frequently impacted species, highlighting the vulnerability of structurally complex, slow-growing assemblages. The information extrapolated from the RAN protocol were used to implement the GRaB index, which combines five ecological indicators (i.e., number of entangled organisms, surrounding biodiversity, degree of biofouling, habitat complexity, and gear features) into an intuitive traffic-light classification. Validation using more than 200 surveys demonstrated that the index provides robust estimates of potential ecological damage, helping determine whether removal should proceed and when specialist intervention is advisable. Beyond its analytical value, the framework strengthens citizen science by actively involving trained divers in data collection and decision processes. It also increases public awareness of ALDFG impacts while offering managers a flexible tool applicable to diverse Mediterranean habitats. By supporting evidence-based, precautionary retrieval strategies, this integrative approach contributes to marine conservation, habitat restoration, and the broader sustainability objectives of the UN Ocean Decade.

KEYWORDS: FISHING IMPACTS, HABITAT-FORMERS, DERELICT FISHING GEAR, SCUBA-BASED REMOVAL

Building a university scientific diving training scheme in Greece: the case of the 'Science Diver: Introduction to Scientific Diving' training program in the Aristotle University of Thessaloniki

PRESENTATION: Oral

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The 'Science Diver' program provides an academic framework for education in scientific diving. The program was delivered in October 2025 by the Center for Education and Lifelong Learning of the Aristotle University of Thessaloniki, in Greece, to address the growing demand for trained and certified scientific divers operating under internationally recognized standards, and the need to enrich and renew university curricula. As marine research and blue economy activities continue to expand, the demand for comprehensive scientific diving training becomes increasingly critical. Aligned with ISO 8804-series and the objectives of the UN Decade of Ocean Science for Sustainable Development, the program aimed to equip participants with standardized competencies in underwater research methodology, safety, documentation, and interdisciplinary collaboration. The program followed a 91-hour modular, hybrid structure combining distance learning with intensive field training. It included an introductory session, 28 hours of online theoretical instruction, 40 hours of on-site skills development, 14 hours of data management workshops, and a 9-hour final assessment. A multidisciplinary group of ten trainees from Greece, USA, and Ireland were mentored by seven expert instructors, covering all training topics. The fieldwork consisted of 14 structured training dives conducted over a 10-day session in Chalkidiki, Greece, advancing from safety and team coordination to mapping, sampling, photogrammetry, and the implementation of a mini research project. Standardized templates, GIS tools, and professional data-logging protocols were integrated into workshops throughout the course. All participants successfully completed the program, exceeding the minimum ISO 8840-1 requirements for supervised scientific dives. Trainees demonstrated proficiency in dive planning, underwater navigation, site establishment (datum, transects, quadrats), scientific sampling, media documentation, and post-dive data processing. The final mini project confirmed their ability to integrate operational safety with scientific accuracy under simulated research conditions. The program validated a scalable academic model for scientific diving education that integrates safety standards, interdisciplinary methodology, and science communication. Its hybrid design and strong mentoring framework provide a replicable blueprint for universities and research institutions seeking to professionalize scientific diving and strengthen ocean literacy within the European and international research community.

KEYWORDS: LIFELONG LEARNING, INTERDISCIPLINARY COLLABORATION, MENTORING, MINI PROJECT, SCIENCE COMMUNICATION

Risk analysis, human factors and other components of a work method statement document applied to *in-situ* sampling of an offshore North Sea wind park

PRESENTATION: Oral

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When sampling at sea in an offshore environment, a structured work method statement (WMS) is required by the concessioner of the industrial zone. This document describes the work zone and all tasks to be performed underwater by the occupational scientific diver. The team selection section of the document considers human factors and the qualification of team members for the assigned tasks. This is followed by a comprehensive risk analysis that takes into account the local legal landscape, the platform used by the sampling team, environmental specifics, the impact of team selection, including human factors, the tools used by the team during underwater sampling, the evacuation plan, and more. Scientific diving at work requires a unique combination of skills at the intersection of professional diving and scientific research. Divers must possess not only robust technical diving skills but also the specific scientific competencies necessary to perform assigned tasks. It is the employer's responsibility to ensure that these competencies are acquired, maintained and regularly assessed. However, technical proficiency alone is insufficient. The diver's psychological readiness is equally essential. Scientific divers must be capable of managing uncertainty, adapting to unforeseen circumstances, managing task load, and maintaining clarity of judgement in challenging conditions, such as the offshore North Sea. In scientific diving, one principle is paramount: no individual shall dive unless they willingly choose to do so. The integrity of the scientific mission and the safety of the team depend on divers who are fully committed, mentally available and acting of their own free will. The freedom to decline a dive — without justification and without consequence — is therefore not a courtesy but a core operational requirement. The supervisor, whose coordination responsibilities are legally defined, occupies a central and multifaceted position in scientific diving operations. Their responsibilities extend far beyond coordination: Scientific diving standards emphasise this dual function, combining technical oversight with surface safety management. During this talk, we will illustrate the construction of a WMS as applied to sampling by the occupational scientific diver on the offshore North Sea Belgian zone of energy production.

KEYWORDS: RISK ANALYSIS, HUMAN FACTORS, WORK METHOD STATEMENT

(re)Breathing Forests: Using Closed Circuit Rebreathers to Study Mesophotic Kelp in the Azores

PRESENTATION: Oral

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Golden kelp (*Laminaria ochroleuca*) forms highly productive marine forests that support biodiversity, sequester carbon, and provide key ecosystem services. Across mainland Europe, these habitats have declined dramatically due to ocean warming and other anthropogenic stressors, yet in the Azores archipelago they persist in deep, mesophotic environments (35–80 m), likely acting as climatic refugia. These "hidden forests" remain poorly studied due to depth limitations of conventional scuba and the constraints of remote operated vehicles surveys. The (Re)Breathing Forests project applies advanced scientific diving using Closed Circuit Rebreathers (CCR) to enable extended, silent, and non-invasive surveys of deep kelp forests across multiple Azorean islands. CCR technology allows precise in situ measurements, biological sampling, and sensor deployment in high-current, low-light environments while minimizing disturbance to fragile habitats. Using depth-stratified surveys (30–60 m), the project combines underwater visual censuses, kelp morphometric measurements, reproductive phenology assessment, and environmental monitoring (temperature, currents, pH, nutrients). Recent dives at shallower depths reveal a marked decline in canopy cover, highlighting the increasing vulnerability of these forests to climate stress and underscoring the urgency of securing robust baseline data and ex situ conservation tools at greater depths. A core outcome of this project is the establishment of the first biobank of Azorean golden kelp, preserving reproductive tissue and genetic diversity as a living archive for future restoration. Beyond ecological research, the project strengthens regional capacity by integrating CCR diving into long-term monitoring and training local scientific divers. By demonstrating the operational and scientific advantages of CCR in mesophotic kelp ecosystems, this project highlights CCR diving as a transformative tool for expanding safe human access, improving data quality, and advancing deep coastal research beyond the limits of conventional scuba.

KEYWORDS: CLOSED CIRCUIT REBREATHERS, DEEP KELP, MONITORING

POSTERS

Underwater Geological Heritage of the Baltic Sea as Habitat for Benthic Fauna

PRESENTATION: Poster

AUTHORS: Anete Fedorovska[1*], Ieva Barda[1], Ingrida Andersone[1], Gustavs Ruskuls[1], Mara Kostanda[1]

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Hard substrate biotopes in the Baltic Sea play a key role forming marine protected habitats, they support marine biodiversity remaining insufficiently mapped and biologically characterised. The research focused on underwater geological heritage with particular attention to its ecological significance. Benthic biodiversity associated with different hard substrate types was investigated. The objective was to assess species composition, abundance and biomass of benthic fauna in relation to substrate characteristics. Fieldwork was conducted using scientific diving combined with underwater video surveys. A research polygon of 2 km^2 was established with sampling points distributed at 100 × 100 m intervals. Video surveys revealed heterogeneous distribution of reefs with elevated hard clay moraine and boulder fields forming distinct benthic habitats. Species richness was relatively even across sites with 9–12 species recorded on stones and boulders and 8–15 species on hard clay moraine. The assemblages were dominated by *Mytilus trossulus* and *Amphibalanus improvisus*, which together accounted for the majority of total abundance and biomass. Size-structure analysis of *M. trossulus* revealed high dominance of small individuals by number while larger mussels though less frequent contributed disproportionately to total biomass indicating their importance for habitat complexity and ecosystem services. This study demonstrated that ecological research is essential for strengthening the value of different hard-bottom substrates as living environments for benthic species that provide key ecosystem services. The results showed that hard clay moraine supports benthic assemblages comparable in diversity and biomass to traditionally studied hard substrates such as stones and boulders while also exhibiting distinct species patterns. Despite low visibility, divers successfully conducted photo and video documentation, collected geological and biological samples and measured clay moraine formation dimensions. The applied methods provided high-resolution ecological and habitat data that cannot be obtained through remote techniques alone supporting their use in integrated underwater habitat assessment and management.

KEYWORDS: BALTIC SEA, BENTHIC ECOLOGY, HARD CLAY MORAINE

Application of Zeolite as a Material for Nutrient Removal from Water in Underwater Installations

PRESENTATION: Poster

AUTHORS: Maciej Gąbka*[1], Mateusz Draga[1], Beta Messyasz[1], Ina Pundienė[2], Thomas Grab[3], Lucas Tausendfreund[3], Richard Gruhn[3], Michał Łach[4], Kinga Korniejenko[4]

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Freshwater ecosystems are increasingly affected by eutrophication, driven primarily by excessive inputs of nitrogen and phosphorus associated with human activity. Elevated nutrient concentrations stimulate phytoplankton growth, often resulting in harmful cyanobacterial blooms, deterioration of water quality, and a decline in biodiversity. These processes not only threaten ecosystem stability but also reduce the economic and recreational value of lakes, including their attractiveness and safety for divers. Consequently, there is a growing need for effective, environmentally sound methods to reduce nutrient concentrations directly within aquatic systems. This study explores the application of zeolites as sorbent materials for phosphate removal from water, with particular emphasis on their potential use in underwater and nearshore installations, including systems deployed and maintained by divers. We tested different types of zeolites: natural and synthetic, to evaluate their phosphate sorption capacity under controlled experimental conditions. Closed-loop circulation systems were constructed to simulate continuous water flow, with phosphate concentrations ranging from 0.5 to 5.0 mg PO_4\/L. Additionally, in situ installations containing zeolite were deployed in the form of floating platforms to assess their effectiveness under field conditions. Our results indicate that significant phosphate sorption occurs primarily in well-buffered waters, with reduction efficiencies reaching up to 80% under optimal conditions. The findings provide insight into the environmental parameters influencing sorption performance and support further modification of zeolite materials to enhance their applicability in lake restoration systems. The study demonstrates the feasibility of integrating material science innovations with practical diving operations to develop in situ nutrient reduction systems. Such approaches offer a promising complementary tool for mitigating eutrophication in freshwater ecosystems. This research was funded by the Polish National Center for Research and Development under the M-ERA.NET 3 program (grant no. M-ERA.NET3\/2023\/67\/CleanLake\/2024).

KEYWORDS: ZEOLITE, PHOSPHATE REMOVAL, FRESHWATER RESTORATION, UNDERWATER INSTALLATIONS, LAKE MANAGEMENT

Scientific Diving as a Validation Tool for Innovative Monitoring of Essential Ocean Variables

PRESENTATION: Poster

AUTHORS: Bianca Reis[1,2], Débora Borges[1], Raul Valente[3], Luís Afonso[1,4], Silvia Chemello[1], Isabel Sousa-Pinto[1,3]

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Monitoring Essential Ocean Variables (EOVs) is critical for assessing coastal ecosystem health and supporting evidence-based marine management. Macroalgae are recognized as an EOV due to their fundamental role in coastal ecosystem functioning. In the North and Central coast of Portugal, subtidal marine forests formed by canopy-forming macroalgae dominate the benthic landscape, structuring biodiversity, regulating productivity, and contributing to carbon cycling and ecosystem resilience. Within the scope of the Bioecoocean project, innovative methodologies, namely environmental DNA (eDNA) analysis and passive acoustic monitoring, are being tested and validated to support macroalgal EOV assessment in the Atlantic Living Lab. Scientific diving provides the validation framework for these approaches. Divers conduct standardized habitat characterization using photoquadrats, visual census techniques, and video, targeting both macroalgal assemblages and associated fish communities. These in situ surveys are synchronously paired with environmental eDNA water sampling and passive acoustic recordings obtained through hydrophone deployment within defined marine forest stands. By combining these structural, taxonomic, molecular, and acoustic observations within the same spatial unit, this design enables controlled cross-validation of detection capacity and ecological interpretability across methodologies. In this context, divers establish the ecological reference against which emerging monitoring tools are evaluated. This integrative approach contributes to the development of robust and scalable frameworks for macroalgal EOV monitoring, reinforcing the indispensable role of scientific diving in advancing next-generation coastal observation systems.

KEYWORDS: MACROALGAE, KELPS, BENTHIC COMMUNITIES, MONITORING

Coral Care: when citizen-science offers a second chance to coralligenous habitat formers

PRESENTATION: Poster

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Over the past five decades, the diving sector has emerged as one of the most popular tourism activities, engaging millions of participants and making a significant contribution to the global economy, with a projected market value exceeding 4.5 billion US dollars. The increasing number of divers committed to marine conservation has also stimulated the growth of Marine Citizen Science (MCS) initiatives, strengthening the bridge between the diving community and researchers. In this context, the non-profit organization Reef Alert Network (RAN) was founded by a group of dedicated underwater explorers, marine scientists, and diving centre owners, with the objective of fostering a new generation of divers able to contribute to scientific monitoring and the recovery of the most threatened Mediterranean habitats. To this end, RAN, in collaboration with the Portofino Marine Protected Area, the Polytechnic University of Marche and the Italian Institute of Technology, started the MCS Coral Care project. The project focuses on the location and collection of so-called "corals of opportunity", mainly consisting of colonies detached from the substrate due to artisanal fishing activities and/or partially affected by necrosis. Healthy fragments from these corals are attached, using two-component epoxy putty, to small terracotta bricks, which in turn are temporarily fixed to ad-hoc nursery tables. After an acclimation period, during which trained volunteer divers periodically monitor the health status and growth of the explants through photographic sampling, all recovered fragments will be reattached to the natural substrate. Coral repopulation efforts will target different areas within zone B of the Portofino MPA (Ligurian Sea, Italy), supporting species resilience in the context of the current climate crisis. This project aligns with the aims of the recently approved Nature Restoration Law, highlighting how the establishment of long-term MCS initiatives and the continuous efforts of trained volunteers can ensure the scalability and the sustained viability of restoration actions.

KEYWORDS: WESTERN MEDITERRANEAN; COMMUNITY-BASED CONSERVATION; PARTICIPATORY SCIENCE; OCTOCORALS

Underwater building inspection by robots to optimize damage detection by divers during inspection processes

PRESENTATION: Poster

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The project aims to develop a cost-effective method of inspecting structures from the water side during ongoing operations, to enable regular, comprehensive inspections. This involves using an autonomous underwater vehicle (AUV) to visually record the structures and use AI software to automatically detect potential damage. Scientific divers then check these sites to make a precise assessment. These findings will be incorporated into a guideline for systematic structural inspection below the waterline.

KEYWORDS: UNDERWATER STRUCTURAL INSPECTION, ARTIFICIAL INTELLIGENCE, ROBOT, SCIENTIFIC DIVER

Scientific Diving Protocols of Microbiome Sampling of Antarctic Sponges: A Comparative Case Study from West Antarctica and the Ross Sea

PRESENTATION: Poster

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Scientific diving provides unique access to complex coastal environments and can play a critical role beyond data generation by supporting indigenous community-led governance and decision-making processes. This case study presents results from the Desertores–Chaitén expedition led by Costa Humboldt, in which scientific diving was used as a boundary practice to support an ongoing administrative evaluation of a coastal Indigenous community in the Patagonian fjords of southern Chile. The indigenous community involved is legally recognized by the Chilean National Corporation for Indigenous Development (CONADI) and is currently assessing which administrative or governance framework best reflects its territorial, ecological, and cultural characteristics. In response to a community-identified need for ecological evidence, biodiversity surveys were designed to inform this decision-making process and strengthen local agency in interactions with regulatory frameworks. Diving operations were conducted at multiple fjord stations using photo-quadrat sampling along standardized transects at shallow depths (5–30 m). This non-extractive approach enabled detailed documentation of benthic macrofauna and macroalgae while producing visually accessible data suitable for both scientific interpretation and community use. Diving protocols were adapted to fjord-specific conditions, including low visibility, freshwater influence, and variable currents. Biodiversity observations were complemented by in situ environmental measurements (temperature, salinity, dissolved oxygen), baited remote underwater video stations (BRUVS), and remotely operated vehicle (ROV) transects, to support ecological interpretation. Preliminary results reveal high benthic biodiversity and marked spatial variability in community composition associated with substrate type, water transparency, and local hydrodynamics. Photo-quadrat records and captured habitat-forming species and less conspicuous taxa, as well as new distribution patterns and invasive species, generating ecological information relevant to discussions of territorial use, conservation value, and governance options. This case study demonstrates how scientific diving can function as a tool for community agency by translating ecological knowledge into usable evidence for administrative processes. The approach highlights the potential of diver-based methodologies to support citizen-oriented science, capacity building, and equitable engagement between coastal communities, scientists, and governance systems in remote marine environments.

KEYWORDS: INDIGENOUS GOVERNANCE, BENTHIC BIODIVERSITY, SCIENTIFIC DIVING, PATAGONIAN FJORDS

Exploring Marine Caves of Northern Corfu: Habitat Mapping and Ecological Significance

PRESENTATION: Poster

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Marine caves are a characteristic feature of rocky Mediterranean coastlines, hosting rich biodiversity, including several rare and protected species. They are classified as a habitat of Community interest (8330) under Annex I of the EU Habitats Directive. Member States are required to maintain or restore their favourable conservation status, designate relevant sites, and monitor both ecological conditions and human pressures. Despite increasing research effort across the Mediterranean, knowledge of this habitat type in the Ionian Sea – particularly along the northern Ionian coasts of Greece – remains limited. Comprehensive mapping of marine cave distribution, geomorphology, and associated protected biota is therefore essential for establishing monitoring baselines and identifying priority conservation areas. This study presents a systematic survey of submerged and semi-submerged marine caves in Northern Corfu Island (north-western Greece), integrating habitat mapping with ecological observations. Cave topography, morphology, and degree of submersion were documented alongside the presence of protected species, while caves were also evaluated for their suitability as habitats for the rare Mediterranean monk seal (Monachus monachus). A total of 25 marine caves were investigated (9 fully submerged, 14 semi-submerged, and 2 terrestrial coastal) using SCUBA diving, snorkeling, and boat-based visual surveys. Six caves were assessed as suitable and six as potentially suitable for monk seal use; suitable caves exhibited the geomorphological features known to support seal resting (e.g. internal platform/beach and protection from wave action), whereas potentially suitable caves presented only partial or seasonally functional characteristics. Eleven protected species were recorded (6 Cnidaria, 2 Mollusca, 1 Porifera, 1 Arthropoda, and 1 Echinodermata). Notably, one cave hosted extensive formations of large rock sponges of high conservation interest. The study provides the first comprehensive baseline on marine cave distribution, habitat features, and protected fauna in Corfu, highlighting priority sites for conservation and monitoring. Further targeted surveys are recommended for selected caves as well as nearby island complexes to better document biodiversity and evaluate potential use by monk seals. This work was carried out within the framework of the project "Monk Seals in Northern Corfu" (2025), supported by the Ionian Environment Foundation and the Blue Marine Foundation.

KEYWORDS: MARINE CAVES, IONIAN SEA, HABITAT MAPPING, PROTECTED SPECIES, MEDITERRANEAN MONK SEAL

Quantifying anchoring damage in *Posidonia oceanica* meadows using diver surveys and 3D photogrammetry

PRESENTATION: Poster

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Within the framework of the project BIOPRESSADRIA, an Interreg Italy–Croatia initiative addressing anthropogenic pressures on Adriatic coastal ecosystems, we implemented a pilot study to evaluate and compare survey methodologies for detecting and quantifying anchoring scars in *Posidonia oceanica* meadows. The study, conceived as an operational project contribution, aimed to assess the accuracy, efficiency and scalability of two complementary approaches applied to the same impact sites. The first approach relied on human-based in situ surveys performed by scientific divers, who measured scars length, width and morphology and recorded biological indicators such as shoot density, rhizome exposure and substrate disturbance. This dataset provided a reference baseline for impact characterization. The second approach used underwater photogrammetry, acquired by trained divers and processed through Structure-from-Motion (SfM) workflows to produce high-resolution three-dimensional (3D) models of the seabed. These models enabled the extraction of spatially explicit metrics of scar geometry, affected area and seagrass cover loss. A comparative analysis was performed focusing on measurement precision, spatial coverage, survey effort and repeatability. Statistical comparison between scientific divers-based measurements and 3D-derived metrics demonstrated a high level of congruence, indicating that photogrammetry, when supported by targeted diver validation, provides a reliable and more operationally efficient protocol for quantifying anchoring impacts. Building on these results, future developments will integrate multibeam echosounder (MBES), airborne and bathymetric LiDAR and AI-based image analysis, enabling up-scaling from site-level surveys to landscape-scale assessments. This multi-sensor framework will support spatial planning and conservation strategies aimed at mitigating anchoring-induced degradation of *Posidonia oceanica* habitats across the Adriatic.

KEYWORDS: POSIDONIA OCEANICA; UNDERWATER PHOTOGRAMMETRY; ANCHORING IMPACT ASSESSMENT

Scientific-Diving Training for Invasive Species Monitoring: A Student-Based Field Application from Kaş

PRESENTATION: Poster

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The Eastern Mediterranean Sea is a well-documented hotspot for Lessepsian migrant species, where biological invasions have caused substantial ecological and socio-economic impacts, including altered food webs, increased competition with native species, and shifts in trophic structure. Concurrently, scuba diving represents one of the most widespread marine-based recreational activities worldwide, involving more than 24 million certified divers. While recreational diving can exert direct and indirect pressures on marine ecosystems, it also presents an underutilized opportunity for supporting biodiversity monitoring and conservation. This case study aims to evaluate whether recreational divers can be effectively trained, within a short time frame, to acquire basic scientific diving and ecological monitoring skills relevant to invasive species observation and Marine Citizen Science (MCS) initiatives. A short-term, training-oriented scientific diving course was designed and implemented in Kaş (Antalya, Eastern Mediterranean), a region characterized by intense diving activity and increasing pressure from non-indigenous species. The program combined five theoretical modules—covering marine habitats, fish external biology, invasive species identification, Underwater Visual Census (UVC) techniques, and underwater photography—with four supervised field dives. Field activities were conducted as demonstrative exercises focusing on observation, transect-based surveys (50 × 2 m), quadrat awareness (1 × 1 m), and photographic documentation, without the intention of generating quantitative ecological datasets. All planned theoretical and practical components were successfully completed. Participants demonstrated the ability to apply standardized visual census techniques, conduct basic species identification, record environmental parameters, and adopt non-invasive diving behaviors. Post-dive debriefings indicated improved understanding of scientific protocols, survey structure, and the ecological relevance of invasive species monitoring. The results indicate that recreational divers can acquire fundamental scientific diving competencies through a short-term, structured training framework. Such programs offer a feasible and accessible pathway for integrating Marine Citizen Science into regions experiencing rapid ecological change, enhancing monitoring capacity while promoting environmentally responsible diving practices.

KEYWORDS: CITIZEN SCIENCE, INVASIVE SPECIES, SCUBA DIVING, MEDITERRANEAN

Monitoring of oyster reef restoration through integrated habitat mapping

PRESENTATION: Poster

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Understanding surrounding habitat conditions prior to oyster reef restoration is essential for evaluating subsequent impacts and the extent to which restoration objectives are achieved. The EU co-funded LIFE NatuReef project represents a relevant case study of oyster reef restoration aimed at enhancing biodiversity and contributing to coastal protection in the Mediterranean Sea. The intervention area is located near the Bevano River mouth (Municipality of Ravenna, Italy), within a NATURA 2000 site. This area constitutes a natural oasis characterised by transitional ecotones between freshwater, brackish, and marine environments, as well as between woodland, dune, and sandy systems. Both terrestrial and aquatic habitats play key ecological roles, serving as spawning and nursery grounds. However, the coastline is experiencing pronounced erosion driven by both natural and anthropogenic factors, placing coastal habitats under increasing pressure. A detailed habitat mapping framework was implemented across the study area, integrating terrestrial and marine remote sensing techniques (e.g. LiDAR, photogrammetry, single- and multibeam sonar), direct field underwater sampling (e.g. sediments, benthic assemblages, vegetation), and in situ measurements and observations (e.g. data loggers, oceanographic buoys, avifaunal monitoring). Where appropriate, such as for surrounding benthic communities, spatially referenced datasets were interpolated to produce species distribution maps. In addition, spatial correlation analyses between biotic and abiotic variables were performed to identify current anomalies and to explore potential future effects associated with reef restoration. These baseline data and habitat maps provide a robust reference framework for detecting ecological changes following oyster reef restoration and support adaptive management by identifying ecologically sensitive areas and guiding restoration actions to minimise potential adverse effects.

KEYWORDS: ECOSYSTEM RESILIENCE, BIOGENIC STRUCTURES, ENVIRONMENTAL MONITORING

Efforts of *Fucus vesiculosus* habitat restoration in the Gulf of Riga, Baltic Sea

PRESENTATION: Poster

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Geomorphologically significant underwater formations in the eastern Baltic region, particularly within Latvian territorial waters of the Baltic Sea, are subject to increasing anthropogenic pressure, fragmented management frameworks, and limited integration of geological and ecological data. Poor underwater visibility, sediment disturbance, and uneven documentation of seafloor features further constrain effective conservation and marine spatial planning. This study aimed to improve the protection, management, and sustainable use of submarine geological heritage through an integrated research approach combining hydroacoustic mapping, scientific diving, underwater photogrammetry, geomorphological assessment, and biological sampling. Scientific diving played a central role by enabling direct in situ observation, substrate characterization, and validation of remotely sensed data. Diving surveys were guided by hydroacoustic datasets, allowing targeted investigation of geomorphologically significant submerged formations and their associated ecological features. The integration of in situ observations with geospatial analyses significantly improved the interpretation of acoustic data and enabled detailed documentation of complex seabed landforms that are difficult to characterize using remote methods alone. Combined geological and biological mapping outputs enhanced understanding of the relationships between seafloor morphology, habitat distribution, and conservation priorities. The results demonstrate that coupling scientific diving with geospatial analysis provides a robust framework for documenting and managing significant underwater geomorphological formations in the Baltic marine environment. This approach highlights the expanding role of scientific diving in multidisciplinary marine research and supports its application as a key method for evidence-based environmental management and marine spatial planning in coastal systems. The research was financed by the Interreg VI-A Latvia–Lithuania Programme project LL-00244 GEOSITES \Enhancing protection and conservation of geological structures in Latvia and Lithuania.

KEYWORDS: FUCUS VESICULOSUS, RESTORATION METHODS, ARTIFICIAL FERTILIZATION

Light traps for sampling larval assemblages in kelp forests: an operational case study along the Portuguese coast

PRESENTATION: Poster

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Scientific diving methodologies are essential to study the ecological functions of critical subtidal habitats, particularly structurally complex systems such as kelp forests – known to create key biogenic habitats that provide shelter, food, and nursery grounds for a wide range of marine organisms. However, the role of European kelp forests as nursery habitats remains poorly understood, partly due to the lack of efficient, standardised, and non-destructive sampling methods suitable for subtidal kelp environments. Underwater light traps represent a promising tool for sampling larval stages of fish and invertebrates in these benthic habitats. Yet their application in benthic coastal habitats is limited, particularly in regions characterised by moderate to high turbidity, such as the Atlantic European continental coast. A pilot study was conducted during the summer season in kelp forests dominated by *Laminaria ochroleuca* off the coast of Peniche (central Portugal), at depths of 14–17 m. The study assessed the operational performance of underwater light traps deployed by scientific divers, with a primary focus on the effect of different light sources on the composition of sampled plankton. Two trap designs constructed from PVC, acrylic, and 500 µm collection mesh were used: a smaller model equipped with disposable chemical light sticks (green light) and a larger model incorporating a reusable programmable LED illumination with a timed relay system, both with comparable light periods (8 hours). Traps were deployed during evening dives and retrieved the following morning over three consecutive nights. LED-equipped traps consistently captured higher abundances and a broader range of larval taxa, including fish and decapod larvae, whereas chemical light traps predominantly sampled invertebrate zooplankton. Accordingly, LED-based light traps are recommended for similar coastal environments, with light intensity and configuration adapted to target taxa and sampling objectives. The integration of programmable timers and dimmers is further advised to optimise sampling periods, minimise unnecessary bycatch, and maximise battery autonomy and LED longevity. This study also provided valuable insights into practical and operational constraints, highlighting the influence of light intensity and visibility range, deployment logistics, and equipment durability in turbid, kelp-dominated environments.

KEYWORDS: SCIENTIFIC DIVING, IBERIAN KELP FORESTS, LARVAL RECRUITMENT, LIGHT TRAPS, CASE STUDY

Bottom-up effects of seabird colonies on Arctic benthic communities mediated by kelp forests

PRESENTATION: Poster

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Arctic seabird colonies concentrate marine-derived nutrients on land through the deposition of guano, fertilising vegetation and supporting local consumers. However, the return flux of these nutrients to adjacent marine habitats, where they accumulate beneath bird cliffs, remains poorly recognised, particularly in non-tropical and non-oligotrophic ecosystems. This study assessed the influence of ornithogenic nutrient enrichment on benthic community structure in the shallow rocky subtidal zone beneath a seabird colony in the Svalbard archipelago—an environment inaccessible to larger research vessels and therefore requiring direct in-water sampling. Fieldwork was conducted along shore-perpendicular transects by scuba divers who collected photoquadrat imagery and benthic invertebrates at fixed 20 m intervals along each transect, enabling high-resolution, non-destructive community assessment and targeted biological sampling across the nearshore gradient. Stable isotope ($\delta^{15}N$, $\delta^{13}C$) analyses of dominant invertebrates were subsequently performed to trace seabird-derived nutrient incorporation. Significant differences in benthic community composition were observed between Seabird and Reference locations, with higher diversity and greater abundance of benthic filter-feeders beneath the bird cliffs. Nitrogen stable isotope ratios ($\delta^{15}N$) of selected invertebrates were consistently elevated adjacent to colonies, indicating the uptake of seabird-derived nitrogen. However, the presence of kelp forests modified this effect. Chitons (*Tonicella spp.*) and hermit crabs (*Pagurus pubescens*) appeared to use ornithogenic nutrients effectively beyond the kelp zone, whereas whelks (*Buccinum spp.*) utilised them closer to shore within dense kelp stands. These findings improve understanding of nutrient transfer processes and the complex coupling between terrestrial and marine ecosystems in the Arctic. Ornithogenic fertilisation extends beyond the coastline into the shallow subtidal, yet remains spatially constrained and more subtle than on land due to hydrodynamic dispersal. Diver-based sampling proved particularly effective for resolving these fine-scale ecological patterns in nearshore habitats that are otherwise difficult to access, highlighting the value of scientific diving for ecosystem-scale biogeochemical studies.

KEYWORDS: COASTAL ECOSYSTEMS, STABLE ISOTOPES, ORNITHOGENIC NUTRIENTS, PELAGIC-BENTHIC COUPLING, SUBSIDIZED ECOSYSTEM

DiverWatch: A Citizen Science Diving Observatory Implementing a Standardized Diver Training Framework for societal engagement and resilience

PRESENTATION: Poster

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Coastal ecosystems, including marine forests, reefs, coralligenous assemblages and submerged caves, are among the most biodiverse and climate-sensitive habitats in the Mediterranean. Yet their systematic monitoring remains limited by constrained scientific capacity and uneven spatial and temporal coverage. Citizen science provides a powerful mechanism to address this gap by engaging recreational diving communities with direct, frequent access to underwater environments, while simultaneously strengthening societal awareness and resilience to environmental change. DiverWatch project establishes a Citizen Science Diving Observatory that integrates divers as trained contributors to long-term ecosystem monitoring through a structured training framework aligned with the emerging ISO 25325 standards for citizen science diver training. The project implements a comprehensive capacity-building model combining theoretical instruction, practical field training, and simplified, standardized monitoring protocols to ensure consistency, safety, and scientific validity in underwater data collection. Divers are trained in key species identification, standardized underwater photographic documentation, and the collection of environmental parameters, with a focus on temperature measurements and habitat condition assessments. This structured training enables participants to apply harmonized, scientifically robust procedures, improving data reliability, comparability, and long-term usability, while ensuring full compliance with diving safety standards. A train-the-trainer approach further empowers instructors and dive professionals to act as local facilitators, strengthening community ownership and enabling sustained dissemination of standardized monitoring practices within diving networks, enhancing social listening, and supporting long-term societal resilience through sustained engagement with environmental change. key innovation of DiverWatch lies in operationalizing a standardized diver training model within a citizen science framework, representing one of the first applied implementations aligned with ISO 25325. This alignment enhances methodological consistency, strengthens confidence in citizen-generated observations, and improves compatibility with scientific monitoring systems. Data collected by trained participants are shared through an open digital platform following FAIR principles, ensuring accessibility, transparency, and long-term use. Beyond data generation, DiverWatch promotes ocean literacy and strengthens collaboration between scientists and citizens. As a pilot implementation of an ISO-aligned citizen science training framework and diving observatory, DiverWatch provides a scalable and transferable model that integrates scientific monitoring (for advancing participatory marine monitoring), public communication and community-based resilience, supporting evidence-based conservation under accelerating environmental change.

KEYWORDS: BIODIVERSITY, SUCCESSION, KELP-ASSOCIATED MACROFAUNA, CLIMATE CHANGE

Development of Algae-Reinforced Geopolymer Composites for Saltwater and Freshwater Engineering Applications

PRESENTATION: Poster

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The proliferation of freshwater algae blooms, driven by nutrient pollution from agriculture and urbanization, generates substantial biomass waste that poses environmental and disposal challenges worldwide. Embracing circular economy principles, valorizing this algae as a bio-waste additive in geopolymer composites enables sustainable resource recovery, reducing landfill burdens and minimizing virgin material extraction. The main aim of the research was investigate the effects of algae additive on the mechanical properties, water absorption, and microstructure of metakaolin-based geopolymers dedicated for saltwater and freshwater engineering applications. The materials were prepared by alkali activation of metakaolin with NaOH\/Na_2SiO_3, incorporating 1–5 vol.% algae. The composites were investigated using research methods such as compressive and flexural strength tests, water absorption and microstructural analysis (SEM, XRF). The achieved results confirm the possibility of applying these composites as a material for saltwater and freshwater infrastructure. The addition of algae slightly reduced compressive strength, but enhanced the flexural strength of metakaolin-based geopolymer. The incorporation of algae did not result in heightened water absorption in the saltwater nor in the freshwater. The microstructural observations show interesting mechanisms of dissolution of diatoms from the algae surface and rebuilding it in the geopolymer structure. These composites hold strong potential for saltwater and freshwater engineering applications, such as resilient coastal barriers, water treatment barriers, and erosion-control structures, advancing sustainable development goals by enhancing durability in corrosive aquatic environments.

KEYWORDS: ALGAE, GEOPOLYMER, SALTWATER INFRASTRUCTURE, FRESHWATER INFRASTRUCTURE

Intrinsic over extrinsic: Species identity shapes spatial and interannual Mg/Ca patterns in Arctic marine calcifiers

PRESENTATION: Poster

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Calcium carbonate biomineralization is a key process shaping marine ecosystems and mediating long-term carbon cycling. In calcifying invertebrates, magnesium is incorporated into calcite during skeletal formation, influencing both mechanical properties and geochemical composition. Because magnesium substitution for calcium in calcite typically increases with ambient temperature during calcification, skeletal Mg\/Ca ratios have been widely used as temperature-sensitive proxies, although this relationship may be modified by additional environmental and biological factors. However, species-specific physiology, local environmental variability can complicate their interpretation. Arctic fjords, with strong gradients in temperature, salinity, and freshwater input, provide a natural laboratory to investigate how intrinsic biological controls and environmental factors shape skeletal geochemistry. We examined skeletal Mg\/Ca ratios in three common benthic taxa: barnacle *Semibalanus balanoides*, spirorbis *Paradexiospira violacea*, and bryozoan *Harmeria scutulata*. Samples were collected by SCUBA across multiple sites in Isfjorden, Hornsund, and Kongsfjorden. Mg\/Ca ratio were quantified using Inductively Coupled Plasma – Atomic Emission Spectroscopy (ICP-AES) to evaluate spatial and temporal patterns. Species identity was the dominant control on skeletal Mg\/Ca, reflecting phylogenetic and biomineralization differences, with *S. balanoides* showing low but highly variable ratios, while *P. violacea* and *H. scutulata* exhibited higher and more consistent values. We found consistent fjord-scale patterns in skeletal Mg\/Ca ratios (Hornsund < Isfjorden < Kongsfjorden), likely reflecting broad gradients in temperature, salinity, and freshwater input. Local microhabitat factors (e.g. carbonate chemistry, food availability, sedimentation, kelp canopy) also potentially contributed to finer-scale variability, as observed across sites and individuals. Interannual trends in skeletal Mg\/Ca ratio were generally weak, with only P. violacea showing a minor correlation with bottom-water temperature. Our results highlight the predominant influence of intrinsic biological controls on skeletal Mg\/Ca and emphasize the importance of species-resolved approaches when interpreting geochemical proxies and assessing the resilience of Arctic calcifiers under rapid environmental change.

KEYWORDS: ARCTIC, GEOCHEMISTRY, MARINE CALCIFIERS

New regulations and opportunities for scientific diving in Italy

PRESENTATION: Poster

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The last two years have seen an evolution in the regulations governing scientific and professional diving in Italy. Specifically for scientific diving, on March 5, 2024, the Ministry of the Environment and Energy Security published a ministerial decree containing the \Operational Guidelines for Technical-Scientific Activities for the Protection of the Marine Environment.

KEYWORDS: ITALIAN SCIENTIFIC DIVER, TRAINING, REGULATION

CIIMAR Scientific Diving Centre: Supporting marine research, long-term monitoring and restoration in Northern Portugal. Case study: Herbivory monitoring in kelp forests

PRESENTATION: Poster

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Long-term marine monitoring is essential to understand ecosystem dynamics under climate change and escalating human pressures. CIIMAR Watch is an institutional long-term monitoring program established along the northern coast of Portugal, integrating multidisciplinary efforts across coastal, estuarine, intertidal, and subtidal ecosystems. Initiated in 2024, the program is establishing baseline data across these habitats. Within this framework, scientific diving plays a central role in assessing subtidal rocky reef communities. Here, we present the subtidal component of CIIMAR Watch, focusing on sessile benthic assemblages and kelp forest ecosystems. Three subtidal sites (two in the Viana do Castelo region and one in Porto) were selected and are monitored biannually. At two sites (20 m depth), semi-permanent 15 m transects were installed on rocky vertical walls to survey sessile macroinvertebrates using standardized underwater photographic methods. Temperature loggers deployed at 10 and 20 m characterize local thermal regimes. At the third site (8–10 m depth), located within a kelp-dominated system, five 25 m transects are deployed radially from a fixed point. Scientific divers conduct underwater visual censuses to quantify kelp density, associated ichthyofauna, and invertebrates. Preliminary analyses reveal spatial differences in the population structure of habitat-forming sessile species, including variability in colony size distributions. In the kelp forest site, surveys indicate marked reductions in kelp density and persistence associated with intense herbivory by fish, more likely Sarpa salpa. These observations suggest that grazing pressure may represent a key local driver influencing kelp forest structure in northern Portugal. The application of standardized scientific diving protocols provides consistent, high-resolution data essential for detecting early ecosystem shifts. Initial findings highlight the combined influence of thermal variability and biotic interactions in shaping subtidal community structure. By establishing robust ecological baselines and identifying emerging pressures, this monitoring framework strengthens regional capacity to anticipate change and inform adaptive marine management along the exposed northern Portuguese coast.

KEYWORDS: LONG-TERM MONITORING; SCIENTIFIC DIVING; SUBTIDAL ECOSYSTEMS; KELP FORESTS; ROCKY REEFS

Integrated Environmental Monitoring and Scientific Diving Approaches for ALDFG Removal in Mediterranean sensitive habitats

PRESENTATION: Poster

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Abandoned, lost, or discarded fishing gear (ALDFG) represents a major threat to marine ecosystems, particularly within structurally complex and ecologically sensitive habitats such as Posidonia oceanica meadows and coralligenous reefs. Removal of ALDFG in these environments poses significant operational and safety challenges for scientific divers due to entanglement hazards, limited visibility, complex substrate morphology, and the need to avoid additional ecological disturbance. Within the LIFE STRONG SEA project, ISPRA scientific diving teams developed and implemented standardized operational and safety protocols for ALDFG removal and inactivation. Diving operations were systematically preceded by remotely operated vehicle (ROV) surveys to assess gear configuration, habitat interactions, entanglement risks, and environmental constraints. Survey results were incorporated into detailed dive planning, including hazard identification, task allocation, emergency procedures, and equipment configuration. Field activities were conducted in Northern Sardinia (Italy), focusing on P. oceanica meadows and coralligenous assemblages. The decision-making process between complete removal and inactivation was supported by a modified GRI (Gear Removal Index), adapted to local habitat ecology and vulnerability. Operations targeted multiple gear types, including gillnets, trawl nets, pots, and longlines, at depths ranging from 8 to 40 m. Recovery operations were supported by fishing vessels equipped with dedicated retrieval systems. Scientific divers applied low-impact manual techniques to release concreted or biologically colonized gear while minimizing damage to benthic communities. Refloating and lifting procedures were conducted using lift bags with calibrated buoyancy to ensure controlled ascent and reduce diver workload and entanglement risk. Operational safety measures included structured pre-dive briefings, defined diver roles, redundant cutting tools and safety equipment, continuous surface support, and systematic post-dive debriefings to assess procedural effectiveness and safety performance. Biological monitoring was performed before and after interventions using standardized biotic indices and standardized monitoring protocols to evaluate habitat recovery and operational outcomes. Overall, 25 removal operations and 6 inactivation interventions were completed, leading to the restoration of more than 11 hectares of P. oceanica meadows and approximately 5 hectares of coralligenous habitats. This experience highlights the importance of integrating scientific diving expertise, technological support, and safety-driven operational planning for effective ALDFG management in sensitive marine ecosystems.

KEYWORDS: ALDFG, BENTHIC HABITAT, DIVING PROTOCOLS

Developing a Crew Resource Management Framework for ISO 8804 Scientific Diver Training

PRESENTATION: Poster

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This pilot study aims to develop and evaluate a Diver Resource Management (DRM) framework adapted from Crew Resource Management (CRM) principles for ISO 8804 scientific diver training. While ISO 8804 standards emphasize technical skills, non-technical skills such as situational awareness, communication, teamwork, decision-making, and leadership remain underrepresented. Given the critical role of Human Factors in reducing errors in high-risk environments, this study investigates the feasibility of integrating DRM training within existing diver certification processes and its impact on divers' self-assessed competencies. A mixed-method quasi-experimental design will be employed with 10-15 scientific divers undergoing ISO 8804 training. Participants will complete pre- and post-intervention surveys assessing Human Factors competencies using Likert-scale self-assessments. The DRM module will be embedded into the standard training, including theoretical sessions and practical in-water exercises. Semi-structured interviews with participants and instructors will explore perceptions of the DRM framework's relevance, clarity, and practicality. Instructor observations using behaviorally anchored rating scales will complement the data. Quantitative data will be analyzed using paired t-tests, controlling for confounding variables such as dive conditions and prior experience. Qualitative data will undergo thematic analysis with hybrid coding. Preliminary findings indicate successful integration of the DRM module without disrupting technical training. Statistically significant improvements were observed in situational awareness and communication competencies, with moderate gains in teamwork and decision-making. Participants and instructors reported positive perceptions regarding the module's applicability and instructional clarity. Barriers to implementation were identified, informing future refinements. The DRM framework shows promise as an effective supplement to ISO 8804 scientific diver training, enhancing non-technical skills critical for safety and operational performance. This pilot supports further large-scale evaluation and potential adoption of DRM principles to reduce human error in scientific diving.

KEYWORDS: DIVER RESOURCE MANAGEMENT, CREW RESOURCE MANAGEMENT, HUMAN FACTORS, SCIENTIFIC DIVING, ISO 8804

Pilot study: impact of medicane "Harry" on the hellenistic-roman submerged site at Capo Taormina (Sicily, Italy)

PRESENTATION: Poster

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The Mediterranean basin is currently becoming a strategic laboratory for studying climate-induced extreme events and their effects on the marine ecosystem, as demonstrates the recent catastrophic medicane "Harry" (January 2026). These phenomena demand a paradigm shift in underwater methodologies, moving toward the so-called "Cyber-Ecology", where traditional marine ecology meets advanced computing, robotics, IoT, AI-driven tools and instruments, integrating with the traditional underwater scientific research protocols and the professional ESD standards followed by diving researchers. This study presents an innovative framework promoted by FNOB (Federazione Nazionale degli Ordini dei Biologi, Italy), integrating bionomic investigation, 3d photogrammetry, Gaussian Splatting and 360 reconstruction: all digital and expeditious techniques perfect for creating high-precision Digital Twins in order to evaluate quali-quantitative assessment of ecosystem services and submerged heritage, transforming an underwater biological inspection into a set of georeferenced, reproducible, digitally measurable and readily shareable data for analysis in the global scientific metaverse (D i gi t al R esearch I nf rastructure). It is precisely at this intersection of conservation urgency, digital innovation and professional training needs that the critical intervention at the famous Hellenistic-Roman submerged archeological site in the Bay of Taormina (Sicily), fits in, designated by FNOB as a paradigmatic scenario for the application of such advanced protocols. Within the Isola Bella nature reserve, at depths of 30 meters lie 37 white marble columns from 3rd century AD, before "Harry" totally bio-colonized by a flora-fauna concretion dating back hundreds of years, but recently hit by the medicane. To address this, FNOB is promoting a pilot project focused on baseline surveys and preliminary comparative data, transforming the Taormina disaster into a specialized case study and training program and serving as a laboratory to validate protocols that enhance safety in dive profile and data yield. The project aims to institutionalize advanced digital training for marine biologists, ensuring these new competencies are fully integrable with the ESD framework. By integrating new digital skills with rigorous diving safety standards, FNOB intends to train elite researchers capable of monitoring Mediterranean resilience, ensuring the scientific diver remains a central, tech-savvy figure in Europe's Blue Economy and the protection of global environmental and cultural heritage.

KEYWORDS: CYBER-ECOLOGY; ESD; FNOB; GAUSSIAN SPLATTING; DIGITAL TWIN.

Applying operational best practices for safer scientific diving. The case study of the Hydrobiological Station of Chioggia, Venice Lagoon, Italy.

PRESENTATION: Poster

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Underwater technologies have hugely improved, widening the possibility of scientific enquiries. However, the presence of human personnel underwater is still essential to conduct cutting-edge research. Scientific divers - who can utilize a large variety of sampling techniques, novel technologies, and access peculiar and extreme environments - are essential for correctly carrying out scientific activities. Scientific diving is a complex activity, where each research project requires specific equipment and dive needs (e.g. night dives, deployment of devices, handling of bulky tools, etc.). Therefore, the development and implementation of good practices and strict procedures to mitigate risk is pivotal. All these needs can be met by a research facility fully equipped for diving activities, and endowed with strict and clear diving procedures and risk management measures. Marine zoological stations have played an important role in the study of marine life's history, and from the 1870s onward, a large number of biological stations were funded across Europe. One less-known example of such institutions is the Hydrobiological Station of Chioggia (HSC), located on the Venice Lagoon, and founded in 1940 by the Italian zoologist Umberto D'Ancona. Currently, HSC is a research Facility of the Biology Department of the University of Padua. HSC offers a wide range of equipment and facilities for supporting marine biologists in their underwater research, including boats, diving equipment and dedicated diving experts. Furthermore, this facility provides laboratories, aquaria, and thermostat chambers to broaden research possibilities. Crucially, our Facility adopted official Operating Instructions for Diving Activities, regulating all aspects of diving, clarifying roles and responsibilities, setting explicit best practices to adopt, and risk management protocols. Also, considering the strategic position within the Venice Lagoon, one of the most biologically and ecologically interesting environments in the whole Mediterranean Sea, our Facility is a perfect ground for marine and lagoonal research projects. Here, we present examples of how we applied scientific diving best practices to real field work, tailored to specific dive needs. These examples also highlight the possibilities of research that our Facility offers to marine biology researchers, especially relying on diving for sampling.

KEYWORDS: SCIENTIFIC DIVING BEST PRACTICES, RESEARCH FACILITY, HYDROBIOLOGICAL STATION

How much is enough — full versus 100-point photoquadrat image analysis in search for trends in seabird-subsidized benthic communities

PRESENTATION: Poster

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Photoquadrats are fast, efficient and non-invasive method for estimating the species composition and structure of benthic communities that is successfully applied in various environments around the globe. In the literature a number of software exist that enables the estimation of both the species density and coverage area. Here in a study assessing the influence of large seabird colonies on benthic fauna in their direct vicinity in Isfjorden, Bellsund and Bjornoya we compare the two manual photoquadrat methods. In the first approach, all organisms visible in the photograph were identified and counted, whereas in the second approach only those organisms located beneath the 100 equally spaced grid points superimposed on the quadrat image were recorded. Species number, abundance, as well as diversity measures (Shannon and Simpson indices) were calculated for both methods and compared with the use of Spearman correlation ranks. The results were comparable. The correlation coefficients were overall high indicating that the results were strongly and significantly correlated. The domination plots however indicated observed differences. The time needed for the whole image analysis was one hour while the time for 100 point image analysis lasted 2 times faster enabling a large set of images to be analysed in much quicker time frame which is especially valid for fast diver surveys. The 100 point analysis enables the detection of an individual organism positioned directly beneath each reference point, whereas the full-frame analysis provides greater capacity to record rare taxa and dense aggregations of sessile organisms such as Cirripedia. Consequently, larger variations in species dominance are observed, while the overall species diversity remains largely unaffected. In addition to the comparison of the two methods, the results of benthic inventories were presented.

KEYWORDS: PHOTOQUADRATS, SURVEY, BENTHOS, EPIFAUNA, KELP FOREST, SEABIRDS

Expanding monitoring capabilities at mesophotic depths: a comparative study of optical survey techniques.

PRESENTATION: Poster

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Coralligenous reefs are highly structured and complex habitats in the Mediterranean Sea, typically occurring between 25 and 200 m depth and characterized by the dominance of calcareous algae, gorgonians, and erect sponges. These habitats support high biodiversity and provide essential ecological functions for numerous species of both ecological and economic importance. Until recently, these habitats have posed significant challenges for fieldwork and monitoring, mainly due to the bottom-time limitations when accessing mesophotic depths using open-circuit diving techniques. Traditional in situ approaches include sample collection, visual surveys, and the analysis of photo- and video-imagery, among others. More recently, rapid technological advances, improved accessibility of established methods, and the emergence of innovative approaches have expanded monitoring possibilities. In particular, optical methods such as Structure from Motion (SfM) photogrammetry and low-cost stereo-vision systems enable accurate and cost-effective assessments of benthic mesophotic ecosystems. In this context, the present study evaluates the implementation of innovative, non-destructive survey techniques for monitoring of restoration of the red gorgonian Paramuricea clavata (Risso, 1827), a key-habitat engineering species of Mediterranean mesophotic ecosystems, at the Gallinara Island Site of Community Interest (Liguria, NW Mediterranean). Underwater photographic surveys were used as a traditional two-dimensional method to provide “ground-truth data”, while stereovision and Structure-from-Motion (SfM) photogrammetry were tested to assess restoration success. Comparison of the three methodologies revealed distinct limitations and advantages, including constraints related to data-acquisition, bottom time, calibration complexity, and image resolution. The results highlight the potential of innovative, non-destructive approaches for long-term monitoring of mesophotic habitats; while proposing a preliminary framework that, pending further research and tunning, could be extended to other canopy forming organisms and habitats in the Mediterranean Sea.

KEYWORDS: BENTHIC MONITORING, TWILIGHT ZONE, RESTORATION, OCTOCORALS, NON-INVASIVE TECHNIQUES

Organizing Committee

Sponsors

This project, reference M3.3.B/ORG.R.C./028/2026, has received funding from the Regional Directorate for Science, Innovation and Development through the PROSCIENTIA Incentive Scheme.