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TEMA 1
BIODIVERSITÀ E FUNZIONAMENTO ATTRAVERSO APPROCCI DI ANALISI DI DNA AMBIENTALE (eDNA)

RELAZIONI INTRODUTTIVE

A. PALLAVICINI

Department of Life Sciences, University of Trieste, Italy.
pallavic@units.it

MARINE EDNA METABARCODING: CHALLENGES, METHODOLOGICAL INSIGHTS, AND THE PATH FORWARD

Marine environmental DNA (eDNA) metabarcoding is revolutionizing biodiversity assessment, offering a non-invasive and highly efficient way to monitor marine ecosystems. However, its application still faces significant methodological challenges. The choice of filtration systems, storage methods, and sequencing protocols can drastically affect DNA yield and biodiversity detection, leading to inconsistencies in results. Additionally, environmental factors such as water chemistry, DNA degradation rates, and bioinformatics biases further complicate data interpretation. In this talk, we will explore key limitations in current methodologies, discuss how different technical choices impact biodiversity assessments, and highlight recent innovations aimed at standardizing workflows. Despite these challenges, eDNA metabarcoding remains a promising tool for marine conservation, and addressing these gaps is essential for its broader implementation. What steps must we take to refine this technique and enhance its reliability?

L. ZANE[1,2,3]

[1]Department of Biology, University of Padua, Italy.
[2]National Biodiversity Future Center (NBFC), Palermo, Italy.
[3]National Inter-University Consortium for Marine Sciences (CoNISMa), Roma, Italy.
lorenzo.zane@unipd.it

BIODIVERSITY AND ECOSYSTEM FUNCTIONING VIA ENVIRONMENTAL DNA (EDNA) ANALYSIS

Environmental DNA (eDNA) metabarcoding revolutionized marine biodiversity studies by providing an approach to detect the full array of organisms - from microbes to vertebrates- without sampling them directly. Consequently, assessments of biodiversity are now more efficient, less invasive and more extensive than was formerly achievable. This tool, beyond species detection, sheds light on community structure, habitat connectivity, and ecosystem functioning. Its applications range from tracking trophic interactions and species responses to environmental changes to the assessment of human impacts on the marine ecosystem. Nonetheless, a critical challenge in using eDNA data in ecological practice relates to how biodiversity patterns are related to ecosystem processes. This presentation will provide an insight into the contribution of eDNA to understanding marine ecosystems, with proposed case studies on the new ecological information that can be obtained through this approach, but also highlighting current limitations.

COMUNICAZIONI

G. AGLIERI[1,2], A. LEONE[2,3], F. QUATTROCCHI[2,3], C. BAILLIE[4], S. MARIANI[5], C. CATTANO[1,2], A. CALÒ[2,3], G. TURCO[2,3], D. SPATAFORA[1,2], A. DI FRANCO[1,2], M. DI LORENZO[1,2], P. GUIDETTI[1,2], R. CHEMELLO[3], M. MILAZZO[2,3]

[1]Department of Integrative Marine Ecology, Stazione Zoologica Anton Dohrn, Palermo, Italy.
[2]National Biodiversity Future Center (NBFC), Palermo, Italy.
[3]Department of Earth and Marine Sciences (DiSTeM), University of Palermo, Italy.
[4]Foreign, Commonwealth and Development Office, London, UK.
[5]School of Biological & Environmental Sciences, Liverpool John Moores University, UK.
giorgio.aglieri@szn.it

UNLOCKING THE POTENTIAL OF eDNA METABARCODING FOR MONITORING COASTAL FISH DIVERSITY AND NON-INDIGENOUS SPECIES IN NATURAL AND ARTIFICIAL ENVIRONMENTS

Environmental DNA metabarcoding (eDNA) is a non-invasive tool for assessing marine biodiversity. In the Mediterranean Sea, we provided evidence of eDNA's versatility in both natural coastal ecosystems and port environments, revealing its ability to provide large-scale, comprehensive biodiversity assessments. In natural coastal habitats, eDNA metabarcoding was applied in 11 MPAs spanning the Central and Western Mediterranean Sea, highlighting its capacity to effectively capture the functional diversity of fish communities. Unlike traditional methods, eDNA is functionally non-selective, able to detect a wide array of species and ecological traits, including rare, cryptic, and pelagic species often missed by conventional surveys. This makes it a strategic tool for investigating ecosystem dynamics and functional diversity. Building on its success in coastal environments, eDNA metabarcoding has also demonstrated its strength in port ecosystems, spanning 20 different Sicilian fishing ports. Here, the technique leverages the role of fishing vessels as "mobile samplers," which collect biological material from a variety of marine habitats and deposit it into port waters. This enables eDNA to capture a representative snapshot of fish biodiversity from both coastal and offshore environments. Ports with significant fishing activities effectively act as biodiversity "sinks" allowing for the assessment of fish communities across large spatial areas in a rapid and cost-effective manner. Furthermore, eDNA metabarcoding has proven particularly valuable for the early detection of non-indigenous species (NIS) in these ports, which are critical entry points for invasive species due to their high levels of maritime traffic. NIS thrive in closed, anthropized marine environments, and eDNA enables their identification before they become established, supporting timely interventions to mitigate ecological and economic impacts.

A. AVESANI[1], M. AUGUSTE[1,2], L. DONI[1,2], C. OLIVERI[1], A. AZZOLA[1], E. BOSI[1,2], M. MONTEFALCONE[1], L. VEZZULLI[1,2]

[1]Department of Earth, Environment and Life Sciences (DISTAV), University of Genoa, Italy.
[2]National Biodiversity Future Center (NBFC), Palermo, Italy.
alessia.avesani@edu.unige.it

FIRST SCREENING OF MICROBIAL ASSEMBLAGES IN CORALS FROM MALDIVES ATOLLS

The Maldivian Archipelago hosts ecologically rich coral reefs that have been widely studied for their biodiversity. However, the microbiome of these corals remains largely unexplored. This study represents a first investigation of the microbiota composition, including both bacterial communities and algal endosymbionts, across different coral morphotypes (Acropora, Pocillopora, Porites, Fungia and gorgonians) sampled in May 2022 from four Maldivian atolls (Ari, North Malé, South Malé, and Rasdhoo). Coral and gorgonian specimens were collected via scuba diving from reef sites located in both ocean-exposed and lagoon environments, spanning a depth range of 0–40 m. Additionally, surface seawater samples were obtained near coral assemblages. To characterize microbial diversity, metabarcoding analyses were conducted targeting the 16S rRNA gene for bacterial composition and the Internal Transcribed Spacer 2 (ITS2) rRNA region for microalgal endosymbionts. Coral-associated bacterial communities revealed high diversity, primarily shaped by coral morphotype rather than depth or geographic location. These communities were also distinct from those found in surrounding seawater. The three most abundant bacterial taxa in coral samples included Pseudomonadota (10%–95%), Bacillota (5%–10%), and Planctomycetota (<1%–30%). The majority of Symbiodiniaceae sequences belonged to the genera *Cladocopium*-C and *Durusdinium*-D with distinct host-specific variant types. Overall, this study provides novel insights into the microbiota of Maldivian corals, offering a foundation for future monitoring of coral health and potential responses to environmental changes in the region.

S. CASABIANCA[1,2], M. BASILI[3], S. CAPELLACCI[1], F. RICCI[1], G. RAVERA[1], A. PENNA[1,2], E. MANINI[3]

[1]Department of Biomolecular Sciences, University of Urbino, Italy.
[2]National Inter-University Consortium for Marine Sciences Mare (CoNISMa), Roma, Italy.
[3]Institute for Biological Resources and Marine Biotechnologies (IRBIM), National Research Council (CNR), Ancona, Italy.
silvia.casabianca@uniurb.it

TEMPORAL CHANGES IN COMMUNITIES ON PLASTIC DEBRIS WITHIN A POLLUTED MARINE ENVIRONMENT

In this study, the succession of prokaryotic and eukaryotic communities on polystyrene panels, placed for 25 weeks in a harbor environment impacted by human activity, was examined. These activities contributed to nutrient enrichment from agricultural and sewage runoff, along with the introduction of hydrocarbons and other pollutants. Using an eDNA metabarcoding approach targeting the 16S and 18S rRNA genes, the study provided a detailed analysis of community development and succession, offering insights into biodiversity and ecological dynamics on plastic substrates. Throughout the experiment, the microbial biofilm community remained stable, with *Rhodobacteraceae* (16.97%) and *Flavobacteriaceae* (17.99%) being predominant. Only minor differences were observed between the early and late stages, supporting their role as key biofilm components. In the eukaryotic community, early colonization was dominated by Alveolata (63.39%) and Stramenopiles (23.53%), while in later stages, shifts towards Chlorophyta (20.14%) and Opisthokonta (94.32%) were observed. Richness, as the alpha diversity index based on retrieved ASVs, varied from 1,875 to 2,481 for eukaryotes and from 159 to 405 for prokaryotes, reflecting the adaptive succession of plastic-associated communities in aquatic ecosystems. Potential plastic-degrading prokaryotic groups were found in prokaryotic communities, with a dynamic distribution across colonization stages. Moreover, analysis of the trophic dynamics on plastic debris revealed that heterotrophs dominated the eukaryotic community. Changes in microbial and eukaryotic community on plastic debris indicated temporal variation driven by successional processes, probably influenced by local environmental conditions and pollution levels. Our findings confirmed that plastics act as vectors for diverse microbial communities of bacteria, algae, and invertebrates, including harmful, invasive and/or alien species, affecting local biodiversity and marine food webs across marine ecosystems, with potential risks to marine ecosystem health. Therefore, there is an urgent need for plastic waste management technology, particularly in ports characterized by plastic accumulation due to poor water circulation.

V. CROBE[1,2], M. SPIGA[1,2], A. FERRARI[1], F. TINTI[1], A. CARIANI[1,2]

[1]Department of Biological, Geological, and Environmental Sciences (BiGeA), University of Bologna, Ravenna, Italy.
[2]National Biodiversity Future Center (NBFC), Palermo, Italy.
valentina.crobe2@unibo.it

EDNA-ENABLED MONITORING OFFERS BOTH OPPORTUNITIES AND CHALLENGES FOR THE CONSERVATION OF MEDITERRANEAN ELASMOBRANCHS

Monitoring marine biodiversity is essential for ecosystem conservation and fisheries management. Traditional methods based on visual surveys and capture techniques are invasive, costly, and labour-intensive. Advances in molecular detection from water samples allow for identifying organisms that inhabit, pass through, or interact with the surrounding environment. The environmental DNA (eDNA) currently emerged as an important source of biodiversity information across different ecosystems. Here, we present four case-studies applying different eDNA sampling and screening methods to assess their effectiveness in monitoring Mediterranean elasmobranchs: 1) we tested five eDNA sampling systems, both active and passive, in a controlled mesocosm. Active samplers recovered more DNA and detected all elasmobranchs, whereas passive tools showed lower efficiency; 2) we tested passive tools associated to deep-sea longlines, detecting 78% of captured species and revealing additional biodiversity, including pelagic and mesopelagic taxa not identified by traditional methods; 3) active filtration was applied on 75 samples from 25 sites in the Central Mediterranean, collected at three depths with Niskin bottles, allowing a fine-scale assessment of depth-driven species distribution; 4) over 500 samples were collected along the Italian coasts throughout 2024 using both active and passive tools, expanding spatial coverage and providing comprehensive data on elasmobranch biodiversity shifts. All samples were analysed using eDNA metabarcoding techniques with an elasmobranch-specific marker (elas02-12S), and taxonomic assignments was performed against an improved custom 12S vertebrate reference database. Our findings confirm that eDNA can detect a broader spectrum of marine biodiversity, including elusive taxa not recovered by conventional methods. While eDNA offers insights into marine biodiversity, challenges remain in standardizing methodologies and interpreting abundance data, particularly for passive samplers in fishery applications. Addressing these gaps will enhance eDNA's role as cost effective marine monitoring tool in both conservation and management scenarios.

A. D'ALESSANDRO[1], A. RUSSO[1], N. MERIGGI[2], B. CERASUOLO[1], S. RENZI[1], A. UGOLINI[1], D. CAVALIERI[1]

[1]Department of Biology, University of Florence, Sesto Fiorentino (FI), Italy.
[2]Institute of Agricultural Biology and Biotechnology (IBBA), National Research Council (CNR), Pisa, Italy.
aldo.dalessandro@unifi.it

METAGENOMIC TOOLS FOR SEAFOOD TRACEABILITY AND FRESHNESS

With the world population continuing to increase, seafood consumption has been raising and is bound to increase even more. Such a trend demands sustainable practices that will avoid depleting natural resources making at the same time seafood safe and traceable. In the recent past, microbial communities from seafood have been of interest as possible monitors and regulators of seafood safety. The objective of our research was to determine the possibility of using fish gills-dwelling bacteria as indicator organisms to characterize the origin and spoilage state of the fish. Gills microbiota from the two important commercial species *Dicentrarchus labrax* (sea bass) and *Sparus aurata* (sea bream) from several European nations, i.e., Italy, Malta, Spain, Portugal, and Croatia. Targeted 16S rRNA gene sequencing of V3-V4 regions was performed in combination with untargeted analysis. Regarding the spoilage study, specimen of sea basses were kept for three days in a refrigerator to reflect the retailer-consumer chain, and sampled every day. Gills of sea breams, used for the tracking experiment, were sampled in the country of origin and shipped to us. The sampling was done by swabbing. Results obtained from the tracking experiment highlighted distinct differences among the sampling locations, as evidenced by the presence of site-specific amplicon sequence variants (ASVs). We were able to differentiate samples both at a local scale (within the same country sites) and at a larger scale using the microbial communities. The spoilage experiment revealed a rapid shift in the microbial community, with some microorganisms associated with spoilage (*e.g.*, *Photobacterium*) increasing in abundance over the rest of the community. Our findings shed light on the potential of fish microbiota to assess its origin and state of conservation with a simple and non-destructive sampling method, offering a useful tool for regulatory and inspection bodies.

L. DONI[1,2,3], E. BOSI[1], J. TRINARES[4], J. MARTINEZ-URTAZA[3,5], L. VEZZULLI[1,2]

[1]Department of Earth, Environmental and Life Sciences (DISTAV), University of Genoa, Italy.
[2]National Biodiversity Future Center (NBFC), Palermo, Italy.
[3]Centre for Environment, Fisheries and Aquaculture Science (CEFAS), Weymouth, UK.
[4]Department of Electronics and Computer Science, University of Santiago de Compostela, Spain.
[5]Department of Genetics and Microbiology, Universitat Autònoma de Barcelona, Spain.
luigi.vezzulli@unige.it

DEEP SEQUENCING OF MARINE DNA FOR STUDYING MICROBIAL PATHOGEN ECOLOGY IN THE GLOBAL OCEAN

Bacteria of the genus *Vibrio* are found in marine and brackish waters around the world and are the main cause of infections and deaths in humans and animals from the marine environment. These bacteria pose an emergent threat to human health due to warming ocean temperatures associated with climate change. In 2020, there were about half a million cases of non-cholera *Vibrio* infections worldwide, with projections along U.S. coasts of a 100 percent increase due to sea surface warming over the next 50 years. Nevertheless, the impact of climate change on *Vibrio* populations and the role of the oceans in the spread of these pathogens have remained largely unexplained due to the scarcity of data. Recently, the analysis of metagenomic data derived from global ocean sampling efforts, such as the Continuous Plankton Recorder survey and the Tara Ocean Expedition, have provided an exceptional opportunity to explore the ecology of these bacteria in the marine environment. This contribution will present the analysis of these large datasets providing new insights into the distribution, ecology and connectivity of *Vibrio* populations across the global ocean.

D. SARNO[1,2], W.H.C.F. KOOISTRA[1], M. MONTRESOR [1], I. PERCOPO[1], R. PIREDDA[1,2], N. ROMILLAC[1], G. ZAMPICININI[1,3], A. ZINGONE[1]

[1]Stazione Zoologica Anton Dohrn, Napoli, Italy.
[2]National Biodiversity Future Center (NBFC), Palermo, Italy.
[3]National Institute of Oceanography and Applied Geophysics (OGS), Sgonico (TS), Italy.
diana.sarno@szn.it

INSIGHTS INTO PHYTOPLANKTON DIVERSITY AND ECOLOGY IN THE GULF OF NAPLES: AN e-DNA PERSPECTIVE

Phytoplankton diversity and ecology have been studied in the Gulf of Naples for more than 40 years. Since the beginning of this century, molecular investigations have been introduced in this research, flanking investigations conducted with traditional methods. Particularly, metabarcoding analysis of eDNA fragments have been conducted on samples collected in surface waters at the Long-Term Ecological Research Site LTER-MC. High Throughput Sequencing (HTS) data have been obtained for the V4 fragment of the 18S rDNA for samples spanning over different time scales (1-3 and 10 years). Looking at the whole community, the protist assemblages reveal a high proportion of diversity not attributable to known species and follow a clear temporal succession over the seasons. Dinoflagellates often dominate, with different species assemblages across the year and a previously undetected winter community, contrary to the view that this group is typical of warm waters and stratified water-column conditions. Annual distribution of the widespread genus *Tripos* (formerly *Ceratium*) shows differences in the seasonal occurrence of the different species, which are difficult to capture with routine methods especially for rare taxa. Focusing on individual diatom genera, cryptic diversity has been analysed in the most abundant diatom genera (e.g., *Chaetoceros* and *Pseudo-nitzschia*), revealing distribution differences among morphological similar or identical taxa and interannual changes in haplotype composition. Recently, studies on cryptic diversity have been extended to more diatom genera and have also included some dinoflagellates and Mamiellophyceae, which are hardly detected in fixed samples. These researches indicate that, contrary to common predictions, morphological stasis and phylogenetic affinity among microalgal taxa do not imply similar phenological traits and ecological niche conservatism. Overall, e-DNA metabarcoding has proved effective in uncovering phytoplankton composition at high levels of resolution allowing for deep insights into the diversity and ecology of these organisms.

A. SCHROEDER[1], E. CAMATTI[1], L. BONGIORNI[1], A. PALLAVICINI[2]

[1]Institute of Marine Sciences (ISMAR), National Research Council (CNR), Venice, Italy.
[2]Department of Life Sciences, University of Trieste, Italy.
anna.schroeder@cnr.it

A MULTI-DEPTH E-DNA APPROACH FOR COMPREHENSIVE MARINE BIODIVERSITY ASSESSMENT: INSIGHTS FROM THE TALPRO22-EXPEDITION

The exploration of marine biodiversity is essential for understanding ecosystem dynamics and guiding conservation strategies. The eDNA analysis has revolutionized marine biodiversity assessments by providing a non-invasive, highly sensitive, and comprehensive method for species detection from micro- to macroorganisms. This method is particularly well-suited for oceanographic expeditions with limited time and sample resources enabling comprehensive species monitoring across diverse habitats. Here, we present the findings of TAlPro22, a Med-SHIP campaign that conducted two north-south transects through the Western Mediterranean Sea, where eDNA was utilized to assess biodiversity, based on water samples collected in surface waters, 75 meters, and seabed up to 3000 m depth. To capture a broad taxonomic spectrum, three genetic markers were employed: 18S-V4 for eukaryotes, COI for metazoans, and 12S-MiFishU for fishes. The assemblages showed a clear differentiation across sampling depths. For example, the fish and cetacean assemblages identified largely reflected known habitat preferences: species detected in surface waters included dolphins (*Stenella, Turiopsis* and *Pseudorca*), as well as *Sardina* and *Sardinella*.Other species were present across all three layers, including the swordfish (*Xiphias gladius*), the tunas *Thunnus thynnus* and *T. alalunga*, along with bioluminescent fishes known to perform important diel vertical migration, such as *Cyclothone braueri* and various lanternfish species (e.g., *Notoscopelus elongatus*, endemic to the Mediterranean Sea). In contrast, certain species were predominantly found in the deepest layer, including abyssal fishes, such as the lantern shark *Etmopterus*, *Cataetyx, Polyacanthonotus, Stomias*, and the viperfish *Chauliodus sloani,* as well as the fin whale *Balaenoptera physalus* in specific samples. This study highlights the benefits of eDNA as a crucial tool for monitoring and managing marine biodiversity by enabling integrated datasets that span both horizontally and vertically demonstrating its potential for large-scale, three-dimensional biodiversity assessments when repeated over time.

A. TAGLIABUE[1,2], E. SATTIN[2], L. BERTOLDI[2], G. FURFARO[1,3,4], G. VALLE[2], S. PIRAINO[1,3,4]

[1]Department of Biological and Environmental Sciences and Technologies (DiSTeBA), University of Salento, Lecce, Italy.
[2]BMR Genomics Srl, Padova, Italy.
[3]National Inter-University Consortium for Marine Sciences (CoNISMa), Roma, Italy.
[4]National Biodiversity Future Center (NBFC), Palermo, Italy.
alice.tagliabue@bmr-genomics.it

OPTIMIZING ENVIRONMENTAL DNA METABARCODING FOR ROUTINE BIODIVERSITY ASSESSMENT IN MARINE ECOSYSTEMS

Environmental DNA (eDNA) metabarcoding is emerging as a powerful tool for biodiversity assessment, yet its practical application beyond academic research remains limited. This study evaluates the use of eDNA metabarcoding for monitoring metazoan biodiversity in the Southern Adriatic Sea, with the goal of advancing its implementation in standardized environmental management practices. For our study, we employed a robust experimental design to process 576 samples collected from three sites (one pristine and two impacted), across two seasons (spring and autumn), and two sample types (water and sediment). The study compared the performance of two molecular markers, COI and 18S, to address key methodological questions. Both markers provided a consistent overview of biodiversity, though they differed in resolution. Water and sediment samples captured distinct communities, as did the two seasons, while distance from the coast had a negligible effect. These findings suggest that, for routine applications, a single sample type, one molecular marker, and seasonal surveys may be sufficient for effective biodiversity assessment, offering a balance between efficiency, cost-effectiveness, and reliability in long-term monitoring efforts. Notably, the pristine site did not exhibit higher biodiversity than the impacted sites, likely due to greater habitat heterogeneity in the latter. These results underscore the reliability of eDNA metabarcoding for biodiversity assessments and advocate for its integration into routine environmental monitoring programs. The study also developed a standardized, easily repeatable approach. Future research will extend this framework to the major Apulian ports, where anthropogenic and climate change impacts are most pronounced. Furthermore, this methodological approach will be applied to inland waters, to detect critical indicators of environmental health. By applying eDNA metabarcoding in these high-impact environments, this research aims to enhance long-term monitoring strategies, inform policy decisions, and support aquatic ecosystem conservation. The integration of standardized eDNA protocols will improve the capacity to detect biodiversity shifts, track invasive species and evaluate ecosystem responses to human pressures and climate change.

V. TANDUO[1], R. VIRGILI[1,2,3], P. FASCIGLIONE[4], L. RIZZO[1,5], S. D'ANIELLO[6], R. ZARDOYA[7], F. CROCETTA[1,3]

[1]Department of Integrative Marine Ecology, Stazione Zoologica Anton Dohrn, Napoli, Italy.
[2]Department of Biology, University of Naples Federico II, Italy.
[3]National Biodiversity Future Center (NBFC), Palermo,Italy.
[4]Research Infrastructures for Marine Biological Resources, Stazione Zoologica Anton Dohrn, Napoli, Italy.
[5]Institute of Sciences of Food Production (ISPA), National Research Council (CNR), Lecce, Italy.
[6]Department of Biology and Evolution of Marine Organisms, Stazione Zoologica Anton Dohrn, Napoli, Italy.
[7]Departamento de Biodiversidad y Biología Evolutiva, Museo Nacional de Ciencias Naturales, Madrid, Spain.
valentina.tanduo@szn.it

eDNA STUDIES GOING TOO FAST? THE FIRST DNA DECAPOD DATABASE FROM THE MEDITERRANEAN SEA

Environmental DNA (eDNA) is an increasing tool to provide insights into marine community composition and biodiversity. A crucial step of this technique involves the data taxonomic assignment, which mostly relies on online reference databases. Nevertheless, these databases are often not taxonomically curated and still incomplete, and the available sequences are sometimes of poor quality or even misidentified. This holds true also for the order Decapoda (Latreille, 1802), a group of invertebrates including "true" and hermit crabs, lobsters, and shrimps, that have colonised every aquatic environment and represent a highly ecologically important group. Here, we present the development of the first DNA decapod database from the Mediterranean Sea, based on the cytochrome c oxidase subunit I (COXI) gene. Samplings were carried out (2017–2025) in the Gulf of Naples and nearby (Tyrrhenian Sea) in a wide range of substrates from the tide level to 700m depth. After initial morphological identifications, about 5 specimens per morphospecies were selected for molecular analyses. The Folmer region of the COXI was amplified and a similarity value of 3–4% was used as intraspecific threshold. A total of 925 individuals, corresponding to 181 morphospecies, were barcoded and vouchered. Results generated 198 molecular taxonomic units. First molecular information on the species or specifically on the COXI were obtained for 37 taxa, whereas 41 were first barcoded from the Mediterranean Sea. Moreover, less than 40 species showed mismatches with GenBank data, suggesting putative cryptic diversity, new synonyms, or misidentifications by other authors. Finally, this database represents the first comprehensive and taxonomically curated reference for decapods of the Mediterranean Sea, allowing species-level identification of about 70% of the Italian species and about 50% of the Mediterranean ones. It offers the possibility to monitor and assess decapod and, more in general, marine communities without invasive techniques, and constitutes an important tool to facilitate further management activities.

A.C. TRANO[1], R. PIREDDA[2,3], R. CASOTTI[1]

[1]Department of Integrative Marine Ecology, Stazione Zoologica Anton Dohrn, Naples, Italy.
[2]Department of Research Infrastructures for marine biological resources, Stazione Zoologica Anton Dohrn, Naples, Italy.
[3]National Biodiversity Future Center (NBFC), Palermo, Italy.
annachiara.trano@szn.it

THE *CHAETOCEROS* SPP. PHYCOSPHERE IN THE GULF OF NAPLES (ITALY)

Complex assemblages of microalgae and associated bacteria are a fundamental component of marine food webs, controlling the fate of carbon and the recycling of major elements. Their dynamics are not passively determined by the fluctuation of seasonal and spatial abiotic conditions, but are also the result of chemically mediated interactions. The phycosphere is the region surrounding the algal cell, where molecules can accumulate at high concentrations and close interactions between algae and other organisms occur. In this study, we coupled light microscopy observation for *Chaetoceros* spp. with 16S rDNA metabarcoding of particles-attached bacterial communities, collected at Long-Term Ecological Research Station MareChiara (LTER-MC) in the Gulf of Naples (Italy) from October 2017 to September 2018, to explore putative diatom-bacteria associations by bipartite network analyses. This study identified the presence of six networks selecting 10 *Chaetoceros* species (50% of the total) and 118 prokaryotic ASVs (27.1% of the total) covering 48 different genera. Network inference highlighted that *Chaetoceros* species maintain recurrent distinct bacterial assemblages and that most of these *Chaetoceros* species were chain-forming, although a clear relationship between chain-forming diatoms and associated-bacteria could not be defined. At higher taxonomic level, Alphaproteobacteria and Bacteroidetes were the main phyla associated with *Chaetoceros* spp. confirming literature reports. Analyses at lower taxonomic level revealed that most of bacteria were potentially able to degrade xenobiotics and other environmental contaminants, which are expected to be present in the polluted coastal zone of the Gulf of Naples. These results suggested that geographic origin and the indigenous species influence the taxonomic profile of *Chaetoceros* spp. phycospere. The presence of diazotrophic cyanobacteria was limited, with *Chaetoceros pseudocurvisetus* inferred to be associated with only one cyanobacteria ASV, assigned to nitrogen-fixing genus *Pleurocapsa*, supporting the vision that the availability of fixed inorganic N in coastal waters does not favour the presence of diazotrophs.

M. UBALDI[1,2,3], F. NERI[3], G. MONTALI[3], A. TOMASINI[3], T. ROMAGNOLI[3], S. ACCORONI[3], C. TOTTI[3]

[1]Department of Earth and Marine Sciences, University of Palermo, Italy.
[2]National Biodiversity Future Center (NBFC), Palermo, Italy.
[3]Department of Life and Environmental Sciences, Università Politecnica delle Marche, Ancona, Italy.
m.ubaldi@univpm.it

MONITORING PHYTOPLANKTON COMMUNITIES COMBINING MICROSCOPY AND METABARCODING

The monitoring of phytoplankton structure and composition is essential to detect changes in the marine ecosystems. Currently, light microscope (LM) analysis has represented the routine method allowing to obtain abundance values, community composition in terms of main groups, and a broad species identification. Metabarcoding (MB) allows an in-depth taxa identification, but don't provide abundance values. In this study, we combined the two methods for the study of phytoplankton community in the LTER-SG01 station (Northern Adriatic Sea), using V4 and V9 regions of the 18S rRNA gene, and PR2 and SILVA as reference databases. MB revealed many genera and species never detected before in the study area, although some taxa were detected only by LM. Only a small percentage of taxa were identified by both methods (LM and MB), markers (V4 and V9), and databases (PR2 and SILVA). Surprisingly, metabarcoding failed to detect almost all coccolithophores, mainly due to gaps in reference databases. The use of PR2 database with the V4 marker yielded the highest number of identifications, suggesting this combination is currently the most effective for assessing phytoplankton. Regarding the diversity, a higher number of phytoflagellate and dinoflagellate genera and species were identified through MB, while diatoms and dinoflagellates were the most represented through LM. Considering the community composition in terms of relative abundances of main phytoplankton groups, a dominance of phytoflagellates and diatoms was observed by LM analysis, while dinoflagellates resulted the dominant group using MB. This is explained considering that dinoflagellates have large genomes that led to their overestimation. Indeed, after applying the correction factor proposed by Lapeyra Martin *et al*. (2022), the two methods produced comparable results. Results confirmed that combining MB and LM analysis provides a more accurate and complete representation of phytoplankton community composition and diversity.

POSTER

A. BENVENUTO[1,2], F. MARTINO[1,2], D. DE BATTISTI[1,2], S. DE LAURETIS[1,2], R. GAUFF[1,2], I. GREGORI[1,2], N. MACRI[1,2], I. MARINO[1], G. POLONI[1], J. RIEDL[1,2], G. RIVA[1,2], L. AIROLDI[1,2], L. ZANE[1,2]

[1]Department of Biology, University of Padua, Italy.
[2]National Biodiversity Future Center (NBFC), Palermo, Italy.
anna.benvenuto@phd.unipd.it

EXPLORING THE EFFECTS OF URBANIZATION ON COASTAL MARINE COMMUNITIES USING EDNA METABARCODING

Human activities and increasing urbanization have significantly transformed and degraded coastal marine environments, leading to the loss of natural habitats and their replacement with artificial structures. These transformations not only affect habitat availability but can also drive the homogenization of marine communities, favouring the dominance of synanthropic species, whose spread is facilitated, for example, by maritime traffic. In this study, we used environmental DNA (eDNA) metabarcoding to evaluate the effects of urbanization and the degree of homogenization in marine communities by comparing species richness, community structure, and similarity across seven locations along the Italian coastline. At each site, we collected surface water eDNA samples from three areas at different levels of urbanization (urbanized, periurban, and natural). To achieve the most comprehensive and reliable picture of these communities we used available primers to amplify fragments of three genetic markers: 12S, COI (Cytochrome oxidase I) and 18S targeting fish, metazoans and eukaryotes. This approach yielded a total of 97,586 and 1,690 OTUs (Operational Taxonomic Units) for Tele02, Euka02, and COI datasets, respectively. Our results indicate that overall OTU richness is higher in natural and periurban environments than in urban ones. Additionally, PCoA analyses show that for metazoans and eukaryotes, community structure in urban habitats differs from other treatments. Urban sites form a distinct cluster suggesting a marked difference in species composition. Despite some overlap, likely due to biogeographic influence, these findings highlight the impact of urbanization on coastal community structure. By employing eDNA metabarcoding, this research provides a comprehensive assessment of urbanization’s role in shaping coastal communities. This approach overcoming the limitations of conventional survey techniques can be used alone or in combination with other approaches to develop conservation and management strategies aimed at supporting ecosystems in increasingly impacted coastal areas.

S. BONICALZA[1,2], E. COPPOLA[2], G. PUCILLO[3], E. VALSECCHI[3]

[1]Department of Biomedical Sciences, University of Edinburgh, UK.
[2]Gruppo Foca Monaca APS, Rome, Italy.
[3]Department of Environmental and Earth Sciences, University of Milano-Bicocca, Italy.
sofia@focamonaca.it

LARGE-SCALE CITIZEN-SCIENCE eDNA BIOBLITZ CAMPAIGN FOR MEDITERRANEAN MONK SEAL (*MONACHUS MONACHUS*) ALONG THE ITALIAN COASTS

The Mediterranean monk seal (*Monachus monachus*) is one of the world's rarest marine mammals, and it is classified as Data Deficient in Italy according to the National IUCN assessment. Environmental DNA (eDNA) has emerged as a powerful, non-invasive tool for detecting elusive species' presence making it particularly valuable for long-term monitoring. This study presents a nation-wide eDNA BioBlitz campaign for Mediterranean monk seal monitoring in Italy, relying on an innovative citizen science approach based on a highly coordinated participative effort. Through a structured network of trained volunteers, seawater collection and filtration are conducted eight times per year at designated sites using the WET system, a non-electric portable filtration kit. In 2024, sampling took place at over 30 locations across Italy, with planned expansions in the future. The sampling regime is the same as that adopted by the Spot the Monk (StM) programme, where the BioBlitzs' samples are transferred to the central laboratory for molecular analysis. StM has operated since 2018 over a wide geographical area, embracing neighboring countries that surround the Central-Western Mediterranean. This large-scale initiative provides crucial temporal and spatial data on monk seal presence, helping to identify potential hotspots and track population trends over time around the Italian peninsula, a key area for monitoring the apparent expansion of the population towards the western sector of the Mediterranean basin. The first samples are currently undergoing analysis with preliminary results to be presented. This pioneering approach demonstrates how citizen science, combined with advanced molecular tools can significantly contribute to marine conservation. The presented eDNA BioBlitz campaign represents a scalable model for long-term monitoring of elusive marine species reinforcing the importance of public engagement in biodiversity conservation.

M.C. ELISO[1], M. CHAUVET[2], A. LANZÉN[3,4], L. GARATE[3], M. GOURMELON[2], A.C. TRANO[1], R. SIANO[2], R. CASOTTI[1]

[1]Department of Integrative Marine Ecology, Stazione Zoologica Anton Dohrn, Naples, Italy.
[2]Ifremer, DYNECO/Pelagos, Plouzané, France.
[3]AZTI, Marine Research, Basque Research and Technology Alliance (BRTA), Pasaia, Spain.
[4]IKERBASQUE, Basque Foundation for Science, Bilbao, Bizkaia, Spain.
mariaconcetta.eliso@szn.it

UNVEILING MICROBIAL BIOINDICATORS OF RIVER RUN-OFF IN EUROPEAN COASTAL WATERS USING EDNA

River run-off plays a key role in shaping marine and coastal ecosystems by transporting nutrients, sediments, contaminants, and microorganisms that influence biodiversity and water quality. Understanding these dynamics is crucial for effective ecosystem monitoring and management. Environmental DNA (eDNA) has emerged as a powerful biomonitoring tool offering high taxonomic resolution and cost-effective detection of microbial communities indicative of riverine influence. However, a standardized European framework for defining microbial bioindicators is still lacking. As part of the Horizon Europe OBAMA-NEXT project, this study aimed to identify microbial bioindicators of riverine influence through a close collaboration between AZTI, Ifremer, and SZN, enabling extensive data sharing. Samples were collected from estuarine and offshore sites in the English Channel, Bay of Biscay, and the Tyrrhenian and Adriatic Seas covering environments ranging from river-influenced (mixed) to predominantly marine waters. Using amplicon sequencing of eDNA (V4-V5 16S rDNA), we analyzed bacterial communities across these sites. Indicator Species Analysis (IndVal) and Analysis of Compositions of Microbiomes with Bias Correction (ANCOM-BC) enabled the identification of key taxa, including *Comamonadaceae* and *Flavobacteriaceae*, whose presence showed a strong statistical correlation with freshwater influence. Our findings underscore the effectiveness of eDNA in identifying microbial bioindicators of riverine influence. By enabling the detection of taxa linked to freshwater inputs, eDNA provides a high-resolution tool for biomonitoring programs. The ability to characterize microbial communities in mixed and marine environments supports its use in developing a standardized European framework for assessing riverine impacts. This research highlights eDNA's potential to enhance environmental monitoring program to protect coastal and marine ecosystems.

G. GIMENEZ, M. MOLARI, D. GRECH, C. PODDA, E.M.D. PORPORATO, V. SANTINELLI, M. BAROLI

IMC International Marine Centre, Torregrande (OR) Italy.
ga.gimenez@fondazioneimc.it

BRIDGING THE GAP: ADVANCING EDNA METABARCODING FOR BIOMONITORING IN SARDINIAN COASTAL LAGOONS

Coastal lagoons are dynamic ecosystems with complex environmental gradients that host unique biota. In the Mediterranean Sea, these ecosystems provide essential ecological and socio-economic services, with many under the protection of the Natura 2000 network. However, they are increasingly threatened by anthropogenic pressures, including climate change and invasive species, requiring effective biomonitoring strategies. In this context, environmental DNA (eDNA) metabarcoding has emerged as an innovative tool for biodiversity assessment, offering enhanced sensitivity and efficiency compared to traditional morphological approaches. Nevertheless, its effectiveness is hindered by gaps in reference sequence databases. In Sardinia, the biodiversity of coastal lagoons has been investigated to varying degrees, however, a comprehensive synthesis of macrozoobenthic diversity and its representation in global genetic repositories remains lacking. This study aims to bridge this gap by evaluating the coverage of macrozoobenthic species from Sardinian lagoons in global genetic repositories: a critical step for enhancing eDNA biomonitoring. To this end, we conducted a systematic literature review to identify previously studied lagoons and cross-referenced the compiled species list with the most widely used genetic repositories (NCBI GenBank, BOLD, and SILVA) to assess barcode availability. Our analysis identified 43 previously studied lagoons, encompassing 536 macrozoobenthic taxa, of which 401 were identified at the species level. However, significant genetic data gaps were highlighted, with only 42% of the identified species having 18S sequence representatives (SILVA) and 69% COI barcodes (BOLD). Substantial deficiencies were registered for Mollusca and Nemertea in both databases, as well as for Arthropoda (SILVA) and Echinodermata (BOLD). These findings underscore the urgent need to expand reference libraries to improve the applicability of eDNA metabarcoding for Sardinian lagoon biomonitoring. Addressing these gaps through targeted sequences efforts (*i.e.* barcode) will improve the accuracy and reliability of molecular assessments, facilitating the effective integration of eDNA into the conservation and management of Mediterranean coastal lagoons.

A. LEONE[1,2], G. AGLIERI[2,3], G. TURCO[1,2], F. QUATTROCCHI[1,2], A. CALÒ[1,2], C. CATTANO[2,3], D. SPATAFORA[2,3], R. CHEMELLO[1,2], M. MILAZZO[1,2]

[1]Department of Earth and Marine Science, University of Palermo, Italy.
[2]National Biodiversity Future Center (NBFC), Palermo, Italy.
[3]Department of Integrative Marine Ecology, Stazione Zoologica Anton Dohrn, Palermo, Italy.
agostino.leone@unipa.it

ENHANCING MARINE BIODIVERSITY MONITORING THROUGH ENVIRONMENTAL DNA (eDNA) ANALYSIS IN MPAS NETWORK TO MEET EU GOALS FOR BIODIVERSITY CONSERVATION

Italy is committed to meeting the targets of the Kunming-Montreal Global Biodiversity Framework and the EU Biodiversity Strategy and, among these, to efficiently protecting 30% of its Exclusive Economic Zone at sea, and at least the 10% under strict protection level. Several strategies are in place to achieve these ambitious targets. However, key questions are still calling on which biodiversity facets and which areas should be prioritized for conservation and protection. In this scenario, novel cutting-edge technologies, such environmental DNA (eDNA) metabarcoding, might represent a non-invasive and cost-effective tool for evaluate marine biodiversity. Here, we present the approach and the experimental design we adopted in the last two years within the Spoke 1 of the National Biodiversity Future Center (NBFC) to contribute to conservation planning, MPA network optimization and evaluation of its potential connectivity. More than 500 eDNA samples were collected spanning coastal and pelagic waters up to 50 m depth in different protection zones of all national MPAs, Natura 2000 sites, "aree marine di reperimento" and several unprotected zones around Sicily. To accomplish the project's objectives, eDNA metabarcoding of the mitochondrial 12S marker will be employed to analyse bony fish and elasmobranch biodiversity. The analysis will shed light on the composition of fish communities and their functional roles within and among the different areas under scrutiny. These data will be complemented with other surveys performed in the same sites and using standard sampling techniques like underwater visual censuses and baited remote underwater videos to obtain a more comprehensive understanding of fish species diversity and distribution patterns within and among locations. These results will support local and national decision-making processes focused on enhancing conservation efforts and advocate for the incorporation of eDNA data into management strategies, ensuring that conservation initiatives are grounded in the most accurate and current information available.

M. SANTORSOLA[1], L. ROSELLI[2,3], I. DI CAPUA[2,3], F. LESCAI[1], D. SARNO[2,3], R. PIREDDA[2,3]

[1]Department of Biology and Biotechnology "Lazzaro Spallanzani", University of Pavia, Italy.
[2]Department of Research Infrastructures for Marine Biological Resources, Stazione Zoologica Anton Dohrn, Naples, Italy.
[3]National Biodiversity Future Center (NBFC), Palermo, Italy.
roberta.piredda@szn.it

TRAMP: A TOOL FOR TRAIT-BASED ANNOTATION OF MARINE PLANKTON

A key challenge for the marine scientific community is to better understand the link between taxonomic profiles and their associated functions. For marine eukaryotic plankton, the wide taxonomic range from microbes to zooplankton, can be now assessed using environmental DNA (eDNA), enabling faster and comprehensive description of plankton communities, compared to traditional methods. Important ecological processes mediated by plankton and the extensive taxonomic data available, required bioinformatic tools to easy infer functional information from taxonomic profiles in eukaryotic plankton. Functional data, including genes, enzymes, metabolic pathways, morphological and phenotypic traits, as well as biochemical aspects, are available and can be retrieved from literature for several planktonic groups at different taxonomic ranks. Here, we present trait-based annotation of marine plankton (TrAMP), an R package allowing the rapid and automatic annotation of taxonomic profiles generated from (but not only) metabarcoding studies. In this first version, TrAMP provides annotations based on literature data for three key planktonic groups: copepods, phytoplankton and mixoplankton. Users provide a taxonomic profile in a table format, e.g. Excel or TSV, and TrAMP outputs the original table enriched with functional annotations alongside simple visualizations, such as barplot or heatmap, illustrating functional patterns. TrAMP offers an easy way for data visualization and interpretation in plankton ecology studies, network analyses and development of diversity indicators. By supporting research on ecosystem modelling of communities in response to environmental change and anthropic pressures, TrAMP also promotes knowledge transfer across science, policy, and society.

TEMA 2
BIODIVERSITÀ E IMPATTI SULLE SPECIE IN MAR MEDITERRANEO

RELAZIONI INTRODUTTIVE

G. BAVESTRELLO[1,2,3]

[1]DISTAV, Università di Genova, Italia.
[2]Consorzio Nazionale Interuniversitario per le Scienze del Mare (CoNISMa), Roma, Italia.
[3]National Biodiversity Future Centre (NBFC), Palermo, Italia.
giorgio.bavestrello@unige.it

IMPATTI ANTROPICI E RISCALDAMENTO GLOBALE: EFFETTI SULLA BIODIVERSITÀ MARINA BENTONICA

Negli ultimi decenni il progressivo aumento delle temperature superficiali dell'acqua ha determinato impressionanti cambiamenti nella biodiversità del Mediterraneo con sostituzioni di specie, talvolta soggette a mortalità massive, modificazioni della loro distribuzione batimetrica e stagionale e delle loro strategie riproduttive. Nonostante i numerosi dati disponibili questi effetti sono sicuramente sottostimati per i gruppi di organismi che presentano criticità sia per la determinazione tassonomica che per la generalizzata mancanza di una *baseline*. Un recente studio che ha preso in considerazione la comunità a idrozoi di Portofino (Mar Ligure), previamente studiata nel 1980 e nel 2004, ha mostrato una riduzione della biodiversità di circa il 50%. Oltre al riscaldamento delle acque, numerosi impatti antropici, principalmente legati alla riduzione degli habitat e all'*overfishing*, influenzano negativamente la biodiversità marina. La presenza in mare di rifiuti di varia natura, in particolare di attrezzi da pesca persi, soffoca le comunità bentoniche con danni particolarmente rilevanti alle foreste di organismi strutturanti. Uno dei più gravi fenomeni di riduzione dell'habitat è legato allo strascico che, come accade per la pesca del gambero rosso in Mar Ligure, insistendo sulle stesse cale, compromette gravemente le comunità macrobentoniche, in particolare le foreste di gorgonie profonde. Un impatto molto particolare, del quale è difficile valutare oggi la portata, riguarda la pesca del corallo rosso con attrezzi trainati che, attuata per secoli, ha interessato ogni tratto di costa rocciosa del Mediterraneo Occidentale tra 40 e oltre 100 m di profondità. Ancora oggi, in talune zone persiste un'attività di pesca illegale attuata con questi devastanti metodi. Un esempio impressionante di *overfishing* è stato osservato sulle sommità delle montagne sottomarine dove le comunità di invertebrati così come quelle ittiche impiegano tempi probabilmente molto lunghi per strutturarsi. In questi siti le campagne di pesca producono inizialmente catture estremamente abbondanti che però si azzerano nel giro di pochi anni.

L. BOLOGNINI[1,2]

[1]Istituto per le Risorse Biologiche e le Biotecnologie Marine (IRBIM), Consiglio Nazionale delle Ricerche (CNR), Ancona, Italia.
[2]National Biodiversity Future Center (NBFC), Palermo, Italia.
luca.bolognini@cnr.it

UNA PESCA PIÙ SOSTENIBILE PER RICONOSCERE IL VALORE DELLA BIODIVERSITÀ E LA SALUTE DEGLI ECOSISTEMI MARINI - OPPORTUNITÀ DAL PNRR-NBFC

La crescente crisi della biodiversità marina, causata principalmente da attività antropiche come la pesca, rappresenta una minaccia significativa per la salute degli ecosistemi e i servizi che essi forniscono. Questo lavoro si inserisce nel contesto del Piano Nazionale di Ripresa e Resilienza (PNRR), nell'ambito del National Biodiversity Future Center (NBFC), e mira a valutare i principali fattori antropogenici che compromettono la biodiversità marina, con un focus specifico sull'impatto della pesca.
Comprendere le pressioni dirette e indirette esercitate dalla pesca sugli organismi marini e sulla loro resilienza è fondamentale per sviluppare soluzioni innovative e adottare misure di mitigazione efficaci contro la perdita di biodiversità. L'obiettivo primario è promuovere la salute degli ecosistemi marini per le generazioni future, riconoscendo il valore intrinseco della biodiversità e dei servizi ecosistemici. Nell'ambito dello Spoke 2 del NBFC, l'Attività 1.1 si concentra sulla "Riduzione degli impatti della pesca e protezione della biodiversità". Le azioni intraprese includono la valutazione delle minacce, l'analisi delle interazioni ecologiche e lo studio di strategie per una gestione più sostenibile delle risorse marine. Le indagini multidisciplinari condotte hanno integrato diverse metodologie per caratterizzare gli ambienti marini, la distribuzione delle specie e le interazioni trofiche, evidenziando il ruolo cruciale di specifici habitat nel supportare la biodiversità e le complesse reti ecologiche. Sebbene la maggior parte delle analisi sia ancora in corso, i risultati preliminari sottolineano l'importanza di comprendere a fondo le dinamiche degli ecosistemi marini per definire efficaci strategie di conservazione e gestione della pesca. Verranno presentati i risultati iniziali di queste attività, evidenziando le opportunità offerte dal PNRR-NBFC per promuovere una pesca più sostenibile e la conservazione della biodiversità marina in Italia.

COMUNICAZIONI

M. ANGIOLILLO[1,2], M. BO[3,4,5], S. CANESE[2,5], AL. CAU[6], B. DI LORENZO[1], T. FORTIBUONI[7], F. ANDALORO[2], S. GRECO[8], L. TUNESI[1], M. TOMA[1,3]

[1]Italian Institute for Environmental Protection and Research (ISPRA), Roma, Italy.
[2]Stazione Zoologica Anton Dohrn, Napoli, Italy.
[3]Department of Earth, Environmental and Life Sciences (DISTAV), University of Genoa, Italy.
[4]National Inter-University Consortium for Marine Sciences (CoNISMa), Roma, Italy.
[5]National Biodiversity Future Center (NBFC), Palermo, Italy.
[6]Department of Life and Environmental Sciences, University of Cagliari, Italy.
[7]Italian Institute for Environmental Protection and Research (ISPRA), Ozzano dell'Emilia (BO), Italy.
[8]University of Gastronomic Sciences of Pollenzo, Bra (CN) Italy.
michela.angiolillo@isprambiente.it

FROM SHALLOW TO DEEP WATER: A LARGE-SCALE ASSESSMENT OF SEAFLOOR MARINE LITTER IN THE ITALIAN WATERS THROUGH ROV-IMAGING

The seafloor represents worldwide the ultimate sink for most litter. The study of seafloor marine litter demands a great sampling effort to comprehensively assess its abundance, composition, distribution, and impact on marine ecosystems. Although significant efforts have been made in the last two decades, the collection of quantitative data with standardised and comparable protocols still needs to be improved. A large-scale dataset obtained from over 45 oceanographic surveys conducted between 2007 and 2023 using remotely operated vehicles (ROVs) surveys in the Italian seas (Mediterranean basin), allowed for a comprehensive census of seafloor marine litter from mesophotic to bathyal zones (40-2130 m). The explorations mainly targeted rocky areas, including continental shelf reliefs, canyons, and offshore seamounts. This ROV-imaging dataset allowed gathering important information on litter quantity, composition, patterns of geographic and bathymetric distributions, and its effect on benthic communities and biodiversity over a latitudinal gradient of about 600 NM. It reported standardised presence/absence data, depths of occurrence, and litter categorisation and quantification on 686 transects. Analysis reported over 10,986 items, with litter abundance up to 16.1 items 100 m^{-2} (average 1.8 items 100 m^{-2}). Significant local differences emerged in litter quantities and composition, strongly related to type of substrate and its inclination. Only 8.6% of transects were litter-free, and 1.2% showed abundance greater than 10 items 100 m^{-2}. Fishery-related litter (mainly lines and ropes) was the most common type (≈70.7% of items). This work represents the first comprehensive broad picture of the seafloor marine litter in the Italian seas. In addition, this dataset could contribute to the definition of threshold values (expressed as litter density) for marine seafloor litter, as required by the Marine Strategy Framework Directive (MSFD) under Descriptor 10. Finally, our results further stress the need for urgent and specific measures to manage marine pollution and reduce environmental litter inputs.

M. ANGIOLILLO[1], M. GIUSTI[1], M. TOMA[1,2], A. TURSI[3,4], C. DE BLASI[3,4], R. TARANTINI[3,4], B. CATALANO[1], G. CHIMIENTI[3], A. COSMA[2,4,5,6], G. FRANCESCHINI[1], T. DELLI CARRI[2,4], D.A. FERRANTE[2,4], A. MOLINARI[1], M.L. PICA[4,7], S. BUSETTO[4,8], N. PORCU[4,8], G.F. RUSSO[4,7], AL. CAU[4,8], M. BO[2,4,6], F. MASTROTOTARO[3,4], G. GIORGI[1], L. TUNESI[1]

[1]Italian Institute for Environmental Protection and Research (ISPRA), Roma, Italy.
[2]Department of Earth, Environmental and Life Sciences (DISTAV), University of Genoa, Italy.
[3]Department of Biosciences, Biotechnologies and Environment (DBBA), University of Bari Aldo Moro, Italy.
[4]National Inter-University Consortium for Marine Sciences (CoNISMa), Roma, Italy.
[5]Department of Earth and Marine Sciences (DiSTeM), University of Palermo, Italy.
[6]National Biodiversity Future Center (NBFC), Palermo, Italy.
[7]Department of Science and Technology (DiST), University of Naples "Parthenope", Italy.
[8]Department of Life and Environmental Sciences (DiSVA), University of Cagliari, Italy.
michela.angiolillo@isprambiente.it

DIVING INTO SEAMOUNTS: UNVEILING DEEP-SEA BIODIVERSITY HOTSPOTS OF THE ITALIAN SEAS

Seamounts and seamount-like structures are prominent seafloor features, hosting diverse and vulnerable deep-sea ecosystems enhancing biodiversity and ecosystem functioning, such as the habitat-forming cold-water corals (CWCs). Due to their ecological significance and vulnerability to anthropogenic impacts, seamounts are recognized as priority conservation targets. As part of the PNRR Marine Ecosystem Restoration (MER) project, a large-scale explorative activity is underway across 79 Italian seamounts located beyond 12 NM from the coast. The aim is to map the distribution and assess the biodiversity of key benthic species and habitats up to 2000 m depth, using multibeam and remotely operated vehicles (ROVs). The first oceanographic campaign was conducted between January and March 2025 aboard the S/V Ievoli Cobalt in the Sicily Channel (northwestern Mediterranean Sea) by a ROV work-class at 80-997 m depths. The survey focused on eleven structures, namely Alfil-Linosa III, Avventura-Pantelleria-Talbot, Bannock, Bouri, Central Pantelleria, Euridice, Madrepore, Pinne, and Urania banks, and Cimotoe and Empedocle seamounts, seven of which previously unexplored. Preliminary results revealed extensive fields of *Funiculina quadrangularis* (100-140 m) and the scattered presence of keratoisidids (400-891 m) on soft bottom. Sponge grounds and assemblages of giant barnacles and oysters were observed. Rocky areas and volcanic walls hosted healthy diverse assemblages of *Madrepora oculata, Desmophyllum pertusum, Antipathes dichotoma, Leiopathes glaberrima*, including *Corallium rubrum* (down to 900 m), and forests of *Callogorgia verticillata* and *Antipathella subpinnata*. Biodiversity hotspots were identified, highlighting differences in species composition, presence of key habitat-forming species, associated megafauna, and marine litter across the investigated areas. The findings enhance our knowledge about the distribution of long-lived, slow-growing, and vulnerable Mediterranean species. This study will also provide valuable insights into the distribution of key deep-sea habitats, supporting a network of marine protected areas, in line with the 2030 EU Biodiversity Strategy, the CBD and the MSFD targets.

M. ARPAIA[1,2], I. DI LAURO[1,2], N. GARGANO[1,2,3], E. SPERONE[2], F.G. TROVA[1,2,3], M. BOTTARO[1] AND THE TEAM OF LIFE ELIFE PROJECT

[1]Genoa Marine Centre, Department of Integrative Marine Ecology, Stazione Zoologica Anton Dohrn - National Institute of Marine Biology, Ecology and Biotechnology, Genoa, Italy.
[2]Department of Biology, Ecology and Earth Sciences, University of Calabria, Arcavacata di Rende (CS), Italy.
[3]Triton ETS – Marine Research and Conservation, Rome, Italy.
massimiliano.bottaro@szn.it

CHALLENGES AND PRIORITIES FOR SHARKS AND RAYS IN THE MEDITERRANEAN: INSIGHTS FROM THE LIFE ELIFE PROJECT

The Mediterranean Sea is considered by the International Union for Conservation of Nature (IUCN) as one of the top three global hotspots for threatened elasmobranch biodiversity. Like other seas and oceans globally, the decline in shark and ray populations in the Mediterranean Sea can be attributed to bycatch and the alteration of critical habitats, including trophic downgrading and habitat loss. However, our knowledge of the true magnitude and dynamics of this loss is still very limited, as historical information on the presence of these animals is rare and difficult to find. Similarly, understanding the biology and ecology of most of the species reported in this basin is far to be clear. This has, so far, made it impossible to develop concrete and focused management and conservation actions, which have therefore been based on a too generalized "one size fits all" approach that fails to correctly address the complexity within this group. This critical situation is further complicated by the Mediterranean's complexity: although it is a relatively small basin, it spans three continents and 22 countries, many of which are facing controversial geopolitical issues, making it difficult to foster joint scientific research. The LIFE ELIFE project, co-funded by the European Union (EU), has been working for the past five years to mitigate the effects of bycatch on threatened elasmobranch species and to raise awareness among fishermen, other marine stakeholders, and the public. The results achieved thus far highlight some priorities that should be considered to develop a more focused approach to the management and conservation of these species, including also: 1) improving the historical baseline, which has been insufficient to date; 2) increasing biological knowledge of the species; and 3) fostering the active involvement of fishers. The EU should also prioritize developing agreements with non-EU countries to establish a collaborative program on this issue.

L. BISANTI[1], G. TURCO[1,2], G. VISCONTI[3], V. CATANIA[1],
L. SCIRÉ CALABRISOTTO[1], R. CHEMELLO[1,2]

[1]Department of Earth and Marine Sciences, University of Palermo, Italy.
[2]National Biodiversity Future Centre (NBFC), Palermo, Italy.
[3]Marine Protected Area "Capo Milazzo", Milazzo (ME), Italy.
luca.bisanti@unipa.it

WARNING FROM OVERLOOKED VERMETID REEFS IN THE WESTERN MEDITERRANEAN SEA DUE TO EXTREME CLIMATE CONDITIONS

In the recent decades, the Mediterranean Sea has been facing increasingly frequent and intense transient extreme events, leading to mortality events that are reshaping ecological patterns. Vermetid reefs, formed by gastropods of the genus *Dendropoma*, are important biogenic structures inhabiting intertidal zones. In the summer of 2022, analysis of climatological metrics revealed that prolonged desiccation events (PDEs) occurred along the northern coast of Sicily (Italy), during which vermetid reefs were exposed to extreme heat for several consecutive days. Coinciding with these extreme environmental conditions, we recorded a widespread die-off of *Dendropoma cristatum* (with mortality rates between 64% and 84%) in three areas characterized by extensive vermetid formations (Capo Milazzo, Capo Gallo-Isola delle Femmine, and Macari-San Vito Lo Capo). We also observed an increasing general abundance of bacteria affiliated with genera known to be opportunistic pathogens of marine invertebrates (e.g., *Acinetobacter* and *Brevundimonas*) in associated microbial communities of still-living specimens. Additionally, we analyzed the mollusk community associated with three macroalgal species (*Ericaria amentacea*, *Jania rubens*, *Padina pavonica*) and the *Laurencia* complex that inhabit these shallow reefs at Capo Gallo-Isola delle Femmine MPA following the 2022 MMEs. Overall, 740 mollusk specimens from 40 species were identified in 2022, with *J. rubens* showing the highest abundance and species diversity. These findings were compared with previous years (2014 and 2018) revealing a significant shift in mollusk composition since 2014, with a dramatic change occurring after the 2022 extreme events. Ongoing climate trends could further disrupt the ecological dynamics of these shallow rocky habitats, potentially altering the biodiversity of the Mediterranean intertidal zone. Understanding the effects of PDEs, their causes, and the resilience of marine assemblages is vital for developing effective conservation strategies.

M. CALABRÒ[1,2], V. GEORGES[1], V. PALUMMO[3,4], G. CASTELLAN[2,5], G. CHIMIENTI[6], A. MERCORELLA[5], A. PROFETA[7], D. MASSI[1,2], M. BARBATO[1], G. MILISENDA[4], F. FIORENTINO[1,4], S. VITALE[1], T. RUSSO[1,8], V. LAURIA[1,2]

[1]Institute for Marine Biological Resources and Biotechnology (IRBIM), National Research Council (CNR), Mazara del Vallo (TP), Italy.
[2]National Biodiversity Future Center (NBFC), Palermo, Italy.
[3]Department of Integrative Marine Ecology, Stazione Zoologica Anton Dohrn, CRIMAC, Calabria Marine Centre, Amendolara (CS), Italy.
[4]Department of Integrative Marine Ecology (EMI), Stazione Zoologica Anton Dohrn, Sicily Marine Centre, Palermo, Italy.
[5]Institute of Marine Sciences (ISMAR), National Research Council (CNR), Bologna, Italy.
[6]Department of Bioscience, Biotechnology and Environment, University of Bari Aldo Moro, Italy.
[7]Institute for Marine Biological Resources and Biotechnology (IRBIM), National Research Council (CNR), Messina, Italy.
[8]Department of Biology, University of Rome Tor Vergata, Italy.
monica.calabro@cnr.it

IDENTIFICATION OF THE REMAINING HOT-SPOTS OF THE BAMBOO CORAL *ISIDELLA ELONGATA* (ESPER, 1788) TO PRESERVE VULNERABLE MARINE ECOSYSTEMS IN THE STRAIT OF SICILY

The identification and mapping of Vulnerable Marine Ecosystems (VMEs) is one of the main objectives of the EU Biodiversity Strategy for 2030. These ecosystems are identified by the presence of "sensitive" species, such as deep-sea corals, that are poorly resilient to anthropogenic impacts, such as trawling. *Isidella elongata*, a nearly endemic coral species of the Mediterranean Sea, is classified as "critically endangered" on the IUCN Red List and serves as an indicator of VMEs on muddy bottoms, and in recent decades its abundance has drastically decreased to a few scattered patches due to trawling pressure. In the Strait of Sicily (SoS), some colonies of *I. elongata* still persist but remain unprotected. To predict and map *I. elongata* habitat suitability and remaining hot-spots in the SoS, a Species Distribution Model (SDM) was developed using MEDITS survey data (2017-2021). Successively, a scientific survey was conducted aboard the CNR research vessel *GAIA BLU* to validate habitat suitability models and identify sites for conservation planning. High-resolution multibeam acoustic surveys were conducted alongside visual inspections using Remotely Operated Vehicles (ROVs) Saab Seaeye Falcon DR. A total of 11 transects were performed in a depth range between 200 and 860 m. The study area, predominantly composed of muddy bottoms, also features rock formations hosting species such as *Leiopathes glaberrima*, *Madrepora oculata*, and *Desmophyllum pertusum*, all indicators of VMEs. The video analysis results validated the prediction of the habitat suitability model, showing *Isidella* grounds with healthy colonies. In addition, more than 50 associated species were identified. These findings will provide a scientific basis for proposing a Fisheries Restricted Area (FRA) in the central Mediterranean Sea, ensuring the protection of important marine ecosystems in the region.

A. CONSIGLIO[1], W. ZUPA[1,2], M. CASINI[3], M.C. FOLLESA[4], G. GAROFALO[5], P. MAIORANO[6], P. RINELLI[7], M. SBRANA[8], P. CARBONARA[1,2]

[1]Fondazione COISPA ETS, Stazione Sperimentale per lo Studio delle Risorse del Mare, Bari, Italy.
[2]COISPA Tecnologia e Ricerca s.c.r.l., Bari, Italy.
[3]Laboratory of Marine Biology and Fisheries, Department of Biological, Geological and Environmental Sciences, University of Bologna, Fano (PU), Italy.
[4]Department of Life and Environmental Sciences, University of Cagliari, Italy.
[5]Institute for Marine Biological Resources and Biotechnology (IRBIM), National Research Council (CNR), Mazara del Vallo (TP), Italy.
[6]Department of Biology, University of Bari Aldo Moro, Italy.
[7]Institute for Marine Biological Resources and Biotechnology (IRBIM), National Research Council, Messina, Italy.
[8]Consorzio per il Centro Interuniversitario di Biologia Marina ed Ecologia Applicata (CIBM), Livorno, Italy.
consiglio@fondazionecoispa.org

HOW IS THE MED? UNVEILING THE FUTURE OF MEDITERRANEAN BIODIVERSITY

The Mediterranean Sea is a biodiversity reservoir, but it is facing significant threats caused by various environmental and human-induced stressors, especially climate change, habitat degradation, and overfishing. These pressures are contributing to biodiversity loss, altering ecosystem functions and community structures. In response, a holistic, ecosystem-based management approach could enhance the sustainable management of marine resources, since it aims to understand the spatial and temporal dynamics within ecosystems to protect as many species as possible. As part of the B-Useful project, the MEDITS data collected between 1999 and 2021 have been employed to assess the overall health of the Mediterranean Sea, focusing on the Italian geographical sub-areas (GSAs), namely GSAs 9, 10, 11, 16, 17, 18, and 19. The MEDITS survey is a standardized program, that gathers essential information on the population distribution and the demographic structure of species using the bottom trawling fishing method. This data provides valuable insights into the state of marine ecosystems across different regions. The study examines the spatial variation of biodiversity, focusing on α-diversity indices such as species richness, Shannon, and Simpson indices. Additionally, it explores the spatial persistence of biodiversity hotspots and coldspots, to investigate possible spatio-temporal patterns in the investigated time series. This would be crucial to further understand how anthropogenic activities could impact the ecosystem and what measures can be implemented to improve management actions. The findings highlight the urgent need for adaptive management strategies to address the ongoing threats (e.g. climate changes and overfishing) to the Mediterranean ecosystem and ensure the preservation of its vital ecosystem services for future generations.

G. COSTANTINO[1], L. CASCIARO[1,2], A. CONSIGLIO[1,2], C. NEGLIA[1,2], W.ZUPA[1,2], P. CARBONARA[1,2]

[1]COISPA Tecnologia e Ricerca s.c.r.l., Bari, Italy.
[2]Fondazione COISPA ETS, Bari, Italy.
costantino@coispa.eu

PENNATULIDAE (CNIDARIA, ANTHOZOA) FROM SOUTH ADRIATIC SEA (GSA 18): DISTRIBUTION, FAUNA AND BIODIVERSITY ASSOCIATED

Pennatulaceans colonize deep-sea soft sediments, acting as key biostructural components that enhance habitat complexity and contribute to increased biodiversity. Additionally, sea pen fields are included by GFCM in the Mediterranean Vulnerable Marine Ecosystems (VMEs) habitats. This study focuses on the three most frequently occurring Pennatulacean species in the Southern Adriatic Sea (geographic sub-area, GSA 18), namely *Pennatula phosphorea*, *P. rubra*, and *Pteroeides griseum*. The spatial distribution of the Pennatulaceans and the biodiversity of the associated faunal community have been explored using 13-year time series (2011–2023) derived from the Mediterranean International Bottom Trawl Survey (MEDITS). The three target species are predominantly distributed on the eastern side of the study area, particularly on the continental shelf, within a depth range of 37.1 to 165 m. Their stable adaptation to the habitat is supported by the absence of significant abundance variations over the study period. Additionally, on the most recent years of the time series the size structure of *P. rubra*'s colonies was described. Biodiversity differences between associated and non-associated faunal communities were assessed using key alpha-diversity indices (*e.g.*, Margalef, Shannon), based on species composition data collected during bottom trawl surveys. Furthermore, a Similarity Percentages (SIMPER) analysis was conducted to evaluate the contribution of each species to the overall dissimilarity between species associations. This allowed for the quantification of the contribution of Pennatulaceans to local biodiversity and assess their potential role in structuring benthic assemblages. The findings of this study contribute to a deeper understanding of the role of these species in benthic ecosystem functioning and support the development of conservation strategies aimed at preserving biodiversity in the Southern Adriatic Sea VME habitats.

A. ESPOSITO[1], A. MASTRANTONIO[1], D. VENTURA[1],
E. CASOLI[1], M.F. GRAVINA[2]

[1]Dipartimento di Biologia Ambientale, Sapienza Università di Roma, Italia.
[2]Dipartimento di Biologia, Università di Roma "Tor Vergata", Italia.
esposito.1711543@studenti.uniroma1.it

QUARANT'ANNI DOPO: QUALI CAMBIAMENTI NELLE COMUNITÀ ZOOBENTONICHE DEI LAGHI COSTIERI DEL PARCO NAZIONALE DEL CIRCEO?

Le specie alloctone invasive, soprattutto se predatori, rappresentano una grave minaccia per la biodiversità perché possono alterare notevolmente la composizione e gli equilibri degli ecosistemi autoctoni. Nemmeno le aree di transizione soggette a tutela come i laghi costieri del Parco Nazionale del Circeo risultano esenti da questa minaccia. Infatti, da diversi anni, sono teatro di una forte invasione ad opera del granchio blu *Callinectes sapidus*. In questo studio è analizzata la struttura della comunità zoobentonica nei tre laghi costieri di Fogliano, Monaci e Caprolace, con lo scopo di confrontare la condizione attuale con quella riscontrata quarant'anni fa prima dell'arrivo e diffusione di *C. sapidus*. I campionamenti sono stati effettuati nel mese di aprile 2024 con le stesse metodologie utilizzate negli anni pregressi negli stessi siti. La ricchezza specifica è risultata maggiore nei Laghi di Fogliano e Caprolace e minore in quello di Monaci in entrambi i periodi; diversamente, l'abbondanza è risultata minore nei laghi di Fogliano e Caprolace nel 2024. La composizione in specie è risultata molto diversificata nei diversi taxa: il numero di specie di policheti di Fogliano è aumentato dal 1982-1983 (5 specie) rispetto al 2024 (10 specie). Per i crostacei, le variazioni maggiori sono riscontrabili a livello di abbondanze di alcune specie, soprattutto anfipodi e tanaidacei. In particolare, il decapode *Carcinus aestuarii* (granchio di laguna), osservato con numerosi individui negli anni '80, non è stato più campionato nel 2024. Analogamente, i bivalvi campionati negli anni '80 (*Venerupis aurea, Abra ovata, Cerastoderma glaucum*) non sono stati ritrovati nel 2024. A fronte delle variazioni modeste nei valori di temperatura e salinità nel corso degli ultimi quarant'anni, la principale causa dei cambiamenti registrati nel popolamento zoobentonico è attribuibile alla presenza e abbondanza di *Callinectes sapidus* che, diffusosi a spese di *Carcinus aestuarii*, è anch'esso un attivo predatore di bivalvi e crostacei.

A. FALACE[1,2], E. DESCOURVIÈRES[1,3], V. BANDELJ[2,3], G. ALONGI[4], M. ORLANDO[5], S. BEVILACQUA[1]

[1]Department of Life Sciences, University of Trieste, Italy.
[2]National Biodiversity Future Center (NBFC), Palermo, Italy.
[3]National Institute of Oceanography and Applied Geophysics (OGS), Trieste, Italy.
[4]Department of Biological Geological, Environmental Sciences, University of Catania, Italy.
[5]Marine Biology Station Piran, National Institute of Biology, Piran, Slovenia.
falace@units.it

LONG-TERM CHANGES IN MACROALGAL DIVERSITY IN THE NORTHERN ADRIATIC SEA: SPECIES LOSS AND TAXONOMIC HOMOGENIZATION

Coastal marine ecosystems are undergoing unprecedented biodiversity losses due to cumulative anthropogenic pressures and climate change. While marine biodiversity shifts have been widely studied, long-term assessments of macroalgal communities remain scarce, limiting our understanding of ecosystem responses to environmental stressors. The Adriatic Sea, one of the most impacted regions of the Mediterranean, has experienced profound environmental transformations, reshaping community structures and species diversity. The northern Adriatic, a key biogeographical zone, is particularly threatened by warming, urbanization, and oligotrophication. Here, we present a comprehensive long-term analysis of macroalgal diversity shifts in the northern Adriatic over the past six decades. By compiling historical datasets from literature and unpublished records, we assessed species turnover, local extinction trends, and taxonomic diversity changes between two time periods (1960–1989 and 1990–2023). Temporal β-diversity analysis revealed a 42% shift in species composition, primarily driven by species turnover. A total of 132 species recorded in the earlier period were absent in the latter, while only 63 new species were documented, resulting in a net loss of 69 species. The most pronounced decline was observed among Phaeophyceae, particularly Fucales. Taxonomic distinctness analyses further indicated a contraction in phylogenetic diversity, suggesting increasing taxonomic homogenization. The disappearance of cold-water and Atlantic-affiliated species, alongside the proliferation of warm-water and Indo-Pacific taxa, underscores an ongoing climate-driven biogeographical shift. A particularly concerning case is *Fucus virsoides* J. Agardh, a glacial relict endemic to the Adriatic, which has suffered an alarming decline. Our comprehensive Adriatic-wide survey indicates that only ~20 fragmented populations remain, with local extinctions in Slovenia and functional extinction in Croatia. We analyzed the primary drivers of its decline and highlight the urgent need for immediate conservation measures to prevent further biodiversity erosion and ensure the long-term survival of *F. virsoides* and other vulnerable macroalgal species in Mediterranean coastal ecosystems.

R. GALLI[1], G. BAVESTRELLO[1,2,3], V. CAPPANERA[4], F. ENRICHETTI[1,2,3]

[1]DISTAV, Università di Genova, Italia.
[2]Consorzio Nazionale Interuniversitario per le Scienze del Mare (CoNISMa), Roma, Italia.
[3]National Biodiversity Future Centre (NBFC), Palermo, Italia.
[4]Area Marina Protetta di Portofino, Santa Margherita Ligure (GE), Italia.
francesco.enrichetti@edu.unige.it

VALUTAZIONE DELL'IMPATTO DELLA PESCA ARTIGIANALE COL TRAMAGLIO SULLE FORESTE ANIMALI DI UNA SECCA MESOFOTICA DEL MAR LIGURE ORIENTALE

Le foreste animali mesofotiche sono ecosistemi complessi e vulnerabili, il cui equilibrio può essere compromesso dalle attività antropiche, in particolare la pesca. Nel Mediterraneo, tra i mètier maggiormente adottati sulle secche rocciose del largo, sulle quali prosperano ricche foreste animali, vi è la pesca dell'aragosta col tramaglio. Il presente studio si propone di valutare gli effetti del tramaglio per aragosta sulle biocenosi della Secca Fonda di Punta del Faro, una secca mesofotica del Mar Ligure orientale (60-80 m) dominata da foreste di gorgonie e coralli neri e inclusa nella ZSC "Fondali Monte di Portofino" (IT1332674). La quantificazione dell'impatto si basa sul confronto tra le catture commerciabili e lo scarto (commerciale e bentonico) di sei pescate sperimentali. I risultati evidenziano una netta predominanza dello scarto bentonico rispetto alle altre categorie, sia in termini di numero di individui (80%) sia di diversità (93%). Gli cnidari arborescenti e i briozoi eretti con scheletro carbonatico costituiscono i gruppi più abbondanti; di particolare rilevanza sono la gorgonia *Eunicella cavolini* (Koch, 1887), il corallo nero *Antipathella subpinnata* (Ellis & Solander, 1786) e numerose altre specie incluse in convenzioni internazionali. Significativa è anche la quantità di substrato rimosso (costituito da pietre e materiale carbonatico), con valori che possono raggiungere i 15 kg per pescata. Infine, l'analisi della spazzatura raccolta identifica le principali fonti di inquinamento nella pesca e nel diporto. In conclusione, viene evidenziato il forte squilibrio tra il profitto commerciale (stimato, nel presente studio, in una media di 60 euro lordi a pescata) e l'elevato impatto arrecato alle biocenosi dei fondi duri mesofotici, suggerendo la necessità di una maggiore attenzione nella gestione di questo mètier. Viene inoltre confermata l'elevata vulnerabilità del sito che potrebbe essere tutelata attraverso la sua inclusione all'interno dei confini dell'AMP di Portofino, situati a meno di 200 m di distanza.

P. LA VALLE[1], E. SALVATI[2], D. PAGANELLI[1], B. LA PORTA[1], L. LATTANZI[3], L. NICOLETTI[1], M. TARGUSI[1], A. PAZZINI[1], R. PROIETTI[1], M. PULCINI[1], F. GIAIME[1]

[1]ISPRA, Rome, Italy.
[2]Stazione Zoologica Anton Dohrn, Rome, Italy.
[3]Via Rodolfo Lanciani, 1 - 00019 Tivoli (RM), Italy.
paola.lavalle@isprambiente.it

REEF HABITATS: NEW FINDINGS IN THE CENTRAL TYRRHENIAN SEA (MEDITERRANEAN SEA)

ISPRA, on behalf of the Port Network Authority of the Central Northern Tyrrhenian Sea, carried out a characterization study in an area off the southern coast of Lazio (Central Tyrrhenian Sea) to identify a marine site suitable for the potential sediment dumping. The proposed site was located about 12 NM offshore Terracina (Latina), between 100 and 200 m depth. The identified site was characterized according to the Italian Decree 173/2016. The study, carried out in 2016 - 2017, included geophysical surveys and the physical, chemical, and biological characterization of the seabed. Geophysical investigation, performed in an area of about 87 km^2, through Multibeam and SSS, highlighted several morphologically elevated structures, probably of rocky nature, and depressed features interpreted as pockmarks. For this reason, a further survey was performed using a ROV to avoid the presence of sensitive or protected species associated with these structures. Regarding the soft bottom benthic assemblages, results showed the predominance of species typical of the Coastal Terrigenous Muds and the Bathyal Muds biocenoses. Video surveys showed benthic assemblages typical of the Hard Bottom Circalittoral biocenoses. The investigations also revealed the presence of three protected species of Anthozoa: *Callogorgia verticillata* (Pallas, 1766), *Parantipathes larix* (Esper, 1790) and *Funiculina quadrangularis* (Pallas, 1766). *C. verticillata* and *P. larix*, typical of rocky reef, are included in Annex II of the SPA/BIO Protocol; *F. quadrangularis*, typical of the lower circalittoral muddy substrates, is included in the IUCN Red List in the category "critically endangered species" (CR). Furthermore, Vulnerable Marine Ecosystem (VME) taxa indicators of "Coral garden" (*Acanthogorgia hirsuta, C. verticillata, Paramuricea macrospina, P. larix, Paralcyonum spinulosum)* and "Sea pen fields" (*F. quadrangularis*) were observed. This study focused on the occurrence of habitat-forming species of circalittoral and deep-sea habitats in the central Tyrrhenian Sea on the identified rocky elevated structures, and the possible impacts that might affect their conservation status.

C. MARESCALCHI[1], C. MANCUSI[1,2], F. CAPANNI[1], V. MENONNA[3], A. CASADIO[3], G. RUBERTI[3], N. DELLA GIOVAMPAOLA[1], F. BONUCCI[1], V. PAOLETTI[4], M. MASCHIO[5], L. MARSILI[1,6]

[1]Department of Physical Sciences, Earth and Environment, University of Siena, Italy.
[2]Environmental Protection Agency of the Tuscany Region (ARPAT), Livorno, Italy.
[3]Regione Toscana, Protection of Nature and the Sea, Firenze, Italy.
[4]Associazione Elbamare ETS, Livorno, Italy.
[5]Argentario Scuba Point, Porto Santo Stefano (GR), Italy.
[6]Centro Interuniversitario per la Ricerca sui Cetacei (CIRCE), Department of Physical Science, Earth and Environment, University of Siena, Italy.
c.marescalchi@student.unisi.it

ENHANCING NATURA 2000 NETWORK THROUGH CITIZEN SCIENCE: MONITORING CRYPTIC AND ENDANGERED MARINE INVERTEBRATES IN THE TUSCAN MEDITERRANEAN SEA

Citizen science projects represent a powerful tool to enhance biodiversity conservation over large geographical areas, especially for species that are difficult to detect. This study applies an innovative citizen science approach to address knowledge gaps on the conservation status of six priority invertebrate species listed in the Habitats Directive (92/43/EEC) and relevant to the Natura 2000 Network in Tuscan Mediterranean waters: *Centrosthephanus longispinus*, *Corallium rubrum*, *Lithophaga lithophaga*, *Pinna nobilis*, *Patella ferruginea* and *Scyllarides latus*. A multidisciplinary approach was adopted, involving pre-activity briefings and structured observation reporting by trained citizens. Data collection took place from May 2023 to September 2024, with the participation of 28 diving centers and one kayak center. The most frequently reported species was *P. nobilis*, primarily as dead specimens (28 reports, 33.7% of total observations), with only 4 live individuals (4.8%) documented. *C. rubrum* (19 sightings, 22.9%) and *C. longispinus* (14 validated records, 16.9%) followed in frequency. Notably, *P. ferruginea* was detected in previously unrecorded site, while observations of *C. rubrum* and *P. nobilis* provided key insights into their persistence and local extirpation. Additionally, the presence of cryptic species such as *L. lithophaga* and *S. latus* was confirmed. Validated data offer a preliminary assessment of species distribution, contributing to future proposals for new Sites of Community Importance (SCI) and the development of evidence-based conservation and management strategies. This citizen science initiative demonstrates its potential as a cost-effective and scalable approach to monitor priority species and establish a baseline for long-term biodiversity databases.

S. MELCHIORI[1], V. ASNAGHI[1,2,3], F. ENRICHETTI[1,2,3], G. LA MESA[4], M. DALÚ[4], L. TUNESI[4], M. MONTEFALCONE[1,3]

[1]Department of Earth, Environment and Life Sciences (DiSTAV), University of Genoa, Italy.
[2]National Inter-University Consortium for Marine Sciences (CoNISMa), Roma, Italy.
[3]National Biodiversity Future Center (NBFC), Palermo, Italy.
[4]Italian Institute for Environmental Protection and Research (ISPRA), Roma, Italy.
silviamelc@gmail.com

A COMPREHENSIVE ASSESSMENT OF THE ITALIAN MARINE HABITATS AND SPECIES UNDER THE EU HABITATS DIRECTIVE (92/43/EEC): METHODOLOGICAL CHALLENGES AND THE NEED FOR STANDARDISED CONTINUED MONITORING

Under the Habitats Directive (92/43/EEC), a cornerstone of European nature conservation, EU Member States are required to submit a national report every six years, contributing to a comprehensive European assessment of habitats and species of community interest. This study details the work undertaken in Italy to compile the fifth national report on marine habitats and species for the 2019-2024 period. Led by the Italian Institute for Environmental Protection and Research (ISPRA), in collaboration with 28 experts from the Italian Society of Marine Biology (SIBM), the report updates the conservation status of 8 habitats and 27 species by systematically evaluating parameters such as distribution, abundance, pressures, and implemented conservation measures. Our approach combined advanced GIS-based mapping, including high-resolution spatial analyses and digital cartography, to generate detailed distribution maps of habitats and species. These maps were subsequently integrated into the standardised reporting framework adopted across Europe, thereby ensuring data consistency and enabling robust comparability over successive evaluations. As case studies, we focused on two emblematic Mediterranean elements: the *Posidonia oceanica* meadows (habitat code 1120) and the red coral, *Corallium rubrum* (species code 1001). By comparing current findings with previous reporting cycles, we identified key methodological strengths, such as improved spatial resolution and data availability, as well as persistent limitations, including the limited availability of information for certain species and habitats and the challenge of providing precise quantitative measures. This evaluation allowed us to highlight critical elements for improvement, guiding future assessments toward greater accuracy, consistency, and effectiveness in monitoring conservation status.

L. PIAZZI[1,2], L. CASTRIOTA[3], M.F. CINTI[1], A.M. DE BIASI[1], S. LIVI[4], L. PACCIARDI[1], M. PERTUSATI[1], C. PRETTI[1,2,5], P. GENNARO[6]

[1]CIBM, Livorno, Italia.
[2]CoNISMa, Roma, Italia.
[3]ISPRA, Palermo, Italia.
[4]ISPRA, Roma, Italia.
[5]Dipartimento di Scienze Veterinarie, Università di Pisa, San Piero a Grado (PI), Italia.
[6]ISPRA, Livorno, Italia.
lpiazzi00@gmail.com

VALUTAZIONE DELL'IMPATTO DI INVASIONI BIOLOGICHE IN HABITAT PRIORITARI

La Direttiva Quadro Strategia Marina (MSFD 2008/56/CE) sottolinea l'importanza della gestione delle Specie Non Indigene (NIS), promuovendo azioni mirate per monitorarne la distribuzione e l'impatto sui popolamenti nativi e misure di intervento volte al mantenimento del buono stato ambientale degli ecosistemi marini. In questo contesto, il presente contributo propone e descrive una procedura standardizzata per valutare la qualità ecologica di habitat marino-costieri mediterranei in relazione al grado di invasione di macroalghe alloctone, attraverso l'impiego dell'indice ALEX (ALien Biotic IndEX). La procedura è stata applicata alle scogliere coralligene e alle praterie di *Posidonia oceanica* in cinque siti del Mediterraneo occidentale, tre all'interno di Aree Marine Protette e due in zone non protette. Sono state identificate cinque specie introdotte (le Chlorophyta *Caulerpa cylindracea* e *C. taxifolia* var. *distichophylla* e le Rhodophyta *Acrothamnion preissii*, *Womersleyella setacea* e *Asparagopsis* spp.). I popolamenti coralligeni hanno mostrato una maggiore abbondanza di *C. cylindracea* e *W. setacea* mentre le praterie di *P. oceanica* sono risultate principalmente invase da *A. preissii*. I valori dell'indice variavano da 0.69 a 0.90, classificando i siti studiati con una qualità ecologica da buona a elevata. Il monitoraggio degli habitat mediante l'applicazione di ALEX ha permesso di valutare l'evoluzione della qualità ecologica nel tempo in base al livello di invasione biologica. L'impiego di ALEX, congiuntamente ad altri indici di qualità ecologica, si è dimostrato un approccio valido per l'integrazione dei piani di monitoraggio della Strategia Marina e la pianificazione di programmi di conservazione sempre più efficaci e completi.

G. PROCACCINI[1,2], J. PAZZAGLIA[1], I. PROVERA[1], F. BLANCO MURILLO[1], I. OLIVÉ[1], E. DATTOLO[1,2]

[1]Department of Integrative Marine Ecology, Stazione Zoologica Anton Dohrn, Naples, Italy.
[2]National Biodiversity Future Centre (NBFC), Palermo, Italy.
gabriele.procaccini@szn.it

RACING AGAINST CHANGE: HARNESSING ASSISTED EVOLUTION FOR RESILIENT SEAGRASSES

Seagrass meadows provide important ecological and socioeconomic services worldwide, but they are under increasing threat due to human activities and climate change. To guarantee the resilience of seagrasses and the preservation of their ecosystem functions, novel human-assisted interventions must be implemented to support traditional management strategies (*i.e.* restoration). Research is increasingly focusing on assisted evolution strategies aimed at accelerating the adaptation of natural populations to global environmental changes and enhancing their stress tolerance. However, the effectiveness of these strategies in enhancing seagrass resilience remains to be properly investigated. We apply several assisted evolution approaches on different seagrass species, in order to assess the benefits and risks associated with them. Specifically, our focus is on the following approaches: (i) stress hardening (or priming) in *Posidonia oceanica* and *Cymodocea nodosa*, which enhances stress tolerance by exposing organisms to sublethal stress events. This first exposure activates the stress memory through epigenetic and transcriptional modifications, that improve the plant capacity to respond to future stressors; (ii) identification of traits associated with improved stress tolerance, through screening trials and laboratory stress on *P. oceanica* seeds; (iii) assisted migration in *Zostera marina*, with the potential to improve the existing genetic basis of natural populations with previous identification of thermally robust source populations for potential restoration; (iv) assisted ecological succession, through multi-species transplants with *C. nodosa* to improve *P. oceanica* seedling viability. Successful results have already been achieved through the short-term application of stress hardening and phenotypic screening trials in mesocosm facilities, progressing also on the understanding of mechanisms underlying assisted evolution in seagrasses. Future activities are planned to build on these first results and to assess their success once implemented for restoration effort.

A. REBOA[1,2], A. BANDI[1], G. BAVESTRELLO[1,2], M. BERTOLINO[1,2]

[1]Department of Earth, Environmental and Life Sciences (DISTAV), University of Genoa, Italy.
[2]National Biodiversity Future Center (NBFC), Palermo, Italy.
anna.reboa@edu.unige.it

CHANGES IN THE SPONGE FAUNA OF A ROCKY CLIFF IN THE PORTOFINO MPA AFTER 47 YEARS

The increasing issues of pollution and climate change make monitoring actions necessary to assess the health status of protected habitats. The Portofino Marine Protected Area (north-west Italy) is characterised by massive rocky cliffs and is a hot spot of biodiversity. Porifera are benthic organisms of high ecological importance, both for their filtration activity and for contributing to the three-dimensionality of the habitat. A vertical profile (down to 20 m depth) of a rocky cliff in Portofino, named "Aurora transect" was investigated 47 years after the first study, principally focusing on the sponge community. Squares of 20 cm × 20 cm of the substrate were removed following the same methodology as in the previous study, to compare the biodiversity of the sponge fauna between the past and the present. Here are presented the results of the most superficial portion of the transect (0-9 m depth). While in 1976 sponge species were more uniformly distributed, in 2023 the number of species decreases with depth, and it is much lower than in the past. Thus, many sponge species present in 1976 were not found in this study, and a marked reduction in the massive/erect habit was noted. The three-dimensionality of the cliff also decreased due to the complete loss of other massive and arborescent organisms, such as *Eunicella cavolini* (Koch, 1887), which are now replaced by algal turfs. These results highlight how ongoing climate change is affecting the benthic fauna, particularly sponge populations.

F. RENDINA[1], A. COCOZZA DI MONTANARA[1,2,3], G.F. RUSSO[1]

[1]Dipartimento di Scienze e Tecnologie, Cattedra UNESCO "Ambiente, Risorse e Sviluppo Sostenibile", Università di Napoli Parthenope, URL CoNISMa, Napoli, Italia.
[2]Stazione Zoologica Anton Dohrn, Napoli, Italia.
[3]National Biodiversity Future Center (NBFC), Palermo, Italia.
francesco.rendina@uniparthenope.it

BIODIVERSITÀ DELLE COMUNITÀ BENTONICHE DEI LETTI A RODOLITI MESOFOTICI DEL MAR TIRRENO

I letti a rodoliti sono habitat biogenici diffusi su scala globale formati dall'accumulo di fome libere di alghe rosse calcaree. Essi ospitano un'elevata biodiversità e svolgono importanti servizi ecosistemici, tra cui il sequestro del carbonio. Nel Mar Mediterraneo, si trovano prevalentemente a elevate profondità (40-150 m) e dunque la loro distribuzione, complessità strutturale e biodiversità sono ancora poco conosciute. Tuttavia, sono habitat estremamente vulnerabili a diverse pressioni antropiche, come la pesca a strascico. Questo studio prende in considerazione quattro letti a rodoliti del Mar Tirreno (Capri, Sorrento, Ischia e Cilento) compresi tra i 50 e i 70 m di profondità, analizzandone la loro composizione floristica e faunistica. Inoltre, per la prima volta in letti mediterranei, oltre alla comunità macrofaunistica è stata considerata anche quella meiofaunistica. I risultati mostrano una notevole variabilità nella copertura di rodoliti e nella complessità strutturale dei letti. È emersa una grande diversità di alghe coralline (>10 taxa). Il letto a rodoliti del Cilento, che presenta la maggiore copertura e complessità strutturale, si è distinto anche per l'elevata abbondanza macrofaunistica e la ricchezza di specie. In tutti i letti analizzati si riscontrano dominanze simili tra i principali gruppi tassonomici (Polychaeta, Mollusca, Crustacea ed Echinodermata). In particolare, i policheti sono i più abbondanti, mentre i molluschi contribuiscono con il maggior numero di specie. Tra le gilde trofiche dominanti, i depositivori hanno un ruolo chiave nel caratterizzare la struttura della comunità, evidenziando anche il ruolo dei rodoliti nelle reti trofiche detritiche. Inoltre, la comunità meiofaunistica strettamente legata ai rodoliti è risultata significativamente differente da quella che caratterizza i sedimenti sottostanti, con una prevalenza di copepodi e di molte specie temporanee della meiofauna (giovanili della macrofauna), a conferma del ruolo di *nursery* di questi habitat. Questi risultati confermano l'elevata diversità floristica e faunistica dei letti a rodoliti, evidenziando il loro ruolo cruciale come *hotspot* di biodiversità del Mar Mediterraneo.

C. SILVESTRINI[1], A. CICCOLELLA[2], P. D'AMBROSIO[3], F. DE FRANCO[2], L. MUSCOGIURI[4], S. FRASCHETTI[1]

[1]Department of Biology, University of Naples Federico II, Italy.
[2]Consorzio di Gestione di Torre Guaceto, Carovigno (BR), Italy.
[3]Department of Research Infrastructures for marine biological resources, Infrastructure for Marine Research, Stazione Zoologica Anton Dohrn, Amendolara (CS), Italy.
[4]Consorzio di Gestione Area Marina Protetta Porto Cesareo, Porto Cesareo (LE), Italy.
chiara.silvestrini@unina.it

FISHERY IS A DRIVER OF HABITAT LOSS ALSO IN MARINE PROTECTED AREAS

Fishery is considered one of the human activities most responsible for marine habitat fragmentation and loss. However, while the impacts of industrial fisheries (large-scale fisheries, LSF) have been extensively studied, the potential impact of artisanal fisheries (small-scale fisheries, SSF) on benthic habitats is more often presumed rather than quantitatively assessed. To address this knowledge gap, we carried out a fine-scale assessment with the collaborative involvement of local artisanal fishers operating within the Marine Protected Areas of Torre Guaceto and Porto Cesareo, in Southern Italy. Through *in situ* landing photo-sampling, we characterized both the sessile benthic bycatch and the commercial catch components from 145 fishing trips, comparing the results across two of the most ecologically relevant habitats in the Mediterranean Sea (i.e. *Posidonia oceanica* beds and coralligenous reefs), that also represent the most common artisanal fishing grounds. Our findings indicate that benthic bycatch accounted, on average, for 41% of the total catch by abundance, and 28% by biomass, representing a concerning and non-negligible fraction. To quantitatively assess habitat loss driven by SSF, we combined data on the bycatch of two habitat-forming species (*Axinella cannabina* and *Posidonia oceanica*) with information on fishing effort. Results revealed substantial impacts of fishing on coralligenous reefs, with the loss of *A. cannabina* affecting approximately 4000 m^2 of habitat within the PPA and up to 6400 m^2 in the surrounding unregulated areas. Quantifying artisanal fishing pressure and its effect on ecosystems, together with filling the knowledge gaps on distribution of vulnerable habitats in space and time, is a key aspect to develop regional management strategies that promote eco-sustainable local fisheries and contribute to reversing trajectories of loss.

POSTER

A. AMATO[1,2], B. PINTO[1,3], R. ESPOSITO[1], E. PRATO[4], F. BIANDOLINO[4], M. COCCA[5], L. MANFRA[1,6], G. LIBRALATO[1,2], V. ZUPO[3], M. COSTANTINI[1]

[1]Department of Ecosustainable Marine Biotechnology, Stazione Zoologica Anton Dohrn, Napoli, Italy.
[2]Department of Biology, University of Naples Federico II, Italy.
[3]Stazione Zoologica Anton Dohrn, Department of Ecosustainable Marine Biotechnology, Ischia Marine Centre, Italy.
[4]Water Research Institute (IRSA), National Research Council (CNR), Taranto, Italy.
[5]Institute of Polymers, Composites and Biomaterials, National Research Council, Pozzuoli (NA), Italy.
[6]Institute for Environmental Protection and Research (ISPRA), Rome, Italy.
amalia.amato@szn.it

EFFECTS OF MICROPLASTICS DERIVING FROM POLYLACTIC ACID VIRGIN POLYMER AND COMMERCIAL DISPOSABLE CUPS ON LARVAE OF THE SHRIMP *HIPPOLYTE INERMIS* LEACH, 1816

Plastics are a worrying issue for marine environments. Several chemical substances, as the additives usually added to plastic polymers to enhance their properties, trigger additional noxious effects to the life cycles of planktonic and benthic invertebrates. Notably, biodegradable plastics may contain toxic, non-biodegradable and leachable additives. Polylactic acid (PLA) is widely used as a biodegradable polymer produced from renewable sources. In this research, a multiphasic approach was applied to evaluate on the shrimp *Hippolyte inermis* Leach, 1816, the toxic effects of microplastics (MPs) derived from virgin PLA (335.00±182.01 µm) and from PLA-based disposable glasses (38±212 µm). Shrimp larvae were exposed to three MPs concentrations, *i.e.*, 1, 5 and 10 mg/L. After ten days, mortality rates were compared among treatments and vs. controls (seawater without MPs). Results showed that virgin PLA, at all concentrations, induced mortality with statistically significant effects as compared to the control; differently, PLA obtained from disposable glasses exhibited no significant effects. Molecular investigations evaluated the variations in the expression levels of eighteen genes involved in stress response and detoxification processes, after the exposure to MPs. Virgin PLA induced down-regulation in most genes analyzed, already at the concentration of 5 mg/L. PLA obtained from disposable products induced up-regulation of most genes attached, at the highest concentration tested. Our findings demonstrated that *H. inermis* is an excellent marine model organism for ecotoxicological studies, since crustaceans play a fundamental role in aquatic food webs, being links between primary producers and consumers, both in benthic and planktonic communities. Noteworthy, MPs can cause mechanical stress in zooplankton and such effect was strictly associated with the size of the MPs they meet in the sea. Research conducted in the framework of the Project – Biomonitoraggio di micro e nanoplastiche biodegradabili: dall'ambiente all'uomo in una prospettiva one health (BioPlast4Safe) - with the technical and economic support of the Italian Ministry of Health – PNC.

F. BLANCO-MURILLO[1], L. PEDICINI[2], I. OLIVÉ[1], E. DATTOLO[1,3], J. PAZZAGLIA[1,3], U. CARDINI[1], A. PUSCEDDU[4], F. BULLERI[2], G. PROCACCINI[1,3]

[1]Department of Integrative Marine Ecology, Stazione Zoologica Anton Dohrn, Naples, Italy.
[2]Department of Biology, University of Pisa, Italy.
[3]National Biodiversity Future Centre (NBFC), Palermo, Italy.
[4]Department of Life and Environmental Sciences, University of Cagliari, Italy.
gabriele.procaccini@szn.it

EFFECT OF MARINE HEAT WAVES (MHW) ON *POSIDONIA OCEANICA* RHIZOSPHERE: A MULTIDISCIPLINARY APPROACH

Climate change has detrimental effects on marine coastal communities, and, among its associated phenomena, marine heat waves (MHW) is one of the most threatening. In the case of the Mediterranean endemic seagrass, *Posidonia oceanica*, anomalous temperature increments have triggered stress response. However, there is a relevant lack of information regarding the physiological, metabolic and biogeochemical responses of the belowground compartment, known as rhizosphere. To fill this knowledge gap, the BORIS project, funded by the National Recovery and Resilience Plan (PNRR), aims to evaluate how sediment warming might influence biogeochemical cycles, and the subsequent ecosystem services related to them and to investigate the potential buffering effect of the matte against MHWs. Temperature loggers were deployed within *P. oceanica* meadows in 4 locations along the Italian coast (Porto Conte and Capo Carbonara in Sardinia, Livorno and Ischia Island along the Tyrrhenian coasts). In order to test the differences among meadows compartments, continuous temperature recording was set at −30 cm, −10 cm, sediment surface and canopy level. Seasonal sampling of plant (leaf, rhizome and roots), sediment and porewater is also being performed, between summer 2024 and summer 2025. The following traits are being analysed: (1) plant metabolism and transcriptomics, (2) rhizosphere-associated microbiome composition, (3) plant and sediment biochemical composition, and (4) pore-water nutrient and gases levels. This project aims to highlight the need for interdisciplinary approaches to answer the complex interactions of climate changes with marine communities and their functioning. Preliminary results supported the buffering role of the *P. oceanica* matte layer, where temperatures are more stable compared to canopy-level values, supporting the initial hypothesis of this research. Temperature profiles, plant metabolism, microbiome dynamics and sediment biochemistry will provide insights into the belowground processes being affected by MHW and how these changes might alter ecosystem functioning and services such as nutrient balance and carbon sequestration.

L.M. CAPUANO[1], A. CARLUCCIO[1,2], M. SPACCAVENTO[1], G. D'ONGHIA[1,2]

[1]Dipartimento di Bioscienze, Biotecnologie e Ambiente, Università di Bari Aldo Moro, Italia.
[2]CoNISMa, Roma, Italia.
leonardamartinacapuano@gmail.com

FAUNA BENTOPELAGICA SU FONDALI A RODOLITI E BANCHI DI OSTRICHE RILEVATA MEDIANTE *BAITED LANDER*

I sistemi di campionamento visivo, come i *baited lander*, sono un valido strumento a basso impatto ambientale per lo studio della biodiversità marina associata ad habitat vulnerabili formati da biocostruttori. In questo lavoro si fornisce un contributo alla conoscenza della fauna bentopelagica associata a fondali a rodoliti e banchi di ostriche, attraverso l'esplorazione condotta mediante il lander MEMO in tre aree del Mediterraneo. In particolare, sono stati investigati i fondali intorno all'Isola di Marettimo (Arcipelago delle Isole Egadi, Tirreno meridionale) e al largo di Vieste e Monopoli (Adriatico meridionale), a profondità comprese tra 70 e 90 m, per un totale di 43 ore di video-registrazione. Nelle 8 stazioni esaminate, sono stati identificati: 4 taxa di cefalopodi, 11 di crostacei e 19 di pesci teleostei. Al fine di valutare le differenze nella composizione della fauna tra i siti esplorati, sono stati considerati i valori di abbondanza di ciascuna specie, standardizzati al tempo di registrazione, rispetto ad alcuni tra i principali fattori caratterizzanti le tre aree di indagine: area geografia, tipologia di habitat e periodo del giorno di video-registrazione. Inoltre, l'osservazione diretta delle specie nel loro habitat ha consentito di rilevarne il comportamento nonché alcune interazioni intraspecifiche e interspecifiche.

F. CARDONE[1,2], A. GIOVA[3], V. COSTA[4], M. GENOVESE[5], E. SALVATI[1,2], F. STENICO[6], S. GRECO[7]

[1]Integrative Marine Ecology Department, Stazione Zoologica Anton Dohrn, Naples, Italy.
[2]National Biodiversity Future Centre (NBFC), Palermo, Italy.
[3]Department of Chemical, Biological, Pharmaceutical and Environmental Sciences, University of Messina, Italy.
[4]Department of Integrative Marine Ecology (EMI), Stazione Zoologica Anton Dohrn, CRIMAC, Calabria Marine Centre, Amendolara (CS), Italy.
[5]National Institute of Marine Biology, Ecology and Biotechnology, Stazione Zoologica Anton Dohrn, Naples, Italy.
[6]Department for Research Infrastructures for marine biological resources (RIMAR), Marine Robotics Technology Implementations (ITR), Stazione Zoologica Anton Dohrn, CRIMAC, Calabria Marine Centre, Amendolara (CS), Italy.
[7]University of Gastronomic Sciences of Pollenzo, Bra (CN), Italy.
frine.cardone@szn.it

UNVEILING THE HIDDEN DIVERSITY OF CORONATAE JELLYFISH IN THE DEEP MEDITERRANEAN SEA

The deep pelagic realm, comprising the water column below 200 m, represents the largest and least explored biome on Earth. It serves as a reservoir of underestimated biodiversity, yet remains equally vulnerable to the increasing impacts of human pressures. Advances in deep-sea exploration technologies, particularly remotely operated vehicles (ROVs), have significantly improved our ability to document fragile and elusive organisms such as gelatinous zooplankton. Among these, the order Coronatae (Cnidaria, Scyphozoa) remains poorly studied, with limited records in the Mediterranean Sea. In this study, we report the first *in situ* observations of coronate jellyfish in the deep Mediterranean, based on video analyses from three oceanographic campaigns conducted between 2021 and 2023. A total of 13 specimens were recorded between 800 and 1000 m depth in the Ionian Sea (off Calabria) and Western Sardinia. Morphological analyses suggest that at least some of the specimens belong to *Paraphyllina* cf. *ransoni*, expanding the known distribution of this genus within the Mediterranean. These findings emphasize the importance of the *in situ* exploration methods for assessing deep-sea gelatinous biodiversity, revealing previously unknown species distributions and their ecological traits.

L. CASTELLANO[1], C. ARCURI[1,2,3], N. PEREZ[1], A. ATZORI[2], M. SPOTO[2], C. CATTA[2], G. CORRIERO[3], T. LAZIC[3], M. RAVISATO[3], C. PIERRI[3], M. GRISTINA[2]

[1]Acquario di Genova, Costa Edutainment SpA, Genova, Italy.
[2]IAS-CNR, Palermo, Italy.
[3]DBBA, University of Bari, Italy.
lcastellano@costaedutainment.com

HIPPOCAMPUS GUTTULATUS (CUVIER, 1829) AND *H. HIPPOCAMPUS* (LINNAEUS, 1758) CAPTIVE BREEDING: PRELIMINARY DATA

Seahorse populations (*Hippocampus* spp.) worldwide face severe threats due to habitat degradation, bycatch in commercial and artisanal fisheries, and overexploitation driven by demand in traditional medicine. In recent years, in several European regions, both Mediterranean seahorse species (*Hippocampus guttulatus* and *H. hippocampus*) have been subjected to illegal harvesting, primarily to supply the Chinese medicine market, exacerbating population declines and underscoring the urgent need for conservation initiatives. One of the key conservation strategies to mitigate these threats is the implementation of captive breeding and release programs aimed at restoring wild populations. Therefore, the primary objective of the present study was to develop a standardized and comprehensive breeding protocol for the two seahorse species, ensuring optimal husbandry conditions, promoting reproductive success, and prioritizing animal welfare. Establishing best practices for captive breeding is essential not only for the sustainability of conservation programs but also for potential reintroduction efforts aimed at locally reinforcing wild populations. A total of 10 breeding pairs (seven *H. guttulatus*, three *H. hippocampus*) were collected from the Mar Piccolo of Taranto and transported to the Acquario di Genova. The reared seahorses were provided with a diet tailored to their developmental stage, determined through multiple trials involving various prey types. These trials incorporated enrichment agents (Easy DHA, Spresso, Red Algamac and living microalgae) added to live prey to enhance their nutritional value. Throughout the study, the seahorses were fed *ad libitum*, ensuring continuous food availability. The live prey used included *Acartia tonsa* (copepods), *Artemia salina* (brine shrimp), and *Neomysis integer* (mysids), all reared under controlled temperature, salinity, and feeding conditions to maximize their nutritional content. To date, 159 *H. guttulatus* and 100 *H. hippocampus* individuals have reached one year of age and attained the adult stage (>96.0±8.0 mm and >66.1±1.0 mm total length, respectively).

G. DONATO[1], A. ROSSO[1,2], G. VISCONTI[3], D. SERIO[1,2], E. DI MARTINO[1], F. SCIUTO[1,2], R. SANFILIPPO[1,2]

[1]Department of Biological, Geological and Environmental Sciences, University of Catania, Italy.
[2]National Inter-University Consortium for Marine Sciences (CoNISMa), Roma, Italy.
[3]Management Consortium of the Marine Protected Area Capo Milazzo, Milazzo (ME), Italy.
gemma.donato@phd.unict.it

BIODIVERSITY AND MORPHOLOGY OF THE CORALLIGENOUS HABITAT IN THE CAPO MILAZZO MARINE PROTECTED AREA: FINDINGS AND CHALLENGES

The coralligenous habitat, characterized by a three-dimensional structure that provides shelter and substrate for numerous marine species, is one of the most complex and biodiverse ecosystems in the Mediterranean Sea. However, its composition and morphology can vary significantly across different spatial scales due to environmental and often anthropogenic factors. This study aims to analyze the biodiversity and structure of the coralligenous habitat at four different sites within the Capo Milazzo Marine Protected Area (NE Sicily). Sampling was carried-out using non-invasive methods, such as photo-quadrats and video surveys with a Remotely Operated Vehicle (ROV), complemented by direct collection of small bioconstruction samples for the identification of small/cryptic species. The surveys enabled the compilation of detailed taxonomic lists, revealing the presence of several protected species of conservation interest not yet reported, such as the sponge *Axinella polypoides*, the cnidarian *Astroides calycularis*, the mollusks *Pinna rudis* and *Lithophaga lithophaga*, and the echinoderms *Ophidiaster ophidianus* and *Centrostephanus longispinus*. Preliminary results indicate variations in taxonomic composition and coralligenous morphology among the examined sites. Some areas exhibit more complex structures and higher biodiversity, while others show signs of structural simplification and reduced diversity, suggesting the influence of local environmental factors such as hydrodynamics. Additionally, the monitoring activities identified several environmental concerns, including summer mucilage blooms covering gorgonians, the presence of invasive species like the green algae *Caulerpa cylindracea* and the predatory fireworm *Hermodice carunculata*, as well as evident necrotic areas on both gorgonians and calcareous algae. The presence of abandoned fishing nets was also recorded. These findings provide new insights into coralligenous communities along the Tyrrhenian coast of Sicily and emphasize the importance of continuous monitoring for the conservation of this vulnerable marine habitat. The observed among-sites differences offer valuable input for future management and protection strategies within the Capo Milazzo Marine Protected Area.

S. FARINA[1], F. PINNA[1], R. VARGIU[1], P. MASUCCI[2], M. SIMEONE[2]

[1]Dipartimento di Ecologia Marina Integrata (EMI), Stazione Zoologica Anton Dohrn, Istituto Nazionale di Biologia, Ecologia e Biotecnologie Marine, Genova Marine Centre, Italia.
[2]AMP Parco Sommerso di Gaiola, Napoli, Italia.
m.simeone@areamarinaprotettagaiola.it

PROGETTO URCHIN: VALUTAZIONE QUANTITATIVA DELLA POPOLAZIONE DI *PARACENTROTUS LIVIDUS* (LAMARCK, 1816) NELL'AREA MARINA PROTETTA PARCO SOMMERSO DI GAIOLA

Il Progetto URCHIN "Underwater Research Coralligenous Habitat In Naples", selezionato e finanziato dal MUR a valere sulle risorse del Piano Nazionale Ripresa e Resilienza (PNRR), nell'ambito del Programma di Ricerca "National Biodiversity Future Center" (NBFC - Spoke 8), è un progetto a cura dell'Area Marina Protetta (AMP) Parco Sommerso di Gaiola che ha come obiettivo generale il monitoraggio e lo studio dello stato di conservazione della ZSC IT8030041 "Fondali Marini di Gaiola e Nisida" attraverso l'analisi di 2 target principali: la biocenosi coralligena e il riccio di mare, da cui l'acronimo URCHIN. I due target di progetto sono stati identificati da un processo di analisi delle criticità e vulnerabilità ancora esistenti rispetto agli obiettivi di conservazione del Parco. In questo lavoro sono presentati i risultati preliminari delle indagini inerenti il secondo target progettuale. In particolare, sono state svolte analisi della dimensione e della struttura della popolazione di *Paracentrotus lividus* (Lamarck, 1816) e dell'abbondanza di *Arbacia lixula* (Linnaeus, 1758) in relazione ai diversi livelli di protezione dell'AMP, e nei settori costieri esterni a est e a ovest dell'AMP. In particolare, dalle prime indagini emerge un netto effetto riserva su *Paracentrotus lividus* con un'elevata densità di popolazione e classi di taglia maggiori nella Zona A del Parco, e un marcato gradiente in diminuzione verso l'esterno. Anche i dati acquisiti sulla comunità ittica mostrano come all'interno dell'AMP prevalga una predazione naturale (da parte delle famiglie Sparidae e Labridae), mentre all'esterno prevale il prelievo antropico. La valutazione dell'abbondanza della popolazione e della frazione adulta, nonché delle taglie giovanili e il monitoraggio della loro evoluzione nella stagione, in rapporto ai predatori naturali e alle attività di pesca spesso illegale ormai diffuse su tutte le coste italiane, rappresentano strumenti conoscitivi fondamentali per la pianificazione di misure gestionali adeguate alla conservazione degli ecosistemi bentonici superficiali.

P. GENNARO[1], S. LOMIRI[2], P. TOMMASETTI[2], S. DI MUCCIO[2], M.F. CINTI[3], L. PIAZZI[3]

[1]ISPRA, Livorno, Italia.
[2]ISPRA, Roma, Italia.
[3]CIBM, Livorno, Italia.
paola.gennaro@isprambiente.it

STRONG SEA LIFE: VALUTAZIONE DELL'IMPATTO E PRIORITÀ DI RIMOZIONE DEGLI ALDFG NELL'HABITAT CORALLIGENO

STRONG SEA (Survey and TReatment ON Ghost nets SEA) è un progetto finanziato dal programma Life Natura e Biodiversità con l'obiettivo di tutelare e migliorare lo stato di conservazione degli habitat *Posidonia oceanica* e coralligeno minacciati dagli ALDFG (Abandoned, Lost or otherwise Discarded Fishing Gears). L'impatto degli ALDFG sull'ambiente marino può essere importante, ma anche la loro rimozione può danneggiare gli habitat; qualunque intervento deve quindi essere valutato preventivamente. In questo quadro, lo sviluppo di strumenti di valutazione idonei risulta importante per una corretta gestione degli ALDFG. A tal fine è stato testato nell'ambito del progetto l'indice RAI (Removal Aid Index), riadattando la proposta originale sviluppata nel Ghost Med program per ampliare la risposta a una più ampia gamma di casistiche. L'indice si basa su 4 criteri (impatto ambientale e paesaggistico, rischio per la fruizione e difficoltà tecniche della rimozione), e viene calcolato assegnando un punteggio alle valutazioni che li quantificano. Sommando i punteggi si ottiene il valore dell'indice che varia su una scala numerica suddivisa in cinque livelli di priorità della rimozione: 1, fortemente raccomandata; 2, raccomandata; 3, altamente consigliata; 4, consigliata; 5, sconsigliata. L'indice è stato applicato su 6 reti segnalate sul coralligeno del nord Sardegna, tre localizzate entro 40 m di profondità e tre a profondità maggiore. Il monitoraggio è stato effettuato con immagini video ottenute mediante ROV per le reti profonde e operatori subacquei dotati di fotocamera per quelle più superficiali. I risultati hanno restituito valori di RAI che indicavano l'idoneità alla rimozione per tutte le reti. L'impiego di questa tecnica si è dimostrato uno strumento di supporto efficace per la gestione degli ALDFG. L'applicazione dell'indice RAI, infatti, consente di effettuare, in modo relativamente veloce e poco costoso, una valutazione sia dell'impatto degli ALDFG sia della priorità di rimozione.

B. MAGNANI[1], F. BETTI[2], M. CANESSA[1], F. ENRICHETTI[1,3], G. BAVESTRELLO[1,2,3]

[1]DISTAV, Università di Genova, Italia.
[2]Consorzio Nazionale Interuniversitario per le Scienze del Mare (CoNISMa), Roma, Italia.
[3]National Biodiversity Future Centre (NBFC), Palermo, Italia.
martina.canessa@edu.unige.it

CAMBIAMENTI NELLA STRUTTURA DI POPOLAZIONE DI *CORALLIUM RUBRUM* (L., 1758) NELL'AREA MARINA PROTETTA DI PORTOFINO SU SCALA PLURIDECENNALE

Il corallo rosso è tra le specie più emblematiche del coralligeno, biocostruzione endemica del Mediterraneo che caratterizza il circalitorale roccioso e le grotte semi-oscure. A causa di più di due millenni di pesca eccessiva e degli effetti legati al cambiamento climatico, è attualmente classificato come "in pericolo" dalla IUCN su scala regionale e italiana. Nell'Area Marina Protetta di Portofino esiste una serie storica inaugurata nel 1964, in cui furono raccolti dati di presenza/assenza e relative profondità minime delle colonie in 40 stazioni. Inoltre, vennero ottenute misure di densità e biomassa mediante prelievo di colonie su superfici standard; la raccolta dei dati quantitativi è stata replicata nel 1993 e nel 2012. Per valutare lo stato di conservazione della specie, nel 2024 è stata nuovamente censita la distribuzione di *Corallium rubrum* nelle 40 stazioni originali, mentre i dati quantitativi sono stati ricavati da 10 siti scelti randomicamente. Oggi la specie è stata ritrovata in tutte le stazioni in cui risultava presente nel 1964 con l'eccezione di una, nonché in 7 stazioni dove non era stata segnalata. Dopo 60 anni, la profondità minima media è rimasta pressoché invariata (circa 25 m). Dopo un periodo in cui la dimensione media delle colonie è progressivamente aumentata, portando la biomassa per m^2 da circa 300 a 1500 g, negli ultimi dieci anni questo parametro si è drasticamente ridotto decrescendo fino a circa 450 g, senza che la densità aumentasse. Benché il corallo appaia molto resiliente, le dimensioni delle colonie sembrano risentire di fattori ambientali non completamente chiariti: è stato recentemente proposto che in condizioni di stress le colonie possano autotomizzare gli apici. Inoltre, l'attività di pesca e l'involontario impatto dei subacquei possono causare la rottura dei rami. Infine, è rilevante che nell'ottobre 2018 la scogliera di Portofino sia stata colpita dalla più devastante mareggiata mai registrata.

A. MASTRANTONIO[1], A. ESPOSITO[1], E. CASOLI[1], M.F. GRAVINA[2], M. OLIVA[3], C. PRETTI[3,4], P. COLANGELO[5], D. VENTURA[1]

[1]Dipartimento di Biologia Ambientale, Sapienza Università di Roma, Italia.
[2]Dipartimento di Biologia, Università di Roma "Tor Vergata", Italia.
[3]Centro Interuniversitario di Biologia Marina ed Ecologia Applicata "G. Bacci" (CIBM), Livorno, Italia.
[4]Dipartimento di Scienze Veterinarie, Università di Pisa, Italia.
[5]Istituto di Ricerca sugli Ecosistemi Terrestri (IRET), Consiglio Nazionale delle Ricerche (CNR), Montelibretti (RM), Italia.
mastrantonio.1813615@studenti.uniroma1.it

EFFETTI DEL DISTURBO ANTROPICO SULLE POPOLAZIONI DI GRANCHIO BLU *CALLINECTES SAPIDUS* (CRUSTACEA: DECAPODA) IN TRE LAGHI COSTIERI: FOGLIANO, MONACI E CAPROLACE

Callinectes sapidus (Rathbun, 1896), comunemente noto come granchio blu, è una specie eurialina appartenente alla famiglia dei Portunidae, originaria dell'Oceano Atlantico occidentale. Dopo la sua prima segnalazione avvenuta sulle coste Atlantiche Francesi nei primi anni del 1900, attualmente è divenuta una specie ampiamente diffusa e in continua espansione nelle acque del Mar Mediterraneo, rappresentando un invasore di successo e una seria minaccia per l'intero ecosistema. Il presente studio è stato condotto nell'area del Parco Nazionale del Circeo, in particolare in tre laghi costieri: Lago di Fogliano, Lago dei Monaci e Lago di Caprolace. Mediante un approccio multidisciplinare basato su analisi morfologiche ed ecotossicologiche effettuate negli esemplari di *Callinectes sapidus* è stato possibile identificare i principali effetti del disturbo antropico su tale specie invasiva. I risultati hanno fornito un quadro preliminare sullo stato ecologico del granchio blu suggerendo che i tre laghi costieri sono soggetti a differenti gradi di contaminazione con conseguenti implicazioni dirette sulla biologia e salute della specie. In particolare, sia i valori stimati legati alla componente dell'asimmetria fluttuante, misurati a livello dei chelipedi, sia i biomarcatori impiegati per la valutazione dello stress ossidativo e della neurotossicità, hanno rivelato come nei due bacini maggiormente colpiti dalla presenza di contaminanti (Fogliano e Monaci), gli esemplari mostravano anomalie morfologiche e nei tessuti analizzati significativamente differenti rispetto al lago di Caprolace. Alla luce di tali dati si può quindi affermare che anche le specie aliene, sebbene tolleranti, resistenti e in grado di prosperare anche in ambienti altamente stressati, non sono immuni al disturbo antropico.

R. MIROGLIO[1], R. NUGNES[1], G. LASTRICO[1], P. SORO[1], V. PIAZZA[1], F. GARAVENTA[1,2], M. FAIMALI[1,2], C. GAMBARDELLA[1,2]

[1]Institute for the Study of Anthropic Impact and Sustainability in the Marine Environment (IAS), National Research Council (CNR), Genova, Italy.
[2]National Biodiversity Future Center (NBFC), Palermo, Italy.
roberta.miroglio@ias.cnr.it

TYRE WEAR PARTICLES THREATEN THE MEDITERRANEAN PLANKTONIC FOOD WEB

Tyre wear particles (TWP), generated by road traffic, represent a significant source of microplastics pollution. Every year, thousands of tonnes of TWP enter aquatic environments through road runoff events, leaching a potentially harmful mixture of chemicals (*i.e.* metals and organic compounds) that affect biodiversity and ecosystem functioning. In this study, we investigated the impact of TWP leachates using a multidisciplinary approach. Chemical analysis and ecotoxicological bioassays were conducted on Mediterranean species belonging to the first levels of the marine trophic web. Specifically, two phytoplanktonic species (*Isochrysis galbana, Chrysotila elongata*), the larval stage (nauplii) of the crustacean *Amphibalanus amphitrite* and the embryos of the echinoderm *Paracentrotus lividus* were exposed to different concentrations of TWP leachates to assess acute toxicity. The leachates were prepared by incubating 1 g/L of micronized (<250 µm) TWP in seawater for 72 hours. Naupliar immobility and behaviour, algal growth inhibition and sea urchin larval skeletal malformations were assessed after 48 and 72 hours, respectively. Several additives were identified in the TWP leachates, including rubber antioxidants, UV absorbers, plasticizers, preservatives, flame-retardants and fungicides. The ecotoxicological results show that TWP leachates negatively affected *C. elongata* and *I. galbana* algal growth, *A. amphitrite* naupliar behaviour, and *P. lividus* larval development. Overall, our findings highlight the harmful effects of TWP pollution on marine planktonic food web in coastal areas, emphasising the urgent need to reduce TWP emissions and limit the presence of those additives that could impact marine ecosystem health and therefore marine biodiversity.

C. MURANO[1,2], T. BENTIVOGLIO[3], S. ANSELMI[3], L. ROSELLI[4], I. DI CAPUA[4], M. RENZI[3,5], A. TERLIZZI[1,2,4]

[1]Department of Integrative Marine Ecology, Stazione Zoologica Anton Dohrn, Naples, Italy.
[2]National Biodiversity Future Center (NBFC), Palermo, Italy.
[3]Bioscience Research Center, Orbetello (GR), Italy.
[4]Department of Research Infrastructures for marine biological resources, Stazione Zoologica Anton Dohrn, Naples, Italy.
[5]Department of Life Sciences, University of Trieste, Italy.
carola.murano@szn.it

TRACKING SUB-MICRON AND NANOPARTICLE UPTAKE: THE ROLE OF EPIPELAGIC COMMUNITIES

Plastic pollution has become one of the most pressing environmental challenges, especially the smaller fractions known as microplastics (1 µm- 5mm) and nanoplastics (<1 µm). Nowadays, nanoplastic particles have not been extensively measured yet in the environment but there is increased concern that this size fraction of plastic may be more extensively distributed and hazardous than larger-sized particles. In this context, the aim of this study is to determine the biomagnification of nanoparticles and nanoplastics along the marine food chain, from phytoplankton and zooplankton communities to fish specimens such as *Engraulis encrasicolus* and *Scomber colias* in the Gulf of Naples. In order to obtain information on the potential accumulation pattern, a positive control case study was performed in which specimens of phytoplankton and zooplankton were exposed to fluorescent polystyrene nanoplastics (PS-NPs, 100 nm) at different concentrations 0.01, 0.2, 2, 5, 10 mg/L for 24h, under controlled laboratory conditions. Different approaches, including optical microscopy, fluorimetry, and Raman spectroscopy, were employed to detect the presence of PS-NPs in both phytoplankton and zooplankton organisms at all tested concentrations. Moreover, the results obtained revealed that the internalization rate is clearly dose-dependent and quite similar between phytoplankton and zooplankton communities. Notably, in natural samples no particles were detected in fish muscle or liver tissues, suggesting limited translocation. Unexpectedly, titanium oxide particles (<1 µm) were found in natural phytoplankton, highlighting the potential presence of other nanoparticles in marine systems. These findings suggest that, despite detection challenges, plankton communities are major biosensors of ENMs/NPs contamination and highlight the need for ongoing environmental monitoring to assess ecological impacts and potential risks of nanoparticle bioaccumulation in marine ecosystems.

J. PAZZAGLIA[1,2], A. ALAGNA[1,2], I. OLIVÉ[1], F. BLANCO-MURILLO[1], S. BRASSEUR[3], E. DATTOLO[1], I. PROVERA[1], A. RICCARDI[1], G. PROCACCINI[1,2]

[1]Stazione Zoologica Anton Dohrn, Napoli, Italy.
[2]National Biodiversity Future Center (NBFC), Palermo, Italy.
[3]Sorbonne University, Paris, France.
jessica.pazzaglia@szn.it

STRESS, MEMORY, AND RESILIENCE: DECODING *POSIDONIA OCEANICA*'S (L.) DELILE, 1813 RESPONSE TO CLIMATE CHANGE

Seagrasses, such as *Posidonia oceanica*, are highly vulnerable to climate change, facing extreme events like marine heatwaves and combined stressors, including changes in water quality. These plants are essential to coastal ecosystems, and understanding their response to multiple stressors is key to assessing their resilience. The present project is part of the National Biodiversity Future Center and investigates the stress responses of *P. oceanica* using multifactorial experiments conducted in mesocosm systems. These experiments simulate realistic environmental scenarios, exposing *P. oceanica* to dynamic marine heatwaves, reduced light levels (mimicking turbidity), and their combinations. The study also incorporates non-invasive methods, such as priming, to enhance stress tolerance in seeds and seedlings while exploring memory formation and maintenance. A multi-level assessment of plant performance was conducted, focusing on photo-physiological traits, transcriptomics, and epigenetics, to better understand the complex mechanisms that regulate stress responses and identify key regulatory factors. Initial results from experiments at the Stazione Zoologica Anton Dohrn (SZN) indicated that while temperature and light individually affected plant responses at various biological levels, the effects were more pronounced during the second heatwave exposure, even though it was less intense than the first. This suggests that *P. oceanica* can adapt to initial environmental changes but struggles with repeated exposure to fluctuating temperatures, leading to structural and functional alterations. Furthermore, the combination of multiple stressors induced antagonistic effects. These findings emphasize the need for further research on the complex interactions of multiple stressors, as *P. oceanica* responses vary. Ongoing transcriptomic and DNA methylation analyses, along with stress memory studies in younger individuals, will enhance our understanding of regulatory mechanisms that can identify stressful conditions in natural population, supporting seagrass conservation and restoration efforts.

S. REDOLFI BRISTOL[1], M. BOSCHIERO[1], C. FACCA[1], M. LANZONI[2], G. CASTALDELLI[2], M. ZUCCHETTA[3], P. FRANZOI[1]

[1]DAIS, Ca' Foscari University of Venice, Italy.
[2]DISAP, University of Ferrara, Italy.
[3]Institute of Polar Sciences (ISP), National Research Council (CNR), Mestre (VE), Italy.
s.redolfibristol@unive.it

FISH FAUNA OF THE PO DELTA LAGOONS BEFORE AND AFTER THE RAPID POPULATION INCREASE OF THE INVASIVE BLUE CRAB

Fish are widely used as indicators of environmental quality in aquatic ecosystems, including transitional waters. Fish fauna, as well as benthic fauna, may be impacted by invasive species, such as the blue crab *Callinected sapidus* Rathbun, 1896. *C. sapidus*, which is one of the most invasive species in the Mediterranean and has significant impacts on traditional fishing activities and local biodiversity, in 2023 and 2024 greatly increased its presence in the northern Adriatic, particularly in the Po Delta lagoons. The aim of this work was to analyze the nektonic fauna in the transitional water ecosystems of the Po Delta before and after the demographic explosion of the blue crab. Nektonic fauna was collected with a beach-seine net (2 mm mesh size) in the five most important lagoons of the Po Delta (Veneto Region): Caleri, Marinetta, Barbamarco, Canarin and Scardovari. Samplings were carried out in May–June and September–October in both 2021 and 2024, at 16 and 18 shallow water stations, respectively. Results highlighted a marked difference between lagoons and a high seasonality; however, differences between years in terms of environmental parameters were not evident, except for temperature and for stations located in Scardovari lagoon. Scardovari, especially in 2021, was the lagoon with the highest abundance and biomass of individuals. In general, except for Barbamarco, the densities of individuals sampled in 2024 were lower than those recorded in 2021 and were mainly attributable to the decline of marine migrant species. Even Decapoda, represented in 2021 mainly by *Crangon crangon*, decreased drastically in 2024. Conversely, in 2024, lagoon resident species were significantly more abundant than in 2021, especially due to *Atherina boyeri* and *Pomatoschistus marmoratus*. Fish fauna associated with transitional environments appears to be a good indicator for the study of the impact of blue crab.

F. SCARCELLI[1], A. PIRO[1], D. OLIVA[1], S. GRECO[2], S. MAZZUCA[1]

[1]Laboratorio di Biologia e Proteomica Vegetale, Dipartimento di Chimica e Tecnologie Chimiche, Università della Calabria, Rende (CS), Italia.
[2]Stazione Zoologica Anton Dohrn, Istituto Nazionale di Biologia Ecologia e Biotecnologie Marine, Centro Ricerche ed Infrastrutture Marine Avanzate in Calabria (CRIMAC), Amendolara (CS), Italia.
silvia.mazzuca@unical.it

RESILIENZA ALLE ONDATE DI CALORE IN *POSIDONIA OCEANICA*: RISPOSTE CONTRASTANTI TRA GENET DEL TIRRENO E DELLO IONIO CALABRESE

Lo studio ha esplorato la capacità di resilienza alle ondate di calore dei genotipi di *Posidonia oceanica* provenienti da due praterie, una situata lungo la costa tirrenica e l'altra lungo la costa ionica della regione Calabria, in Italia. In esperimenti in mesocosmo, le piante sono state sottoposte a ondate di calore simulate, replicando le attuali temperature più calde e lo scenario futuro più estremo previsto per il 2100, utilizzando la temperatura preindustriale come riferimento. L'inibizione della crescita fogliare, la diminuzione del contenuto di clorofilla e i tassi di mortalità sono risultati più marcati alle temperature più elevate, in particolare tra le piante della prateria ionica, dove il 50% degli individui è morto. L'analisi proteomica ha rivelato un aumento dell'espressione di proteine coinvolte nei metabolismi energetico, degli amminoacidi e dei carboidrati, accompagnato da una riduzione delle proteine associate al trasporto intracellulare e alla sintesi proteica, suggerendo una riallocazione delle risorse per rispondere allo stress. Il ruolo della ferredoxina nel potenziare la fotosintesi durante la fase di recupero e quello dell'istone H2B nella rimodellazione della cromatina basata sulla memoria per affrontare futuri stress sono emersi come elementi chiave nella resilienza termica. Le risposte inadeguate dei genotipi ionici alle temperature più elevate sono state principalmente attribuite alla maggiore vulnerabilità dei meristemi nei rami apicali e verticali. Le praterie ioniche risultano maggiormente sensibili alle ondate di calore, a causa del notevole impatto dei fattori locali e delle caratteristiche genetiche all'interno di queste popolazioni, che risultano geneticamente distinte da quelle del bacino tirrenico.

M. SPACCAVENTO[1], L.M. CAPUANO[1], A. CARLUCCIO[1,2], C. TURCO[1], F. CAPEZZUTO[1,2], P. MAIORANO[1,2]

[1]Dipartimento di Bioscienze, Biotecnologie e Ambiente, Università di Bari Aldo Moro, Italia.
[2]Consorzio Nazionale Interuniversitario per le Scienze del Mare (CoNISMa), Roma, Italia.
m.spaccavento6@phd.uniba.it

BIODIVERSITÁ DELLE COMUNITÀ DI CROSTACEI NEL MAR IONIO: CHE COSA È CAMBIATO NEL CORSO DI 30 ANNI?

La biodiversità del Mediterraneo è minacciata dall'effetto sinergico di differenti impatti antropici, tra cui cambiamenti climatici e overfishing che agiscono ai diversi livelli dell'ecosistema marino. I crostacei sono una componente dominante e diversificata delle comunità marine del Mediterraneo, anche sui fondali mobili tradizionalmente impattati dall'attività di pesca. I decapodi, in particolare, svolgono un ruolo ecologico chiave all'interno della rete trofica marina e molte specie rappresentano risorse commerciali importanti. Il presente studio ha come obiettivo la valutazione della diversità delle comunità di crostacei nel Mar Ionio e la loro eventuale variazione nel corso di trent'anni, anche in risposta alle principali forzanti antropiche. I dati analizzati sono stati raccolti annualmente, dal 1995 al 2023, nell'ambito del progetto MEDITS durante campagne di pesca a strascico sperimentale condotte all'interno della GSA 19 (Mar Ionio Nord-Occidentale). I campionamenti hanno coperto un ampio range batimetrico, compreso tra i 10 e gli 800 m. A partire dai dati standardizzati di densità e biomassa, gli indici di diversità ecologica (ricchezza specifica di Margalef, dominanza di Simpson, diversità di Shannon-Wiener e equitabilità di Pielou) e l'analisi multivariata sono stati utilizzati per valutare le variazioni nel tempo della struttura della comunità. Nell'intero intervallo temporale esplorato, sono stati identificati in totale 94 taxa di crostacei appartenenti agli ordini Decapoda e Stomatopoda. Le specie *Polycheles typhlops*, *Parapenaeus longirostris* e *Plesionika martia* sono state rinvenute con maggiore frequenza e *P. longirostris* è stata la specie più abbondante. La tendenza degli indici ecologici e l'analisi multivariata hanno mostrato variazioni temporali delle comunità a crostacei nell'area investigata e hanno evidenziato pattern differenti tra le comunità di piattaforma e di scarpata, a conferma del ruolo determinante che la profondità gioca nella caratterizzazione delle comunità demersali. Lo studio effettuato mediante la lunga serie temporale di dati ha consentito di tracciare la variabilità nel tempo nello stato delle comunità demersali del Mar Ionio.

C. TURCO, G. D'ONGHIA, G. GALASSO, L. SION, F. CAPEZZUTO

Dipartimento di Bioscienze, Biotecnologie e Ambiente, Università di Bari Aldo Moro, ULR CoNISMa, Italia.
cristina.turco@uniba.it

BIODIVERSITÀ "NASCOSTA": NUOVE SEGNALAZIONI NEL MAR IONIO SETTENTRIONALE ATTRAVERSO L'ANALISI DEI CONTENUTI STOMACALI

Questo studio riporta la prima segnalazione di *Lestidiops sphyrenoides* (Paralepidae) (Risso, 1820) e fornisce nuove evidenze della presenza della specie lessepsiana *Bregmaceros nectabanus* (Bregmacerotidae) Whitley, 1941 nel Mar Ionio settentrionale (Mediterraneo orientale). Entrambe le specie sono state rinvenute attraverso l'analisi dei contenuti stomacali di individui di nasello europeo (*Merluccius merluccius*) campionati durante campagne sperimentali di pesca a strascico nell'ambito del progetto MEDITS (International Bottom Trawl Survey in the Mediterranean). L'analisi della dieta del nasello ha permesso di identificare 11 individui di *L. sphyrenoides* in esemplari campionati tra 237 e 607 m di profondità tra il 2017 e il 2024, e 3 individui di *B. nectabanus* in naselli campionati nel 2024 a profondità comprese tra 48 e 66 m. Quest'ultimo ritrovamento conferma la presenza della specie nell'area, già segnalata per la prima volta nel 2021. Inoltre, a luglio 2024, altri 2 individui di *L. sphyrenoides* sono stati direttamente catturati in 2 stazioni di campionamento, a 352 m (Torre Ovo: 40.14309 °N; 17.23821 °E) e a 395 m di profondità (Porto Racale: 39.49526 °N; 17.47407 °E); tali esemplari sono stati identificati mediante caratteri morfologici e analisi degli otoliti. L'identificazione basata sugli otoliti si è dimostrata un metodo efficace per il riconoscimento delle prede nei contenuti gastrici, riducendo le difficoltà causate dai processi digestivi. Inoltre, l'elevata mobilità delle specie mesopelagiche e la probabile bassa densità delle specie non indigene, rendono difficile la loro cattura con metodi di prelievo tradizionali, limitando le informazioni sulla loro abbondanza e distribuzione. In questo contesto, l'analisi del contenuto stomacale si conferma un approccio indiretto, ma efficace per migliorare la conoscenza della biodiversità marina. I risultati ottenuti evidenziano la presenza di *L. sphyrenoides* e *B. nectabanus* nella rete trofica degli ecosistemi del Mar Ionio e sottolineano l'importanza dell'integrazione di metodologie complementari per monitorare in modo più accurato la distribuzione delle specie.

TEMA 3
AMBIENTI ESTREMI COME LABORATORI NATURALI

RELAZIONE INTRODUTTIVA

A. PUSCEDDU

Department of Life and Environmental Sciences, University of Cagliari, Italy.
apusceddu@unica.it

EXTREME LABS IN THE FIELD: FROZEN ELEVATORS, ANOXIC METAZOAN LIFE, HIGH-VARIANCE TRANSITIONAL ENVIRONMENTS

The change in space and time of environmental conditions toward the extremes of the natural variability range has exposed life to multiple forms of adaptation and selection. For this reason, the present biosphere includes many conditions that can be placed at the extremes of the natural variability ranges for most physicochemical variables. Currently, temperature, oxygen concentration and pH values in the oceans represent, along with salinity, the variables of greatest interest in the context of global change and warming. In addition, current climate change is exposing ecosystems naturally characterized by extreme conditions or by extreme natural variability of physicochemical characteristics, such as ecotonal aquatic environments (particularly coastal lagoons), to an exacerbation of such variability, caused by climate-driven anomalous events like marine heat waves. Here, I will draw from my past experiences studying in the Antarctic annual sea ice, the anoxic and hyperhaline basins of the Mediterranean, the summer mucilage in the Adriatic, and Mediterranean coastal lagoons, to highlight how the study of extreme environments has allowed not only the ecological and evolutionary interpretation of life adaptations to these environments but also to identify process convergences in seemingly very different "extreme" environments and to predict possible future responses to climate change.

COMUNICAZIONI

A. AZZOLA[1,2], C.N. BIANCHI[3], C. MORRI[3], M. MONTEFALCONE[1,2]

[1]Department of Earth, Environment and Life Sciences (DiSTAV), University of Genoa, Italy.
[2]National Biodiversity Future Center (NBFC), Palermo, Italy.
[3]Genoa Marine Center, Stazione Zoologica Anton Dohrn, Genova, Italy.
annalisa.azzola@gmail.com

THE BIOLOGICAL COMMUNITIES OF AN EXTREME ENVIRONMENT: THE BLUE HOLE OF FAANU MUDUGAU, MALDIVES

Blue holes are underwater voids in carbonate banks formed by karstic processes. They are circular, with steep walls, and contain marine, fresh, or mixed-chemistry waters. These ecosystems are generally characterised by extreme conditions, such as anoxia and high concentrations of hydrogen sulphide. Knowledge about them mainly concerns speleogenic and microbiological aspects, more rarely benthic communities. The Faanu Mudugau Blue Hole (Maldives) opens on a seafloor at 30 m depth, with an entrance of 70 m diameter, descending to 85 m depth. The water composition varies along the depth, with a transition zone between 40 and 50 m, where temperature, salinity and pH change significantly. Below 50 m depth, oxygen concentration collapses, while hydrogen sulphide increases. This work provides a first characterisation of the benthic communities of the Faanu Mudugau Blue Hole along its rocky walls. Data were collected in 2019 along two vertical transects from 30 m to 75 m by taking three photographs (of 24×36 cm²) every 5 m depth. Each photoquadrat was analysed to calculate the percent cover of any organism present at the lowest possible taxonomic level and a Corrispondence Analysis (CA) was applied to analyse benthic communities according to the depth. Three depth-related zones with different communities can be recognised: i) a photic zone between 30 m and 40 m depth, with a diverse benthic community dominated by encrusting algae, Porifera and scleractinian corals; ii) a mesophotic zone at 45 m, dominated by mats of Chrysophyceae and Cyanobacteria; and iii) an aphotic zone below 50 m depth, where the community is characterised by chemosynthetic bacteria of the phyla Chloroflexota, Proteobacteria and Desulfobacterota. Blue holes can be seen as natural laboratories that allow for the study of extreme environments. Further investigations on the Faanu Mudugau Blue Hole are worthy to better understand the functioning of this peculiar ecosystem.

F. BOLINESI[1], E. SERINO[1], L.M. CAMPOLI[1,2], M. SAGGIOMO[3], O. MANGONI[1]

[1]Department of Biology, University of Naples Federico II, Italy.
[2]Department of Environmental Sciences, Informatics and Statistics, Ca' Foscari University of Venice, Italy.
[3]Department of Research Infrastructures for marine biological resources, Stazione Zoologica Anton Dohrn, Naples, Italy.
francesco.bolinesi@unina.it

TEMPORAL EVOLUTION OF PHYTOPLANKTON FUNCTIONAL TRAITS AT THE INTERFACE BETWEEN LAND FAST-ICE AND ROSS SEA WATERS IN TERRA NOVA BAY (ANTARCTICA)

The land fast-ice is considered to be the most productive sea-ice subsystem in Antarctica, thanks to the presence of a thick, porous layer generated by the accumulation and consolidation of large flakes of ice, where high nutrient and light availability allow the growth and accumulation of huge amount of sympagic microalgae. A large part of them is represented by diatoms (Bacillariophyceae) with the dominance of pennate-benthic species in interstitial spaces, and centric diatoms in the platelet-ice where is higher the contribution of planktonic species. With the rising of temperature, the ice-melt processes release in the water large amount of sympagic diatoms and contribute to stabilizing the water column thanks to freshwater inputs, favoring also the proliferation of planktonic species. However, in recent years changes in the phytoplankton community successions and trophodynamics have been reported in Ross Sea waters by several authors as consequence of the ongoing climate change. The present communication is focused on the description of temporal evolution of microalgal communities associated to land-fast ice in Terra Nova Bay, addressing ecological aspects related to changes in functional-traits during the melting season between late spring and early summer 2015/2016. The research is part of the CEFA project "Coastal Ecosystem Functioning in a changing Antarctic Ocean" - Programma Nazionale di Ricerca in Antartide (PNRA). Our results indicate a high variability in the first meters of the water column below the land fast-ice contrarily to what observed for deeper layer, with the net dominance of diatoms over the time.

C. DELLA TORRE[1,2], S.G. SIGNORINI[1,2], I. D'ANIELLO[3], I. MORO[2,3], F. CROCETTA[2], L. NIGRO[1], A. COLLETTI[4], P. STIPCICH[4], R. DANOVARO[5,6], A. CANNAVACCIUOLO[2,6], R. BERNARDI MALAGUGINI[3], V. CORREALE[3], C. KNIGHT[7], F. MICHELI[7], A. MICCIO[8], V. MATOZZO[3], M. MUNARI[2,3]

[1]Dipartimento di Bioscienze, Università di Milano, Italia.
[2]Dipartimento di Ecologia Marina Integrata, Stazione Zoologica Anton Dohrn, Napoli, Italia.
[3]Dipartimento di Biologia, Università di Padova, Italia.
[4]Dipartimento di Biologia, Università di Napoli Federico II, Italia.
[5]National Biodiversity Future Center (NBFC), Palermo, Italia.
[6]Dipartimento di Scienze della Vita e dell'Ambiente, Università Politecnica delle Marche, Ancona, Italia.
[7]Hopkins Marine Station, Oceans Department, Stanford University, Pacific Grove, CA, United States.
[8]Area Marina Protetta "Regno di Nettuno", Ischia (NA), Italia.
camilla.dellatorre@unimi.it

RISPOSTE ADATTATIVE DI INVERTEBRATI MARINI AGLI AMBIENTI ACIDIFICATI

L'acidificazione degli oceani (OA), causata dall'assorbimento di anidride carbonica di origine antropica, riduce il pH e determina profondi cambiamenti ecologici. Oltre agli effetti fisiologici diretti, le caratteristiche di un habitat acidificato svolgono un ruolo cruciale nel modulare le risposte degli organismi. Sebbene gli esperimenti di laboratorio offrano un quadro controllato, le sorgenti naturali di CO_2 rappresentano un'opportunità unica per studiare gli effetti a lungo termine dell'OA in condizioni complesse e reali. Nei sistemi di emissione di CO_2 dell'Isola d'Ischia, il riccio di mare *Arbacia lixula* (Linnaeus, 1758) e la patella *Patella caerulea* (Linnaeus, 1758) hanno mostrato risposte adattative diversificate, che coinvolgono adattamento genetico, modifica delle funzioni fisiologiche e metaboliche e interazioni ecologiche. *Arbacia lixula* ha evidenziato variazioni nei tassi metabolici e nei comportamenti di *sheltering*, influenzati sia dall'OA che dalle caratteristiche dell'habitat. *Patella caerulea*, nonostante l'erosione del guscio, ha mostrato un aumento delle dimensioni legato alla disponibilità di risorse alimentari, insieme a variazioni metaboliche stagionali. In questa specie è emerso anche un marcato grado di differenziazione genetica tra la popolazione del sito più acidificato, rispetto a quella a pH ambientale. Questi risultati sottolineano la complessità degli impatti dell'OA, evidenziando come l'interazione tra condizioni ambientali e meccanismi biologici plasmi la resilienza degli organismi marini negli habitat acidificati.

M. MUTALIPASSI[1,2], F. CROCETTA[1,2], C. GALASSO[3], D. COPPOLA[4], D. DE PASCALE[4], A. TERLIZZI[1,2,5], L. CIAVATTA[6], E. MOLLO[6], M. CARBONE[6]

[1]Department of Integrative Marine Ecology, Stazione Zoologica Anton Dohrn, Napoli, Italy.
[2]National Biodiversity Future Center (NBFC), Palermo, Italy.
[3]Department of Ecosustainable Marine Biotechnology, Calabria Marine Centre CRIMAC, Stazione Zoologica Anton Dohrn, Amendolara (CS), Italy.
[4]Department of Ecosustainable Marine Biotechnology, Stazione Zoologica Anton Dohrn, Naples, Italy.
[5]Department of Life Sciences, University of Trieste, Italy.
[6]Institute of Biomolecular Chemistry (ICB), National Research Council (CNR), Pozzuoli (NA), Italy.
mirko.mutalipassi@szn.it

ALIEN METABOLITES IN PHLEGREAN LAGOONS: THE DEFENSIVE SECRETION OF THE NON-INDIGENOUS MOLLUSK *HALOA JAPONICA*

Coastal ecosystems face significant ecological shifts with alien species introductions, a process exacerbated by invaders' unique "chemical arsenals" unfamiliar to native species. In this study, we focused on *Haloa japonica* (Pilsbry, 1895), a non-indigenous cephalaspidean species recorded in the Phlegraean lagoons (central Tyrrhenian Sea), where it coexists with closely related native species. Analysis of the mucus secreted by disturbed mollusks showed the presence of a main metabolite, which was detected in the mantle tissue, but undetectable in the viscera, suggesting it is not derived from diet. The compound was subsequently structurally characterized as a novel polypropionate. Its discovery in *H. japonica* adds a new element to the chemical picture of cephalaspideans. The metabolite distribution in the mollusk's external parts suggested its involvement in chemical defense. To test this hypothesis, the compound was evaluated for its palatability to the co-occurring generalist shrimp *Palaemon elegans* Rathke, 1836. Shrimp exhibited a dose-dependent rejection response, supporting the defensive role of the mollusk's mucus. This finding distinguishes *H. japonica* from related native species within the family Haminoeidae, which are known to defend themselves using alarm pheromones for intraspecific-communication. In parallel, given that the defensive-compounds of marine organisms often prove to be of interest for potential applications in the pharmaceutical sector, we tested the purified compound for its cytotoxic or anti-inflammatory properties, revealing no cytotoxicity (on human fibroblasts) but a pro-inflammatory response (on LPS-stimulated THP-1 derived macrophages) at µM concentrations. Overall, this study provides new insights into biological invasions, identifying a chemical factor that may have played a role in *H. japonica* worldwide invasion success, while also opening avenues for the potential exploitation of the compound for therapeutic applications. From this latter perspective, the discovery of a bioactive metabolite in a non-indigenous species offers an intriguing opportunity to transform an ecological threat into a resource.

G. NAPOLITANO[1], G. FASCIOLO[2], A. PETITO[2], E. GEREMIA[1], P. VENDITTI[2], G.F. RUSSO[1,3], M.C. GAMBI[4,5], L. DONNARUMMA[1,3]

[1]Department of Science and Technology, Parthenope University of Naples, International PhD Programme, UNESCO Chair "Environment, Resources and Sustainable Development", Naples, Italy.
[2]Department of Biology, University of Naples Federico II, Italy.
[3]National Inter-University Consortium for Marine Sciences (CoNISMa), URL-Centro Direzionale, Naples, Italy.
[4]National Institute of Oceanography and Applied Geophysics (OGS), Trieste, Italy.
[5]Soc. Coop. *Hesperia Terrae*, Ischia (NA), Italy.
gaetana.napolitano@uniparthenope.it

PATELLA SPP. (MOLLUSCA, GASTROPODA) OXIDATIVE METABOLISM ADAPTATION UNDER OCEAN ACIDIFICATION CONDITIONS AT CO_2 VENTS (ISCHIA ISLAND, ITALY)

Anthropogenic ocean acidification (OA) generates extreme conditions that challenge the survival and adaptation of marine organisms. Still little information is available on mechanisms underlying adaptive strategies involving redox homeostasis and metabolism under OA. Natural CO_2 vents, such as those of the Castello at Ischia Island, represent natural laboratories to study the effects of OA on benthic biota. Limpets (*Patella* spp.) occur in the Castello vents even in the most acidified conditions, thus a study on their adaptive strategy has been conducted evaluating biomarkers related to the redox response (reactive oxygen species content [ROS]; oxidative damage to lipids [HPs] and proteins [CO]; susceptibility to oxidants [ΔHPs]; total antioxidant capacity [TAC]), metabolism (electron transport chain functionality [ETC]; cytochrome oxidase activity [COX]) and neurotransmission (Acetylcholinesterase activity [AChE]). Limpets were sampled in two Castello vents areas (S3 and N3, pH 7.0- 7.7, respectively) and two control areas (SP and CS, pH 8.0-8.1, respectively). Limpets from all sites showed the same ROS content with different redox responses. HPs and CO showed the highest values in both N3 and S3. Under acidified conditions, N3 limpets exhibited higher TAC and lower ΔHPs, suggesting an adaptive redox response at this site compared to S3. Interestingly, at the control sites, ΔHPs was higher and TAC was lower in SC than in SP, indicating a possible interaction of SC limpets with acidified sites. The ETC analysis highlighted the lowest values in the Complex I activity of limpets from the N3 and S3 vents sites and the highest ones in the CS site. Although maximal aerobic capacity remained unchanged across all groups, as suggested by unaltered COX activity, results highlighted an effect of low pH on mitochondrial function. Our findings show that low pH shapes mitochondrial functionality and redox homeostasis without altering neurotransmission, as demonstrated by the unaltered AChE activity.

R. PIREDDA[1,2], L. ESCALERA[1,3], D. DE LUCA[4], O. MANGONI[5,6], F. BOLINESI[5,6], M. SAGGIOMO[1]

[1]Department of Research Infrastructures for marine biological resources, Stazione Zoologica Anton Dohrn, Naples, Italy.
[2]National Biodiversity Future Center (NBFC), Palermo, Italy.
[3]Centro Oceanografico de Vigo (IEO-CSIC), Vigo (Pontevedra), Spain.
[4]Department of Humanities, Università degli Studi Suor Orsola Benincasa, Naples, Italy.
[5]Department of Biology, University of Naples Federico II, Italy.
[6]National Inter-University Consortium for Marine Sciences (CoNISMa), Rome, Italy.
maria.saggiomo@szn.it

A SNAPSHOT FROM TERRA NOVA BAY DURING ANTARCTIC SUMMER

The Ross Sea is one of the most productive regions in the Southern Ocean, characterized by marked seasonal and regional variability in primary productivity and carbon export processes driven by sea ice dynamics (formation/melting) and water column change. Protists communities have been explored using metabarcoding of 18S V4 region and morphology during an austral summer at two coastal Antarctic sites Santa Maria Novella (SMN) and Portofino (PTF) located in the Terra Nova Bay. The two stations, part of the Long-Term Ecological Research (LTER) Italian stations in the Antarctic Specially Protected Areas, were sampled on the 21st (T1) and 31th (T2) of January 2018 at 0 and 10 m depth. Metabarcoding dataset was dominated by *Alveolata* that were overestimated in comparison with the morphological approach, due to their high copy number of 18S rDNA gene. *Bacillariophyta* was the second most abundant group with *Fragilariopsis*, *Hemiaulus* and *Pseudo-nitzschia* as dominant genera. Within *Phaeocystis* genus, most of the reads were assigned to *Phaeocystis antarctica* but less of 2% showed more similarity with *Phaeocystis jahnii*. Multivariate analyses highlighted significant higher values of alpha diversity at T1 and a clear temporal shift of assemblages, whereas samples did not significantly differ at spatial level (PTF vs SMN) or for depth (0m vs 10m). Indicator Value index (IndVal) identified taxa that characterized temporal shift, revealing *Mamiellophyceae* (Crustomastix Mantoniella and Micromonas polaris), *Pyramimonadales* (*Pterosperma*) and *Choanoflagellatea* (*Diaphanoeca undulata and Acanthocorbis unguiculata*) characteristic at T1, whereas parasitic *Syndiniales*, showed the similar temporal distribution. In addition, SiO2 and PO4 showed significant association with communities shift. Overall, this study confirmed the ability of environmental DNA (eDNA) to provide a detailed description of microbial communities. Moreover, we highlighted the capability of protists assemblages of rapid shift in responses to environmental changes supporting their importance to trace anthropic pressures in the Antarctic region.

A. PIRO, V. OSSO, D. OLIVA, D.M. NISTICÒ, F. SCARCELLI, S. MAZZUCA

Laboratorio di Biologia e Proteomica Vegetale, Dipartimento di Chimica e Tecnologie Chimiche, Università della Calabria, Rende (CS), Italia.
amalia.piro@unical.it

ADATTAMENTI FISIOLOGICI E BIOCHIMICI DI *POSIDONIA OCEANICA* E *CYMODOCEA NODOSA* AI VENTS DI CO_2

Le sorgenti vulcaniche di Ischia, Panarea e Vulcano (Italia) offrono un'opportunità per studiare l'acidificazione degli oceani. Campioni di *Posidonia oceanica* e *Cymodocea nodosa* sono stati raccolti in questi ambienti e confrontati con popolazioni cresciute in condizioni di pH normale (pH 8,2). I risultati mostrano che *P. oceanica* sviluppa adattamenti metabolici significativi in risposta all'acidificazione. A pH intermedio, si osserva un aumento della sintesi di proteine e acidi grassi, mentre il metabolismo dei carboidrati è ridotto, suggerendo che l'aumento di CO_2 non favorisca direttamente la fissazione del carbonio. Le piante esposte a livelli elevati di CO_2 mostrano una maggiore attività della RuBisCO e un rapido trasporto del glucosio come saccarosio. L'acidificazione influisce anche sul turnover proteico, il citoscheletro e il catabolismo dell'arginina, segnalando un tentativo di ottimizzare risorse e risposta allo stress. La fotorespirazione è ridotta, migliorando l'efficienza della fissazione del carbonio. Per *C. nodosa*, l'analisi proteomica ha rivelato una riduzione delle proteine totali nei tessuti acidificati e un impoverimento delle proteine coinvolte nel metabolismo del carbonio e nella sintesi proteica. Tuttavia, si registra un aumento delle proteine associate alla respirazione cellulare e al processo di raccolta della luce, indicando un adattamento metabolico per compensare lo stress. Il citoscheletro è compromesso, con una riduzione delle proteine strutturali. Sono state osservate modificazioni epigenetiche e un aumento del trasporto dell'auxina, suggerendo adattamenti morfogenetici a lungo termine, sebbene la risposta allo stress osmotico risulti compromessa. Complessivamente, le *seagrasses* non traggono un beneficio diretto dall'aumento di CO_2. La loro capacità di adattarsi sembra dipendere da altri fattori ambientali, come la disponibilità di nutrienti, che potrebbe rappresentare il principale limite nei siti acidificati.

R. VIRGILI[1,2,3], V. TANDUO[1], S. D'ANIELLO[4], A. FONTANA[2,5], X. TURON[6], F. CROCETTA[1,3]

[1]Department of Integrative Marine Ecology, Stazione Zoologica Anton Dohrn, Napoli, Italy.
[2]Department of Biology, University of Naples Federico II, Italy.
[3]National Biodiversity Future Center (NBFC), Palermo, Italy.
[4]Department of Biology and Evolution of Marine Organisms, Stazione Zoologica Anton Dohrn, Napoli, Italy.
[5]Bio-Organic Chemistry Unit, Institute of Biomolecular Chemistry, National Research Council, Napoli, Italy.
[6]Department of Marine Ecology, Centre d'Estudis Avançats de Blanes (CEAB-CSIC), Blanes, Spain.
riccardo.virgili@szn.it

FAVOURABLE TO MANY, EXTREME FOR OTHERS: THE BIZARRE SURVIVAL STRATEGY OF A NEW SPECIES OF *HETEROSTIGMA* ÄRNBÄCK-CHRISTIE-LINDE, 1924 (ASCIDIACEA: STOLIDOBRANCHIA: PYURIDAE)

Soft bottoms are ecologically important habitats, hosting thriving and diverse benthic communities. However, inhabiting these environments also presents complex challenges for some groups of sessile filter feeders, as excessive turbulence and sedimentation may negatively affect their presence and survival. Ascidians are one of these groups, as they usually prefer to live on hard substrates or to attach to heavy objects. However, a small group of mesopsammic species has evolved specific traits for an interstitial lifestyle, representing a unique, but still understudied, case of tunicate adaptation to soft habitats. In this contribution, we present a new species of *Heterostigma* Ärnbäck-Christie-Linde, 1924 (Ascidiacea: Stolidobranchia: Pyuridae) from the littoral soft-bottoms of the highly anthropised metropolitan city of Naples (central Tyrrhenian Sea). An integrative approach was used to characterise the species. Morphological analyses on the newly collected specimens and the type materials of closely related taxa allowed to update the taxonomy of the genus. Molecular phylogenetic analyses on single markers and complete mitochondrial genomes were used to reconstruct the phylogenetic position of this lineage within stolidobranch ascidians. Finally, novel findings on morphological and behavioural changes of this species were discussed. In fact, *Heterostigma* was observed to displace itself through rhythmic contractions of the siphons, a mechanism known to occur only in fully interstitial species. Moreover, our findings show the capability of this species to shift from a sessile to a motile phase, a change which was previously undocumented in ascidians. This process appears as an extreme adaptation strategy to survive in unstable habitats, albeit the inducing factors are still unclear. Present results question the assumptions on this group and expand the knowledge on how sessile tunicates adapt and survive in unfavourable substrates.

V. ZAMMUTO[1,2], A. MACRÌ[1,2], C. GUGLIANDOLO[1,2]

THE MARINE POLYEXTREMOPHILIC *BACILLUS HORNECKIAE* SBP3: ADAPTATIVE STRATEGIES AND BIOTECHNOLOGICAL POTENTIALITIES

[1]Department of Chemical, Biological, Pharmaceutical and Environmental Sciences, University of Messina, Italy.
[2]Research Centre for Extreme Environments and Extremophiles, Department of Chemical, Biological, Pharmaceutical and Environmental Sciences, University of Messina, Italy.
vzammuto@unime.it

Polyextremophilic bacteria from shallow hydrothermal vents of the Eolian Islands (Italy) are ideal candidates to experimentally address questions either to extend our knowledge on the resistance strategies under extreme environmental conditions (low pH, high temperatures, high concentrations of CO_2, H_2S, heavy metals, and hydrocarbons) and to prospect their use for biotechnological purposes. *Bacillus horneckiae* SBP3 (DSM103063), isolated from a vent named Black Point (130°C, pH 3.3) off Panarea Is., was reported as highly resistant to environmental and artificial stressors, also mimicking space conditions (*e.g.*, UV and X-rays radiations, heavy metal ions, vacuum and oxidizing agents). Other than to form spores as resistant forms, it may produce different exopolymers (*e.g.*, exopolysaccharides and lipopeptides) with unique chemical properties and related activities to protect cells *in situ* by binding compounds released from the emissions, improving their solubility and availability or reducing their toxicity. The biosurfactant from SBP3, a surfactin-like lipopeptide with specific mineral-, castor-, and crude- oil removal ability, may be proposed for different industrial applications as a green detergent in household and personal care, antimicrobial and antiadhesive agents, and for oil recovery and remediation purposes. Furthermore, as adsorbent of heavy metals, the surfactine-like biosurfactant could be considered as a candidate material to simultaneously remediate and counteract the toxic effects of arsenic, mercury, and vanadium. Moreover, due to their hydrating properties, SBP3 biopolymers might replace industrially manufactured wetting agents in agriculture, food, and cosmetic industries. With ongoing research on its properties and its related biological activities, biopolymers from SBP3 could be useful in responding to the increasing demand for novel bioproducts in different applications.

POSTER

F. CARDONE[1,2], M. LÓPEZ CORREA[3], A. PALUMBO[1,4], J. RADDATZ[5], A. ROMANO[1,4], T. HANSTEEN[6]

[1]Integrative Marine Ecology Department, Stazione Zoologica Anton Dohrn, Naples, Italy.
[2]National Biodiversity Future Center (NBFC), Palermo, Italy.
[3]GeoZentrum Nordbayern (GZN), Universität Erlangen, Erlangen, Germany.
[4]Department of Biology, University of Naples Federico II, Italy.
[5]Institute of Geosciences, Goethe University, Frankfurt am Main, Germany.
[6]GEOMAR, Kiel, Germany.
frine.cardone@szn.it

DEEP-SEA SPONGE COMMUNITIES OF CAPE VERDE'S SUBMARINE VOLCANOES

During RV-Meteor cruise M80/3, Cape Verde's submarine volcanoes were explored with ROV QUEST6000 to document volcanic rocks and associated cold-water coral and sponge communities. Our work focuses on creating an inventory of common sponges and describing rare species. Samples were collected from 767 to 3753 m, where temperature decreased from 7.2 to 2.9 °C and salinity from 34.99 to 34.86 g/kg. Volcanic rock escarpments with fresh mafic rocks were the most common substrates, supporting encrusting sponges. Pleistocene to recent cold-water coral skeletons littered the volcanic flanks, while siliciclastic sediments were scarce. Sponge macrofauna was dominated by Hexactinellidae, mainly Hexasterophora. *Aphrocallistes beatrix* was common in fossil *Desmophyllum pertusum* grounds at 767-900 m. Several Cladorhizidae and small hexactinellid sponges were found within *Hertwigia falcifera* at 1403 m. At 950 m on Cabo Verde Seamount, the hexactinellid sponge *Sarostegia oculata* hosted numerous polychaetes inside axial cavities. Its atrial cavities were sealed by a parchment containing planktonic foraminifera, which provided settlement sites for zoanthids. We further investigate endolithic sponges through their spicules and tissues embedded in calcitic (e.g., *Keratoisis*) and aragonitic (e.g., *D. pertusum*) cold-water corals. Their trace morphology, analyzed via vacuum epoxy cast embedding and SEM, reveals a rich ichnocoenosis dominated by fungal traces and bioeroding sponges.

A. ELEFANTE[1,2], L. APPOLLONI[3], R. MUSSAT SARTOR[4], P. POVERO[5], L. DONNARUMMA[2], R. SANDULLI[2]

[1]Department of Environmental Sciences, Informatics and Statistics, Ca' Foscari University of Venice, Italy.
[2]Department of Sciences and Tecnology, University of Naples Parthenope, URL CoNISMa, Italy.
[3]Division of Protection and Enhancement of the territory and the Natural Capital, Marine Environment Research Centre, ENEA, Lerici (SP), Italy.
[4]Department of Life Sciences and Systems Biology, University of Turin, Italy.
[5]Department of Earth, Environmental and Life Sciences, University of Genoa, Italy.
956897@stud.unive.it

BENTHIC COMMUNITY STRUCTURE IN THE SHALLOW COASTAL OF TERRA NOVA BAY, ANTARCTICA (ROSS SEA)

Antarctica, an extreme continent with low temperatures, ice, and limited light and nutrients, serves as a natural laboratory for studying marine organisms' adaptations, especially benthic ones, which are key biological indicators of environmental health. This study investigates the distribution of benthic *taxa* on hard and soft substrates in Terra Nova Bay (Ross Sea). During the XXXVII Italian Antarctic expedition of the "National Program of Antarctic Research" (PNRA), in the austral summer 2021/2022, macrobenthic organisms were sampled in 4 sites using an air-suction pump at about 15 m depth. In each site, the hard and soft substrates were collected three times, using a frame of 40x40cm. A total of 21.538 organisms were found belonging to the following *taxa*: gastropods (47.57%), tanaids (23.73%), amphipods (11.82%), isopods (8.58%), polychaetes (7.78%) and bivalves (0.52%). The hard substrate is dominated by gastropods (50%) and tanaids (28%), gastropods beside are also dominant on the soft substrate (34%), together with polychaetes (30%). A focus on gastropods reveals their dominance on algal turf, characterized by red algae *Iridaea cordata* (Turner) Bory and *Phyllophora antarctica* A. Gepp & E.S. Gepp of hard substrate. The most abundant gastropod species is *Laevilitorina antarctica* (E.A. Smith, 1902), which can be considered an important grazer on different algal species in Antarctic shallow coastal ecosystem. The linear regression analysis revealed a strong positive relationship between *Laevilitorina* density and algal biomass, with R^2=0.69 (F=48.77, p<0.0001), suggesting that approximately 68.9% of gastropod variance is explained by algal turf. This study contributes to a deeper understanding of the complex interactions in extreme environments, providing valuable insights for future ecological monitoring and conservation efforts in Antarctica.

M.C. GAMBI[1,2], C. IACONO[3], A. MICCIO[3], V. ESPOSITO[1,4], G. PROCACCINI[5], L. MARIN-GUIRAO[6]

[1]National Institute of Oceanography and Applied Geophysics (OGS), Trieste, Italy.
[2]Coop. *Hesperia Terrae*, Ischia (NA), Italy.
[3]MPA Regno di Nettuno, Ischia (NA), Italy.
[4]National Biodiversity Future Center (NBFC), Palermo, Italy.
[5]Stazione Zoologica A. Dohrn, Napoli, Italy.
[6]Spanish Institute of Oceanography, Murcia, Spain.
mgambi@ogs.it

POSIDONIA BONSAI: NEW DATA AND INSIGHTS ON OCCURRENCE OF DWARF *POSIDONIA OCEANICA* SHOOTS IN CO_2 VENTS AND NO VENTS AREAS, AND THEIR ROLE AS A RAPID COLONIZATION GROWTH STRATEGY

Dwarf, miniaturized *Posidonia oceanica* (L.) Delile shoots, defined as "Posidonia bonsai", were first described in four hydrothermal vents off the island of Panarea in 2021. Their reduced size and other phenological features have been related to the unique water conditions in these vent systems, characterized by CO_2 and H_2S emissions. Here we report new data and insights on the occurrence of "bonsai" shoots in additional CO_2 vent systems off the island of Ischia (Castello North and South sides, Vullatura) and, for the first time, in normal pH zones at Ischia (Castiglione) and Ustica (Cala Galera, San Paolo) islands in the Tyrrhenian Sea (Italy). At Ustica, *Posidonia* bonsai shoots collected in August 2024 were found at 7-14 m, exclusively on rocky bottoms. At Ischia, bonsai shoots collected in September 2024 at 2-6 m depth, were present both on the vents and in a control area, settled on the dead *Posidonia* matte. All bonsai shoots analyzed exhibited a reduced number of leaves (1-4) with significantly shorter leaf length (mean 7-8 cm) and width (0.5-0.7 cm) respect to normal shoots, resulting in an overall reduction of leaf surface area (84-96% lower) and leaf biomass (82-97% lower) when compared to regular-sized shoots from the same sites. As previously observed in Panarea, the dwarf Posidonia shoots at Ischia and Ustica also lacked the typical lepidochronological seasonal cycle of leaf sheaths found in normal shoots. The high number of sheaths recorded per rhizome length suggests a high leaf turnover and fast growth. While the occurrence of bonsai shoots on dead matte at the meadow's margin or behind regular terminal shoots on creeping rhizomes in rocky substrates, leads to hypothesize that *Posidonia* bonsai may represent a rapid colonization strategy under stressful conditions, and point out the remarkable phenotypic plasticity of this seagrass.

A. MACRÌ[1,2], V. ZAMMUTO[1,2], A. SPANÒ[1,2], M.T. CACCAMO[2,3], L.M. RUGGERI[4], M. MORABITO[1], S. MAGAZÙ[2,3], C. GUGLIANDOLO[1,2]

[1]Department of Chemical, Biological, Pharmaceutical and Environmental Sciences, University of Messina, Italy.
[2]Research Centre for Extreme Environments and Extremophiles, Department of Chemical, Biological, Pharmaceutical and Environmental Sciences, University of Messina, Italy.
[3]Department of Mathematical and Computer Sciences, Physical Sciences and Earth Sciences, University of Messina, Italy.
[4]Department of Engineering, University of Palermo, Italy.
angela.macri@studenti.unime.it

THE MARINE THERMOPHILIC *BACILLUS LICHENIFORMIS* S7S-1 PRODUCER OF A SURFACE-ACTIVE BIOPOLYMER WITH HYDRATING CAPABILITIES AND ITS BIOTECHNOLOGICAL POTENTIALITIES

Microbial surface-active molecules, such as biosurfactants (BSs), efficiently reduce surface and interfacial tension, playing a fundamental role to increase the bioavailability of hydrophobic compounds, such as hydrocarbons. The hydrating capabilities of BSs produced by thermophiles, could lead to the development of new moisturizing or wetting agents to counteract the dehydration of human skin and foods, and to improve soil quality. In order to investigate the hydrating capabilities of the biosurfactant (BS s7s-1) produced by the marine thermophilic *Bacillus licheniformis* s7s-1, isolated from a shallow hydrothermal vent (depth, 19.8 m, T 95 °C, pH 5.1) off Panarea Island (Italy), in this study we evaluated: i) the moisture uptake from air humidity, using the gravimetric method; ii) the hydrating states (water content from 0 to 160%, w/w), using ATR-FTIR spectroscopy; and iii) the wetting properties, measuring the contact angle of water solution on a hydrophobic surface. After cultivation in an optimized medium and incubation at 50°C, strain s7s-1 reached the maximum growth after 48h, and the maximum yield of the crude BS (1.1 g/L) after 40h. The BS, chemically attributed to a surfactin-like lipopeptide, possessed high emulsifying activity with kerosene (E_{24}=70%), that could compete with industrially manufactured surfactants, such as TritonX-100 (74%) and Tween 80 (73%). The BS was able to adsorb a large quantity of water from air humidity (two times its weight), prospecting its use as a wetting agent. As result by ATR-FTIR spectra, the BS efficiently captured up to 80% of liquid water molecules. Moreover, the BS decreased the contact angle of water (from 84° to 38°) on a polystyrene hydrophobic surface, indicating that its addition increased the surface wettability. As a nontoxic wetting agent, BS s7s-1 can be proposed as a promising candidate to replace industrially manufactured additives to reconstruct dry compounds in different applications.

S. ZIGIC, O. MANGONI, S. ACETO, E. SERINO, L.M. CAMPOLI, F. BOLINESI

Department of Biology, University of Naples Federico II, Italy.
savannah.zigic@outlook.com

RESPONSE OF ANTARCTIC *CHAETOCEROS* SP. TO SIMULATED MELTING CONDITIONS

Climate change is reshaping the Antarctic marine ecosystem by prolonging the ice-melt season and increasing both brine channel and freshwater inputs, leading to rapid and extreme salinity fluctuations in coastal surface waters. Southern Ocean diatoms, particularly *Chaetoceros spp.*, play a crucial role in the Antarctic food web and act as significant carbon sinks, yet their ability to cope with such fluctuations remains poorly understood. While some studies have examined *Chaetoceros spp.* responses to salinity changes in terms of growth rate, photophysiology, and oxidative stress, little is known about the impact on Antarctic coastal species, particularly at the genetic level. To address this knowledge gap, we isolated a single *Chaetoceros sp.* cell from a sample collected in Terra Nova Bay during the Austral summer of 2017 and established a monoclonal culture. We assessed the effects of salinity variations associated with exacerbated ice melt on growth, cell morphology, photosynthetic capacity, and nutrient dynamics. Results show significant effects of salinity fluctuations on cell size, growth rate, fluorescence parameters, pigment composition, and nutrient uptake. Ongoing phylogenetic and transcriptomic analyses aim to identify the species and characterize gene expression across salinity conditions. These findings highlight the physiological and genetic responses of coastal Antarctic *Chaetoceros sp.* to simulated melt conditions, improving our understanding of the resilience of diatoms to climate-driven environmental changes.

POSTER DEL COMITATO ACQUACOLTURA

P. ALBICINI[1], L. MERONI[1,2], V. ASNAGHI[1,2], J. CIMINI[1], C. PEZZILLI[1,2], M. CHIANTORE[1,2]

[1]Department of Earth, Environmental and Life Sciences (DISTAV), University of Genoa, Italy.
[2]National Biodiversity Future Center (NBFC), Palermo, Italy.
paolo.albicini@edu.unige.it

INNOVATIVE SOLUTIONS FOR THE RESTORATION OF *ERICARIA AMENTACEA* IN BERGEGGI MPA

Aquaculture already represents one of the most sustainable and efficient animal and vegetal production system; the co-cultivation of different species within integrated multi-trophic aquaculture (IMTA) systems could improve economic, social and environmental benefits. Within this context the combination of aquaculture and restoration should be considered to implement one of the most sustainable restorative approaches: reproduce to restore. The University of Genoa, in collaboration with "Aquadema s.r.l", in the context of the European project Novafoodies and of the National Biodiversity Future Centre, is running an experimental IMTA system in the Ligurian Sea (Lavagna, Genova), with *Sparus aurata*, *Dicentrarchus labrax*, *Ostrea edulis* and the seaweed *Ericaria amentacea.* In this study, we tested a new method to evaluate the potential optimization of the growing process of *E. amentacea;* we compared the traditional *ex-situ* outplanting restoration approach with a novel one, involving a period of time in the IMTA plant. In the first scenario, after 3 weeks of cultivation in the laboratory, juveniles were directly deployed in the natural rocky shore of Bergeggi (Punta Predani, SV). In the alternative approach, the juveniles were first placed in submerged cages near the aquaculture facility in Lavagna, for a growing period of 4 months. Following this 4-month growth period (22nd October), *E. amentacea* juveniles were transferred from the aquaculture system to the natural rocky shore of Bergeggi. The growth of *E. amentacea* was monitored under both conditions by assessing the percent cover and measuring the growth of the thalli. Based on first observations, the second approach seems to offer advantages: after 7 months from the deployment at sea, the average percent cover of *E. amentacea* with the traditional approach is about 10%, while the percent cover achieved with IMTA-integrated method reaches approximately 45%. The integration of the brown canopy-forming seaweed *E. amentacea* into an IMTA system presents a promising strategy for large-scale juvenile production, fostering sustainable and efficient restoration efforts.

C. CASSARINO[1], A. MANCUSO[1], A. CAMPANELLI[2], F. GRILLI[2], M. MARINI[2], A. SPAGNOLO[2], A. BASHO[2], C. MAZZOLI[3], S. CAPELLACCI[3], S. CASABIANCA[3], G. RAVERA[3], G. FAMIGLINI[4], G. PRIOLI[5], E. CAROSELLI[1], S. GOFFREDO[1], A. PENNA[3]

[1]Department of Biological, Geological and Environmental Sciences, University of Bologna, Italy.
[2]Institute of Marine Biological Resources and Biotechnologies (CNR-IRBIM), Ancona, Italy.
[3]Department of Biomolecular Sciences, University of Urbino, Italy.
[4]Department of Pure and Applied Sciences, University of Urbino, Italy.
[5]M.A.R.E. S.c. a r.l., Cattolica (RM), Italy.
chiara.cassarino2@unibo.it

ENVIRONMENTAL DRIVERS INFLUENCING FATTENING AND CALCIFICATION PROCESSES OF WILD AND FARMED MUSSELS IN THE ADRIATIC SEA

Mussels (*Mytilus galloprovincialis*) are the most important species for Italian shellfish market. The production mainly comes from sea-farms and wild populations of the northwestern (NW) Adriatic Sea. In recent years, both farmed and wild mussels have experienced meat loss and increased shell fragility, which negatively affects their quality and market value. Since farming techniques have remained mostly unchanged, and wild populations show similar affections, environmental factors are likely contributing to these effects. The main goals of this PRIN-PNRR ENDRIMUS Project are to identify key environmental and biological factors affecting the quality of farmed and wild mussels along a latitudinal gradient on the Adriatic coast, to provide farmers insights for the future development of mussel farms. Environmental analyses showed a salinity gradient toward the south, while other factors (temperature, total alkalinity) and chemistry carbonate parameters resulted homogeneous along the coast. Nutrient concentrations also showed a decreasing gradient toward south during the winter period while during spring season nutrient concentrations appeared more homogeneous across all investigated areas. Moreover, a decreasing trend in chlorophyll *a* was observed towards south. The abundance of target phytoplankton groups in mussel tissues reflected the expected phytoplankton assemblages. All mussel samples contained seeds, with the settlement season extending until spring when specimens of 2-4 mm total length (TL) were found. Shells of the farmed mussels showed to be more porous and less dense compared to the wild ones, while mechanical properties (like the resistance to fracture) resulted homogenous across sites and between farmed and wild mussels. These are preliminary results obtained by seasonal campaigns in the NW Adriatic Sea aim to contribute in understanding this complex phenomenon affecting Adriatic mussels.

F. COLOTTO[1], D. BERTOTTO[2], F. FILICIOTTO[3], T. GAGGERO[1], L. MARINELLI[2], P. MONGILLO[2], M. BORTOLETTI[2], C. GUERINEAU[2]

[1]DITEN, University of Genoa, Italy.
[2]Department of Comparative Biomedicine and Food Science, University of Padua, Legnaro (PD), Italy.
[3]Institute of Polar Sciences (ISP), National Research Council (CNR), Messina, Italy.
colotto.fabio@gmail.com

ANALYSIS OF LONG-TERM UNDERWATER NOISE SOUNDSCAPE IN THE FRAMEWORK OF THE SOS-BASS PRIN 2022 PROJECT

This study investigates the underwater acoustic environment within a seabass farm located in Duino (Trieste, Italy). Acoustic recordings were conducted in the framework of the SOS-BASS PRIN 2022 project using a hydrophone deployed at the center of the farm, a depth of a few meters continuously collecting data from mid-December 2023 to early July 2024 at a 64 kHz sampling rate. To characterize the soundscape of the area, spectral characterization was performed through Power Spectral Density (PSD), Percentile-based analysis of the PSD, Long-Term Spectral Analysis (LTSA), and Sound Exposure Level (SEL). Statistical analyses were conducted to assess periodic variations in noise levels. Special attention was given to anthropogenic noise, integrating Automatic Identification System (AIS) data to reconstruct vessel trajectories and evaluate correlations between maritime traffic and underwater noise. At the same time, a modeling approach was developed to predict underwater noise from ship traffic using environmental parameters such as bathymetry, seabed types, and sound speed profiles. Additionally, parallel research is being carried out on the physiology and behavior of seabasses to assess the potential effects of noise exposure on fish welfare and behavioral dynamics. This multidisciplinary approach provides a comprehensive understanding of the underwater soundscape in an anthropogenically influenced environment, contributing to the assessment of human-induced impacts on marine ecosystems.

A. FABBROCINI, R. D'ADAMO

Istituto di Scienze Marine (ISMAR-CNR), Sez. di Napoli, Italia.
adele.fabbrocini@cnr.it

ANALISI DELLA MOTILITÀ SPERMATICA NELLE SPECIE ACQUATICHE: APPLICAZIONI E PROSPETTIVE DEI SISTEMI CASA-MOT IN ACQUACOLTURA

La misura della motilità spermatica è uno dei principali criteri per la valutazione della qualità del seme, dato che è indicatore dell'integrità strutturale e fisiologica degli spermatozoi e da essa dipende la capacità fecondante. Oltre a misurare la percentuale di spermatozoi motili, l'analisi computerizzata della motilità spermatica (Computer Assisted Sperm Analysis, CASA-Mot) descrive in maniera oggettiva il movimento di ogni singolo spermatozoo lungo la sua traccia. I sistemi CASA-Mot, inizialmente sviluppati per applicazioni nel campo della fertilità umana, sono stati poi utilizzati anche in zootecnia, e solo più recentemente per le specie acquatiche. La nostra attività di ricerca focalizzata sullo studio della motilità spermatica di specie acquatiche ha utilizzato un sistema CASA-Mot per caratterizzare il pattern di motilità spermatica (SPM) di numerose specie di interesse ecologico e/o acquacolturale: bivalvi (*Mytilus galloprovincialis*, *Ruditapes decussatus*, *Ostrea edulis*), echinodermi (*Paracentrotus lividus*, *Sphaerechinus granularis*), pesci (*Sparus aurata*, *Pagellus erythrinus*, *Fundulus heteroclitus*). Innanzitutto, è stata studiata l'interazione spermatozoo/ambiente valutando gli effetti di pH, temperatura e pressione osmotica sulla inibizione/attivazione della motilità; le variazioni dello SPM in funzione del ciclo riproduttivo e delle condizioni ambientali in cui gli esemplari sono maturati sono state poi utilizzate per studiare l'interazione riproduttori/ambiente. Lo SPM ha mostrato una notevole variabilità interspecifica, in relazione alle differenti strategie riproduttive; l'analisi dello SPM ci ha permesso di valutare con successo gli effetti di temperatura e regime alimentare in prove di allevamento in sistemi RAS; è stato utilizzato per una rapida identificazione della qualità dei gameti durante prove di riproduzione controllata e per ottimizzare la gestione dei gameti nella fase post-prelievo; è stato inoltre un sensibile parametro di valutazione durante la criopreservazione e come end-point in ecotossicologia. In conclusione, i sistemi CASA-Mot, considerate anche le caratteristiche di oggettività, rapidità di esecuzione, necessità di ridotti volumi di campione, offrono interessanti prospettive per un più ampio utilizzo in acquacoltura.

M.C. MARTONE[1,2], F. FERRIGNO[2], L. APPOLLONI[3], L. FORTUNATO[2], R. SANDULLI[2], G. NAPOLITANO[1,2], Y. COTRONEO[2], G. BUDILLON[2], J. RIMAURO[4], E. CHIANESE[2], L. DONNARUMMA[1,2]

[1]International PhD Programme, UNESCO Chair "Environment, Resources and Sustainable Development", Department of Science and Technology, University of Naples Parthenope, Italy.
[2]Department of Science and Technology, University of Naples Parthenope, URL CoNISMa, Italy.
[3]Laboratory Biodiversity and Ecosystems, Centro Ricerche Ambiente Marino ENEA, Lerici (SP), Italy.
[4]Laboratory Impacts on Territory and in the Developing Countries, Centro Ricerche ENEA, Portici (NA), Italy.
mariacarolina.martone001@studenti.uniparthenope.it

MYTILUS GALLOPROVINCIALIS FARMS IN THE GULF OF POZZUOLI: BIOLOGY AND ENVIRONMENTAL CONTAMINATION

Mussel farming is a key sector of Italian aquaculture, predominantly based on the mussel *Mytilus galloprovincialis* Lamarck, 1819. As bioindicators, mussels are widely used as "sentinel organisms", effectively reflecting environmental contamination by various pollutants. In June 2024, within the framework of the AMICA project (Financially supported by Parthenope University - "Approccio multidisciplinare allo studio della contaminazione da idrocarburi nei mitili allevati nel Golfo di Pozzuoli"), biological and chemical analyses were conducted at a mussel farm located in Pozzuoli Bay. Shell dimensions and biomass of bivalves, randomly selected from three mussel ropes, were measured, and metal concentrations were assessed in both mussel tissues and inter-shell water. For tissue analysis, 0.25g of dried mussel samples underwent chemical digestion using 8mL of nitric acid (HNO_3) and 2mL of hydrogen peroxide (H_2O_2), before quantification via inductively coupled plasma mass spectrometry (ICP-MS). Inter-shell water samples were similarly pre-treated with the addition of 100 µL of H_2O_2 before ICP-MS analysis. Mussels at the farm have an average shell length of 24.25 ± 13 mm and an average wet biomass of edible individuals (≥5 cm) of 16.2 ± 4 g. Among the analysed metals, vanadium (V), zinc (Zn), and iron (Fe) occurred with high values in both mussel tissues and inter-shell waters, albeit with different percentages. In mussel tissues, V had the highest percentage (74.74±2.80%), followed by Fe (21.35±2.81%) and Zn (3.91±0.66%). Conversely, in the inter-shell waters, Zn exhibited the highest percentage (58.76±4.05%), followed by V (27.92±7%) and Fe (13.32±3.45%). Preliminary results indicate significant exposure of the mussel farm to anthropogenic pollutants. Atmospheric variability and water circulation patterns can influence the occurrence and distribution of the pollution events, including metals in the water column and their accumulation in mussel tissues. These findings are a crucial step in evaluating the quality and safety of *M. galloprovincialis* harvested for human consumption in Pozzuoli Bay.

F. MURA, S. SERRA, G. SANNA, F. CHESSA, C.T. SATTA, M. TRENTADUE, R. DICIOTTI, N. FOIS, R. FLORIS

Agris Sardegna, Servizio Ricerca Prodotti Ittici, Sassari, Italia.
rfloris@agrisricerca.it

PROVE DI APPETTIBILITÀ DI UNA DIETA A BASE DI AGAR-FITOPLANCTON SU GIOVANILI DI RICCIO DI MARE *PARACENTROTUS LIVIDUS*

Il riccio di mare *Paracentrotus lividus* (Lamarck, 1816) rappresenta una risorsa economica importante per la pesca e per l'industria agroalimentare. L'aumento della pressione di pesca ha determinato un declino degli stock naturali per cui esiste l'interesse per una echinocoltura sostenibile. Vari studi riportano indicazioni sull'alimentazione a base di fitoplancton per la sopravvivenza e lo sviluppo delle larve, di diatomee bentoniche per gli stadi postlarvali, di macroalghe marine e di diete a base di carota, mais, pisello e soia, olio di pesce e farina animale per l'alimentazione di individui adulti. L'obiettivo di questo lavoro, condotto nell'ambito del Progetto Interreg Marittimo-IT FR 2021-2027, è stato l'uso del fitoplancton per l'allevamento di giovanili di riccio di mare. Sono state condotte prove di appetibilità per verificare l'accettazione dell'alimento. Sono state preparate diete basate su *Chaetoceros* spp*.* e *Ulva* sp. secca incluse in agar, testando la loro stabilità in acqua e il grado di preferenza su 45 esemplari di *Paracentrotus lividus* (10-20 mm), allevati in 9 beakers (5 l) per 14 giorni. Colture di C. *gracilis* Schütt *e C. calcitrans* (Paulsen) Takano 1968 cresciute in terreno f/2 sono state centrifugate a 4500 rpm a 4 °C per 20 min e i pellettati, inclusi in agar (3%) in piaste Petri (5 cm diametro), conservati a −20 °C fino all'utilizzo. L'alimento così ottenuto è stato somministrato 2 volte alla settimana. Le prime osservazioni mostrano la stabilità dei preparati in acqua ed una buona appetibilità di quelli contenenti il fitoplancton, che venivano consumati completamente dai ricci già dopo 6 ore. Tale risultato risulta essere una interessante base di conoscenza per approfondire lo studio di una integrazione alimentare a base di agar-microalghe per l'accrescimento di giovanili di riccio. Una dieta efficace può contribuire alla produzione di reclute per il ripopolamento degli ecosistemi marini e per la conservazione della biodiversità.

S.M.S. MUSUMECI[1], A.L. LANGELLOTTI[2], M. D'ASCOLI[2], G.L. RUSSO[3], M. TOSCANESI[4], M. TRIFUOGGI[4], A. COLLETTI[1], P. MASI[2,4]

[1]Department of Biology, University of Naples Federico II, Italy.
[2]Centre for Food Innovation and Development in the Food Industry (CAISIAL), University of Naples Federico II, Portici (NA), Italy.
[3]Department of Agricultural Sciences, Unit of Food Science and Technology, University of Naples Federico II, Portici (NA), Italy.
[4]Department of Chemical Sciences, University of Naples Federico II, Naples, Italy.
simonemariasanto.musumeci@unina.it

INNOVATIVE FEED SOLUTIONS FOR *PARACENTROTUS LIVIDUS* (LAMARCK, 1816) FARMING: UTILISING FISH AND VEGETABLE BY-PRODUCTS FOR SUSTAINABLE AQUACULTURE

Sea urchins are essential marine grazers, yet overexploitation has led to a significant decline in *Paracentrotus lividus*, a key Mediterranean species. To address this issue, aquaculture offers a viable solution, although the species' slow growth remains a challenge. A well-balanced diet is crucial for growth, and using sustainable feeds derived from industry by-products offers an innovative approach. This study explores the potential of alternative diets made from anchovy processing by-products and industrial carrot waste for juvenile sea urchin aquaculture. For the first time, these feeds were tested on sea urchins of different size classes to evaluate their long-term effects on growth performance. Two experimental diets (D100 and D50) were compared with a commercial pellet control diet. Results indicate that sustainable feeds support sea urchin growth, although outcomes vary by diet and size class. The D50 and control diets promote higher somatic growth rates (SGR) and better food conversion ratios (FCR) than the D100 diet, which exhibits lower SGR, particularly in larger individuals. Chemical analyses highlight differences in feed assimilation efficiency and nitrogen absorption among diets and size classes. These findings demonstrate the potential of eco-friendly feeds in sea urchin farming, aligning with circular economy principles. While promising, further research is needed to refine feeding protocols and better understand the factors influencing growth and nutrient assimilation. Integrating food by-products into aquaculture could contribute to the conservation of overexploited sea urchin populations and promote more sustainable marine resource management.

S. SCOZZAFAVA[1,2], C. GIOMMI[1], L. EVOLA[1], C. PEDÀ[3], N. SPANÒ[2], T. ROMEO[3,4]

[1]Stazione Zoologica Anton Dohrn, Calabria Marine Centre, CRIMAC, Amendolara (CS), Italy.
[2]Department of Chemical, Biological, Pharmaceutical and Environmental Sciences, University of Messina, Italy.
[3]Stazione Zoologica Anton Dohrn, Sicily Marine Centre, Messina (ME), Italy.
[4]National Institute for Environmental Protection and Research (ISPRA), Milazzo (ME), Italy.
serena.scozzafava@szn.it

IMPACT OF MICROPLASTICS AND MICROBIOPLASTICS ON THE MUSSEL *MYTILUS GALLOPROVINCIALIS* UNDER A CLIMATE CHANGE SCENARIO

Mussels represent one of the most important products of the aquaculture sector, reaching a global production of approximately 1,925,902 tons in 2022, of which 431,006 tons were produced in Europe. However, mussel farming faces a growing challenge in light of plastic pollution and climatic changes. Environmental variables, such as seawater temperature, oxygen concentration, and salinity, are among the most limiting factors for mussel growth. Together with the potential physical and toxicological effects of plastics, these factors can have negatively impact on mussel survival. In this regard, this study aims to investigate the effects of the combination of plastic pollution and climate extremes events on the Mediterranean mussel, *Mytilus galloprovincialis* (Lamarck, 1819), is the most farmed species in EU shellfish aquaculture, through a mesocosm short-term experiment (3 days). In detail, the behavioral (aggregation and foot extension) and physiological (respiration rate, RR) responses of *M. galloprovincialis* were investigated in three different experimental trials, two single stressor experiments, and one multiple stressor experiment. Exposure to conventional (MPs-PP) and Mater-Bi® microplastics (MPs-MB), the effects of short-term temperature extremes (28° C; ET), and the combination of both drivers were evaluated on individual oxygen consumption (n=6) and the behavior of groups of 10 individuals in arenas (n=6). Oxygen consumption (mg/L O_2 h^{-1} g-DW^{-1}) was recorded using an optode in respirometric chambers, while mussel behavior was recorded and classified as the number of aggregations, the number of individuals forming aggregations, and the number of foot extensions. Exposure to MPs-PP, unlike MPs-MB, altered the behavior and the respiration rate of individuals. Overall, both MPs treatments may influence the response of mussels when in combinated with rising temperatures. These results contribute to the current knowledge regarding the effects of multiple stressors on aquaculture resources and the potential environmental impact of biodegradable polymers.

POSTER DEL COMITATO BENTHOS

A. BANDI[1], A. REBOA[1,2], M. SIMEONE[3], G. DI PACE[3], M. BERTOLINO[1,2]

[1]DISTAV, University of Genoa, Italy.
[2]National Biodiversity Future Center (NBFC), Palermo, Italy.
[3]Marine Protected Area "Parco Sommerso di Gaiola", Napoli, Italy.
ada.bandi@edu.unige.it

ASSESSMENT OF POSSIBLE CHANGES IN SPONGE COMMUNITIES OF A SEMI-SUBMERGED SEA CAVE IN MPA "PARCO SOMMERSO DI GAIOLA" AFTER 65 YEARS

In recent decades significant changes have occurred in the composition and distribution of Mediterranean benthic communities. Porifera represent a key group for assessing the effects of environmental changes: some species have been subjected to significant declines, while others have expanded their distribution. This study compares the diversity of sponges over a 65-year period (1958-2023) found in a semi-submerged sea cave at Baia di Trentaremi (Naples), located within the MPA "Parco sommerso di Gaiola". The cave is characterized by a raised floor with puddles of water. Sampling was performed following the same scheme as in Sarà (1958), dividing the cave into 5 zones, and the samples have been collected by scraping, using a square 20x20 cm. The number of identified species decreased from 55 in 1958 to 28 in 2023, with only 16 species in common. Species distribution and abundance have also changed: in 1958 *Suberites carnosus* (Johnston, 1842) was present in all the zones of the cave, and was one of the most common species together with *Tethyspira spinosa* (Bowerbank, 1874) and *Timea fasciata* Topsent, 1934. On the contrary, in 2023 *Aplysina aerophoba* (Nardo, 1833), *Polymastia mamillaris* (Müller, 1806), *Haliclona* (*Haliclona*) *michelei* Van Soest & Hooper, 2020 and *Hemimycale columella* (Bowerbank, 1874) predominate. *A. aerophoba* is the most abundant species with 1.7% coverage in the entire cave. Porifera coverage is 5.9% compared to algae (29.7%) and rock/sand (63.9%). This significant decrease in the number of sponge species, compared to 1958, might reflect an increase in recreational boating in recent decades, and consequently the continued presence of bathers in the cave, before the institution of the park. Anthropogenic pressures, together with ongoing climate change, have contributed to a decline of sponge communities. We thank the Marine Protected Area "Parco Sommerso di Gaiola", as the proponent and financier of the Project.

L. BISANTI[1,2], C. LA CORTE[1,2], M. DARA[1,2], F. BERTINI[1,2], M.G. PARISI[1,2], D. PARRINELLO[1,2], R. CHEMELLO[1,2], M. CAMMARATA[1,2]

[1]Department of Earth and Marine Sciences, University of Palermo, Italy.
[2]National Biodiversity Future Center (NBFC), Palermo, Italy.
luca.bisanti@unipa.it

RESPONSE TO BACTERIAL CHALLENGE SHOWS THE DETRIMENTAL IMPACTS OF WARMER SEAWATER ON IMMUNE ACTIVITIES IN A MEDITERRANEAN THERMOPHILIC SPECIES, *ASTROIDES CALYCULARIS* (PALLAS, 1766)

A worldwide increase in coral diseases and mortality has been linked to anthropogenic ocean warming, due to changes in pathogen virulence and coral immune functions. The anomalous temperature pattern has particularly worried the Mediterranean region over the last 30 years, where intense warming has caused recurring mass-mortality events. To evaluate how warmer seawater conditions influence the immune activities of a Mediterranean endemic species, colonies of *Astroides calycularis* were exposed to either environmental (23 °C) or elevated (28 °C) temperatures and subsequently challenged with *Escherichia coli* lipopolysaccharide (LPS). Through immunolabeling with specific antibodies, the regulation of Toll-like receptor 4 (TLR4), nuclear factor kappa B (NF-kB), and heat shock protein 70 (HSP70) proteins were detected. The activity of these markers, 6 hours after the LPS stimulation, revealed a modulation at environmental temperature. Elevated temperature and LPS-challenge almost suppressed TLR4-NF-kB activity, while HSP70 up-regulation appeared in both treatments under warmer conditions. Moreover, several immune-related enzymatic parameters (phenoloxidase, glutathione peroxidase, lysozyme, alkaline phosphatase, and esterase) were measured over time (6-, 12-, 48-, and 120-h). All five enzymes demonstrated constant values under environmental conditions. Meanwhile, LPS at environmental temperature induced significant up-modulation 6 hours after the exposition, demonstrating an enzymatic response to the pathogen eliciting. Under warmer conditions, constituent values increased over time, indicating a shift in immune strategy to maintain homeostasis. However, elevated temperature impaired the enzymatic activities to LPS, delaying it over time. These findings suggest that temperature influences coral immunity and, in thermophilic *A. calycularis*, leads to an energy trade-off by maintaining its health-state under suboptimal conditions during multiple perturbations. Such an approach is useful for understanding the pathogen-defense mechanisms in corals in order to disentangle the complex interactive effects related to global climate change.

R. CALICCHIO[1,2], L. APPOLLONI[3], F. FERRIGNO[2], F. RENDINA[2], A. COCOZZA DI MONTANARA[4], R. SANDULLI[2], M. MAISANO[5], L. DONNARUMMA[1,2], G.F. RUSSO[1,2]

[1]Dottorato di Ricerca internazionale, Cattedra UNESCO in "Ambiente, Risorse e Sviluppo Sostenibile", Dipartimento di Scienze e Tecnologie, Università di Napoli Parthenope, Italia.
[2]Dipartimento di Scienze e Tecnologie, Università di Napoli Parthenope, URL CoNISMa, Italia.
[3]Laboratorio Biodiversità ed Ecosistemi, Centro Ricerche Ambiente Marino, ENEA, Lerici (SP), Italia.
[4]Stazione Zoologica A. Dohrn, Napoli, Italia.
[5]Dipartimento di Scienze chimiche, biologiche, farmaceutiche e ambientali, Università di Messina, Italia.
rosalia.calicchio001@studenti.uniparthenope.it

IL CORALLIGENO NELLA ZSC DI CAPO PALINURO E NELL'AMP COSTA DEGLI INFRESCHI E DELLA MASSETA: COMPOSIZIONE DELLA FAUNA BENTONICA A DIVERSI LIVELLI DI PROTEZIONE

Le biocostruzioni coralligene sono strutture fondamentali per gli ecosistemi marini del Mar Mediterraneo, fornendo numerosi servizi ecosistemici, tra cui aree di riproduzione e di nursery e fissazione dell'anidride carbonica. La Zona Speciale di Conservazione (ZSC) del "Parco Marino di Punta degli Infreschi" e l'Area Marina Protetta (AMP) "Costa degli Infreschi e della Masseta" sono aree di conservazione fondamentali dell'habitat coralligeno. Nell'ambito del progetto Heasy (Supportato dai fondi PNRR_Centro Nazionale "NBFC-National Biodiversity Future Center" – CN_00000033 - Spoke 1 – Prog. HEASY CUP – B73C22000790001), nell'autunno 2024 sono stati campionati tre siti per la valutazione dello stato ecologico del coralligeno: uno nella ZSC e due nell'AMP, rispettivamente in zona A e zona B. In ciascun sito, sono state raccolte 30 immagini fotografiche, secondo il protocollo STAR, e sono stati campionati con un quadrato, di 40 cm di lato, 6 substrati coralligeni con la tecnica sorbona-grattaggio-sorbona. Dai risultati preliminari dell'analisi d'immagine si evince un ricoprimento percentuale di *taxa* vegetali e animali rispettivamente del 91% e 9% nel sito della ZSC, del 97% e 3% nel sito della zona A dell'AMP e del 99% e 1% nel sito della zona B dell'AMP. In ZSC e in zona B dell'AMP sono, inoltre, presenti organismi eretti. In particolare, in ZSC *Corallium rubrum* (Linnaeus, 1758) ed *Eunicella cavolini* (Koch, 1887) sono presenti con una frequenza percentuale del 17% e del 13%, rispettivamente, mentre in zona Bdell'AMP è presente solo *E. cavolini*, con una frequenza del 33%. Dall'analisi del macrozoobenthos, policheti, molluschi, crostacei, echinodermi e sipunculidi strutturano le comunità delle concrezioni coralligene campionate, con una similarità dell'87,7% tra i siti dell'AMP. In particolare, policheti e molluschi sono i gruppi tassonomici più rappresentativi, con una dominanza quantitativa del 78,5% sul totale di 1040 individui. La complessità della struttura suggerisce una costante necessità di piani di conservazione e monitoraggi mirati, volti alla protezione dell'habitat coralligeno e alle specie minacciate ad esso associate.

I. COCCIA[1], V. FORTUNATO[2], M. MERCURIO[1,2]

[1]Consorzio Nazionale Interuniversitario per le Scienze del Mare (CoNISMa), Roma, Italia.
[2]Dipartimento di Bioscienze, Biotecnologie e Ambiente, Università di Bari Aldo Moro, Italia.
isabella.coccia@uniba.it

LE BIOCOSTRUZIONI A VERMETIDI DELLA COSTA IONICA TARANTINA: DISTRIBUZIONE E MORFOLOGIA

Le biocostruzioni a vermetidi rappresentano ecosistemi costieri di grande interesse ecologico e geomorfologico, la cui distribuzione e morfologia variano significativamente in funzione delle condizioni ambientali locali. In particolare, le specie di Molluschi Gasteropodi appartenenti al genere *Dendropoma* sono note per la loro capacità di edificare piattaforme biogeniche anche molto estese. In questo studio sono state caratterizzate tre tipologie di formazioni a vermetidi presenti lungo un tratto di costa esteso per 40 km in provincia di Taranto (Mar Ionio), analizzandone la distribuzione spaziale e la morfologia. L'indagine è stata condotta mediante rilievi diretti in situ, con raccolta di dati morfometrici e fotografici, per mappare l'estensione delle biocostruzioni e valutare i valori di densità e le dimensioni dell'apertura della conchiglia dei vermetidi. Sono stati individuati tre tipi principali di morfologie: (1) incrostante, composto da un sottile strato di conchiglie di vermetidi presente lungo la porzione più settentrionale della costa indagata; (2) un sistema di piccoli atolli isolati, di dimensioni comprese tra 50 cm e 2 m di ampiezza, situati a breve distanza dalla costa sabbiosa, a una profondità di circa 15 cm; (3) due piccole isole, ricoperte nella porzione più esposta da una biocostruzione a vermetidi: la prima presenta una biocostruzione ben sviluppata con reef, margine esterno e una serie di *cuvettes* nella parte esposta; la seconda, di circa 7 m di larghezza e 80 m di lunghezza, è in buona parte completamente ricoperta da un continuo e sottile strato di vermetidi. I risultati evidenziano come la variabilità morfologica delle biocostruzioni sia fortemente influenzata dalla topografia costiera e dalle condizioni idrodinamiche locali. Queste strutture giocano un ruolo chiave nella protezione della costa dall'erosione e nella creazione di microhabitat per numerose specie marine. L'identificazione e la caratterizzazione di queste formazioni risultano fondamentali per la loro conservazione e per la salvaguardia della biodiversità ad esse associate.

A. COCOZZA DI MONTANARA[1,2,3], G. ZAPATA-HERNÁNDEZ[4], H. GRUBER-VODICKA[5], D. PICA[6], R. DOMINICI[7], U. CARDINI[4], R. SANDULLI[3]

[1]Stazione Zoologica Anton Dohrn, Napoli, Italia.
[2]National Biodiversity Future Center (NBFC), Palermo, Italia.
[3]Università di Napoli Parthenope, URL CoNISMa, Italia.
[4]Genova Marine Centre, Stazione Zoologica Anton Dohrn, Italia.
[5]Zoological Institute, Kiel University, Germany.
[6]Calabria Marine Centre-CRIMAC, Stazione Zoologica Anton Dohrn, Amendolara (CS), Italia.
[7]Dipartimento di Biologia, Ecologia e Scienze della Terra, Università della Calabria, Rende (CS), Italia.
adele.cocozzadm@gmail.com

CONFRONTO TRA LE COMUNITÀ DI MEIOFAUNA ASSOCIATE A PRATERIE MEDITERRANEE DI *POSIDONIA OCEANICA* E *CYMODOCEA NODOSA*

Le fanerogame marine formano habitat fondamentali per una vasta gamma di organismi marini nel Mediterraneo, sia liberamente natanti sia legati al substrato, inclusa la meiofauna bentonica. Nonostante il loro ruolo chiave nella rete trofica bentonica, la distribuzione e la struttura delle comunità di meiofauna associate alle praterie di fanerogame rimangono poco conosciute. Questo studio ha l'obiettivo di analizzare le differenze tra le comunità di meiofauna associate a due specie di fanerogame mediterranee, *Posidonia oceanica* e *Cymodocea nodosa,* e di valutare la distribuzione degli organismi tra diversi settori delle praterie. Sono stati selezionati cinque siti in Calabria settentrionale, distribuiti tra il versante tirrenico e quello ionico: tre caratterizzati da *P. oceanica* (Dino, Tirone e Cariati) e due da *C. nodosa* (Amendolara e Crati). In ciascun sito, sono state campionate tre stazioni: all'interno della prateria (Meadow), al margine (Edge) e all'esterno (Outside), prelevando carote (Ø 2,8 cm) di circa 10 cm di sedimento a una profondità di 5-10 m. In totale, sono stati identificati 10.756 individui appartenenti a 15 taxa, di cui 6.626 associati a *P. oceanica* e 4.130 a *C. nodosa*. Le stazioni esterne alle praterie presentano generalmente le abbondanze più elevate, con l'eccezione del sito Crati (*C. nodosa*) dove il valore massimo è stato registrato all'interno della prateria. In entrambe le praterie, i nematodi risultano il gruppo dominante, seguiti dai copepodi e dai loro nauplii. I valori di diversità (H') ed equitabilità (J) sono più elevati nei siti caratterizzati da *P. oceanica*. In conclusione, i dati ottenuti forniscono un'importante base di partenza per una comprensione più approfondita della meiofauna, una componente ancora poco studiata degli ecosistemi a fanerogame marine.

A. COSMA[1,2,3], M. TOMA[4], M. ANGIOLILLO[4,5], Al. CAU[6,7], S. CANESE[3,5], M. BO[1,3,7]

[1]Department of Earth, Environmental and Life Sciences (DiSTAV), University of Genoa, Italy.
[2]Department of Earth and Marine Sciences (DiSTeM), University of Palermo, Italy.
[3]National Biodiversity Future Center (NBFC), Palermo, Italy.
[4]Area for the protection of biodiversity, protected habitats and marine species, Italian Institute for Environmental Protection and Research (ISPRA), Roma, Italy.
[5]Stazione Zoologica Anton Dohrn, Napoli, Italy.
[6]Department of Life and Environmental Sciences, University of Cagliari, Italy.
[7]National Inter-University Consortium for Marine Sciences (CoNISMa), Roma, Italy.
alessandra.cosma@unipa.it

LARGE-SCALE DISTRIBUTION AND ECOLOGY OF FOUR POORLY KNOWN MEDITERRANEAN DEEP-WATER SCLERACTINIAN SPECIES

The knowledge of the large-scale distribution and ecology of deep-water Mediterranean scleractinians is limited almost exclusively to the so-called white corals. Thanks to a large ROV archive, consisting of 625 sites distributed among five macro-areas (Ligurian Sea, North-central Tyrrhenian Sea, South Tyrrhenian Sea, Sicily Channel and seamounts) and accounting for more than 600 hours of videos and about 700,000 m^2 of investigated seafloor between 40 and 1800 m, we had the chance to focus on the large-scale geographic and bathymetric distribution of four poorly known mesophotic and bathyal species, namely *Caryophyllia cyathus* (Ellis & Solander, 1786), *Thalamophyllia gasti* (Döderlein,1913), *Javania cailleti* (Duchassaing & Michelotti, 1864) and *Paracyathus pulchellus* (Philippi, 1842), and provide information on their population structure and ecological preferences. *Caryophyllia cyathus* was observed in about 40% of the sites in all macro-areas. This species is a typical mesophotic taxon, mainly living on deep coralligenous and outcropping rocks between 50 and 200 m (down to 450 m). *Paracyathus pulchellus* was the second most frequently recorded species (about 24% of the sites), found in similar ecological settings. Both *C. cyathus* and *P. pulchellus* were particularly abundant in the Tuscan Archipelago, eastern Sardinia and South Tyrrhenian Sea. *Thalamophyllia gasti* was reported from about 18% of the sites mainly at mesophotic depths (down to 300 m). It was mostly observed on rocky overhangs. Along the Sardinian coast this species formed bioconstructions, representing a novel habitat for the Mediterranean Sea. Finally, *J. cailleti* was the least recorded species (about 4% of the sites), mainly on seamounts and deep continental rocky reliefs, between 350 and 600 m, confirming as a strictly bathyal species. Large aggregations of this species on Fe-Mn dominated rocks were firstly reported in this study. This study provides important novel information on the structure of deep Mediterranean benthic communities to support their conservation.

S. DE BENEDICTIS[1,2], A. AIELLO[2,3,4], A. TERLIZZI[2,3,5] A. COLLETTI[1,2], E. FABBRIZZI[1,2], L. LICCIARDI[1,2], S.M.S. MUSUMECI[1], C. SILVESTRINI[1,2]

[1]Department of Biology, University of Naples Federico II, Italy.
[2]National Biodiversity Future Centre (NBFC), Palermo, Italy.
[3]Stazione Zoologica Anton Dohrn, Naples, Italy.
[4]Department of Earth and Marine Sciences (DiSTeM), University of Palermo, Italy.
[5]Department of Life Sciences, University of Trieste, Italy.
sara.debenedictis@unina.it

ASSESSING CHANGES IN MARINE PROTECTED AREAS ALONG THE ITALIAN COASTS

Marine Protected Areas aim to protect biodiversity and ensure sustainable resource management. However, for most MPAs, quantitative evidence of seascape recovery remains limited. Here, more than 20 years after a previous study, the status of rocky benthic communities under fully protected and unprotected conditions was assessed through the Ecosystem-Based Quality Index in six Italian MPAs, each characterized by different socio-ecological settings. The relationship between human pressures and the ecological condition of rocky reefs in each MPA was also explored. After 20 years, few significant differences between fully protected and unprotected areas were found. Although localized signs of regression in ecologically important habitats, such as macroalgal forests, were observed, an overall improvement in ecological status also emerged over time. This leads to a discussion about the need of adopting multiple response variables to elucidate the complexity of the effects of protection in the framework of long-term monitoring programs.

I. DEPLANO[1], M. PERRA[1,2], I. AZZENA[2], C. LOCCI[1,2], N. PASCALE[1,2,3], R. SENIGAGLIA[2], D. SANNA[1], F. SCARPA[1]

[1]Dipartimento di Scienze Biomediche, Università di Sassari, Italia.
[2]Dipartimento di Medicina Veterinaria, Università di Sassari, Italia.
[3]Dipartimento di Scienze Chimiche, Fisiche, Matematiche e Naturali, Università di Sassari, Italia.
i.deplano@phd.uniss.it

VALUTAZIONE DELLA VARIABILITÀ GENETICA DI *CALLINECTES SAPIDUS REOVIRUS 1* (CsRV1)

L'aumento della frequenza delle epidemie negli ecosistemi marini sta causando significative perturbazioni alle specie e alle comunità marine. Tra i virus associati a queste epizoozie, il virus *Callinectes sapidus reovirus 1* (CsRV1) riveste particolare interesse poiché provoca fluttuazioni nella distribuzione della specie *Callinectes sapidus* (granchio blu), al punto da agire come regolatore della sua abbondanza. Il CsRV1 è un virus patogeno con un genoma a RNA a doppio filamento segmentato, caratterizzato da elevati tassi di mutazione, brevi tempi di generazione e fenomeni di ricombinazione e riassortimento dei segmenti. In questo contesto, il lavoro presenta una ricostruzione filodinamica basata su un approccio genomico eseguito utilizzando tutti i genomi e segmenti di CsRV1 disponibili nel database NCBI virus. La datazione molecolare basata sull'intero genoma suggerisce un'origine temporale di circa 40 anni fa, seguita da un aumento della variabilità genetica e un'espansione della popolazione virale intorno a 10 anni fa. I tassi evolutivi stimati per i 12 segmenti sono molto simili, aggiornandosi nell'ordine di 10^{-4} sostituzioni per sito per anno. Questo indica che non ci sono segmenti all'interno dell'intero genoma più soggetti a selezione o con tempi evolutivi molto diversi dagli altri. Inoltre, il test di neutralità ha indicato che la maggior parte dei segmenti che codificano proteine con funzioni altamente conservate non è sottoposta a pressione selettiva. Ciò include il segmento 8, che si presume codifichi la proteina del capside esterno virale VP8, la quale tipicamente mostra una maggiore variazione regionale e temporale. Il monitoraggio continuo di CsRV1 è fondamentale nelle regioni in cui è stata confermata la presenza dell'ospite *C. sapidus*. In generale, il monitoraggio genetico dei patogeni è cruciale, soprattutto per i virus segmentati che possono subire riassortimento genetico e generare varianti più pericolose. Questo rischio aumenta con le specie alloctone, che possono introdurre patogeni sconosciuti, minacciando la salute delle popolazioni locali e l'equilibrio ecologico.

C. DI NAPOLI[1], L. MERONI[1,2], F. PINNA[3], S. FARINA[3,4], F. COLOTTO[1], S. GRILLI[1], V. ASNAGHI[1,2]

[1]DiSTAV, Università di Genova, Italia.
[2]National Biodiversity Future Center (NBFC), Palermo, Italia.
[3]Dipartimento di Ecologia Marina Integrata, Genoa Marine Center, Stazione Zoologica Anton Dohrn, Italia.
[4]Istituto per lo Studio degli Impatti Antropici e Sostenibilità in Ambiente Marino (IAS), Consiglio Nazionale delle Ricerche (CNR), Oristano, Italia.
carolina.dinapoli@edu.unige.it

STRUTTURA DI POPOLAZIONE DI *PARACENTROTUS LIVIDUS* (LAMARCK, 1816) IN RELAZIONE AGLI EFFETTI DEL CAMBIAMENTO CLIMATICO

Il riccio di mare *Paracentrotus lividus* (Lamarck, 1816) è uno degli erbivori principali delle zone costiere del Mediterraneo, le cui popolazioni sono influenzate dalla predazione naturale, dalla pesca e dagli effetti del riscaldamento globale, tra cui le ondate di calore (heat waves, HWs) e le fioriture di microalghe tossiche, in particolare *Ostreopsis* cf. *ovata*. Per questo motivo, il presente studio mira ad analizzata la struttura di popolazione di *P. lividus* nel periodo estivo degli anni 2022 e 2024 presso il sito costiero di Quarto dei Mille (Genova), un'area soggetta, durante la stagione estiva, a ripetuti eventi di HWs e fioriture di *O.* cf. *ovata*. I risultati hanno evidenziato una netta modificazione della struttura di popolazione dal 2022 al 2024 dovuta, in particolare, a un calo marcato della densità di individui giovanili e sub-adulti (classi di taglia al di sotto dei 39 mm). Nessuna differenza significativa è stata invece osservata per le classi di taglia superiori ai 40 mm. Tale riduzione della popolazione potrebbe essere attribuita a un basso reclutamento di individui giovanili, probabilmente causato dagli stress termici registrati nella zona di studio tra il 2021 e il 2023 nel mese di giugno, che potrebbero aver causato la morte e le malformazioni nelle larve derivanti dagli ultimi eventi di spawning del periodo riproduttivo della specie (ottobre-giugno). Eventi di fioritura di *O.* cf. *ovata* osservati negli stessi anni presso Quarto dei Mille potrebbero aver ulteriormente compromesso lo sviluppo larvale e la sopravvivenza delle fasi giovanili della specie. Questi risultati contribuiscono ad ampliare le conoscenze sulle dinamiche di popolazione di *P. lividus* in un contesto di cambiamento climatico, evidenziando la vulnerabilità delle prime fasi vitali della specie agli stress ambientali sempre più frequenti nei sistemi costieri mediterranei.

M.P. FERRANTI[1,2], L. RODRIGUEZ[3], M. MIČIĆ[3], E. BATISTINI[4,5], S. CIRIACO[4,5], M. SEGARICH[4,5], T. COLORETTI[1], C. DI NAPOLI[1], A. OPRANDI[1], L. INTINI[1], M. CHIANTORE[1,2,6]

[1]Department of Earth, Environmental and Life Sciences (DiSTAV), University of Genoa, Italy.
[2]National Biodiversity Future Center (NBFC), Palermo, Italy.
[3]Aquarium Pula, Pula, Croazia.
[4]Shoreline Società Cooperativa, Trieste, Italy.
[5]Marine Protected Area of Miramare, Trieste, Italy.
[6]National Inter-University Consortium for Marine Sciences (CoNISMa), Roma, Italy.
mariapaola.ferranti@unige.it

GONADAL MATURATION PROTOCOL OF THE ENDANGERED SPECIES *PINNA NOBILIS* (MOLLUSCA, BIVALVIA)

The fan mussel *Pinna nobilis* Linnaeus, 1758 is an endemic species of the Mediterranean, and is listed as a threatened and protected species under Annex II of the Barcelona Convention and Annex IV of the Habitats Directive 92/43/EEC. Since 2016 it is classified as "Critically Endangered" on the IUCN Red List of Threatened Species following a mass mortality event attributed to a multifactorial disease, in the whole mediterranean basin. Given the critical situation, several conservation and protection efforts have been launched for the species. In this regard, within the Life Pinna project (LIFE20 NAT/IT/001122), an international network of experts from the University of Genoa, Shoreline Soc. Coop., and the Aquarium of Pula (Croatia) are working in parallel to induce the gonadal maturation in a controlled environment to guarantee more reproductive events. From mid-January to April 2025, 4 specimens of *P. nobilis* per laboratory are maintained in tanks with different volumes, gradually increasing the temperature (from 15° to 24 °C) and the photoperiod (from 10 h to 18 h of light), to simulate the seasonal variation and natural spawning. Daily, the specimens are fed between 1.05×10^{10} – 2.1×10^{10} cells/specimen with a mix of three algal strains, depending on the water temperature (60% *Isocrhysis galbana*, 30% *Chaetoceros calcitrans*/*Phaeodactylum tricornutum*, and 10% *Tetraselmis suecica*/*T. chuii*). Additionally, zooplankton (copepods, *Artemia salina* nauplii, and rotifers) were added in known quantities, in vivo or as artificial feed. The possible presence of the pathogen *Haplosporidium pinnae* is monitored through periodic diagnostic genetic analysis of each specimen. Variation of abiotic parameters combined with an adequate diet should promote gonadal maturation and gametes release from April/May, resulting in fertilization and the development of larvae and juveniles. This experiment, integrating expertises, will increase the chances of success in obtaining larvae and juveniles, within the framework of actions for restocking this species.

F. FIORENTINO[1,2], C.V. BADALUCCO[1], G. BONO[1], M. CALABRÒ[1,3], G. GAROFALO[1,3,4], M.R. MANCUSO[1], B. PARLANTE[1], D. SCANNELLA[4], F. FALSONE[1,3], G. SINACORI[1], A. TITONE[1], S. VITALE[1,3], D. MASSI[1,3,4]

[1]Istituto per le Risorse biologiche e le Biotecnologie Marine (IRBIM), Consiglio Nazionale delle Ricerche (CNR), Mazara del Vallo (TP), Italia.
[2]Stazione Zoologica Anton Dohrn (SZN), Palermo, Italia.
[3]National Biodiversity Future Center (NBFC), Palermo, Italia.
[4]Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA), Palermo, Italia.
fabio.fiorentino@irbim.cnr.it

ANDAMENTO DELLA DISTRIBUZIONE E DELL'ABBONDANZA DEGLI ECHINODERMI SUI FONDI STRASCICABILI DELLO STRETTO DI SICILIA

Gli echinodermi sono considerati organismi indicatori di ambienti a elevata produttività biologica particolarmente vulnerabili sia alla pressione della pesca a strascico sia ai cambiamenti climatici. Abbiamo, pertanto, studiato l'andamento nel tempo della distribuzione e dell'abbondanza degli echinodermi dei fondali strascicabili dello Stretto di Sicilia (GSA 16). I dati sono stati raccolti durante le campagne di pesca a strascico MEDITS dal 2008 al 2024. L'analisi ha considerato sia l'insieme degli echinodermi sia le specie più abbondanti (*Antedon mediterranea* (Lamarck, 1816)*, Astropecten irregularis pentacanthus* (Delle Chiaje, 1827), *Leptometra phalangium* (Müller, 1841)*, Parastichopus regalis* (Cuvier, 1817), *Stylocidaris affinis* (Philippi, 1845)). Per ciascuna campagna è stata calcolata la percentuale di occorrenza (Oc%) e l'abbondanza media espressa come Indice di densità (DI; numero individui per km^2). L'andamento nel tempo di tali variabili è stato valutato mediante l'analisi di regressione segmentata, applicata sia ai valori annuali di %Oc sia di DI, questi ultimi trasformati in log. Tale approccio consente di definire il punto in cui il trend cambia significativamente durante l'arco di tempo considerato. I risultati hanno mostrato una diminuzione significativa sia di Oc%, con eccezione di *S. affinis*, sia di DI in tutte le specie, sebbene con alcune differenze nell'anno in cui inizia la riduzione. L'analisi esplorativa della relazione degli andamenti di Oc% e DI con i principali fattori ecologici ha mostrato una correlazione negativa con la temperatura e positiva con il pH dell'acqua nell'area. Tenuto conto della notevole diminuzione dell'attività della pesca a strascico nello stesso periodo e delle indicazioni della recente letteratura, che riportano una elevata sensibilità degli echinodermi alle variazioni dei fattori ecologici sopra riportati, si ritiene che la riduzione della distribuzione e dell'abbondanza sia dovuta alle variazioni delle condizioni oceanografiche legate ai cambiamenti climatici. Tale riduzione potrebbe prefigurare una variazione della produttività dell'ecosistema e delle risorse da pesca nello Stretto di Sicilia.

F. GUIDA[1,2,3], R. ESPOSITO[1], C. AMORIM[4], L. NÓBREGA[4], B. FLEURY[5], E. ESTEVES[6], M. COSTANTINI[1], V. ZUPO[2]

[1]Department of Ecosustainable Marine Biotechnology, Stazione Zoologica Anton Dohrn, Naples, Italy.
[2]Department of Ecosustainable Marine Biotechnology, Stazione Zoologica Anton Dohrn, Ischia Marine Center, Ischia (NA), Italy.
[3]Department of Biology, University of Naples Federico II, Italy.
[4]Graduate Program in Ecology and Evolution, University of the State of Rio de Janeiro, Brazil.
[5]Department of Ecology, University of the State of Rio de Janeiro, Brazil.
[6]Department of Zoology, University of the State of Rio de Janeiro, Brazil.
ful.guida@studenti.unina.it

CHEMOTACTIC RESPONSE AND GENIC ACTIVATION OF THE INVASIVE CORAL-SOL, *TUBASTRAEA COCCINEA* AND *T. TAGUSENSIS*

Tubastraea spp., also known as *coral-sol* (sun coral), is a genus of Cnidaria ascribed to the family Dendrophylliidae. They may become invasive, due to a high adaptability to a wide range of ecological conditions and strong resilience. Natural allochemicals produced by marine organisms might help controlling the expansion of these species, often competing with reef builder corals. In fact, several cyanobacteria, diatoms and sponges produce chemical weapons that may act against the reproduction and the expansion of specific invertebrates. Consequently, this research aimed at investigating the effects of metabolites produced by several organisms on the behaviour and the activation of stress genes in these corals. In this view, bioactive compounds able to influence the ecology and the expansion rhythms of *Tubastraea* spp. could be applied for green biotechnologies aimed at reducing their invasive expansions. We prepared agarose blocks charged with various infochemicals extracted by Mediterranean and tropical organisms and exposed coral colonies collected in Ilha Grande Bay, Rio de Janeiro state, Brazil, to their exudates, within a randomized and replicated experiment. Behavioural reactions of corals were recorded. After the exposure, polyps were collected and their RNA was extracted to monitor the expression of stress genes by Real Time qPCR. The results demonstrated that corals are negatively affected in their behaviour (polyp retraction) by a few extracts and that genic responses are coherent with behavioural reactions. The active extracts will be further fractionated to identify the most promising natural compounds in order to develop conservation biotechnologies. The work was funded by Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – Código de Financiamento 001.

S. IANNUCCI[1], A. DAVANZO[1], M. SEGARICH[2], S. CIRIACO[2,3], R. AURIEMMA[1]

[1]Section of Oceanography, National Institute of Oceanography and Applied Geophysics (OGS), Trieste, Italy.
[2]Shoreline Soc. Coop., Trieste, Italy.
[3]WWF AMP Miramare, Trieste, Italy.
siannucci@ogs.it

EMPTY SHELLS OF *PINNA NOBILIS* (MOLLUSCA: BIVALVIA) AS HABITAT FOR A DIVERSE CRUSTACEAN COMMUNITY

The Mediterranean endemic bivalve *Pinna nobilis* (Linnaeus, 1758) widely recognised as an ecosystem engineer and promoter of local biodiversity, has recently experienced a severe mass mortality across the region. However, the numerous empty shells remained intact and firmly anchored in the sediment continue to serve as a substrate for the colonisation of a diverse epibenthic community. The aim of this study is to assess the persistence of the bioengineering role of the *P. nobilis* shells by investigating the associated macrofaunal community. A preliminary structural and functional analysis of the crustacean community hosted by *P. nobilis* shells collected from two different sites (Miramare and S. Pietro) in the Gulf of Trieste was carried out. The collection of dead specimens of *P. nobilis* was done by scuba diving following a specially developed protocol, aimed at sampling only organisms living in and on the shells of the mussel. A total of 49 crustacean species belonging to seven different orders (Amphipoda, Decapoda, Isopoda, Tanaidacea, Balanomorpha, Cumacea, and Leptostraca) were identified in seven dead specimens of *P. nobilis.* Overall, Amphipoda counted most of the species (26), followed by Decapoda with 11 species and Isopoda with 7 species. Medium-high values of diversity indices were observed, suggesting that the role as ecosystem engineer persists even after the death of the animal, with significant positive effects on local biodiversity, especially in soft sediment bottoms, where the presence of dead shells of *P. nobilis* contributes to the increase of environmental heterogeneity.

A. LOGRIECO[1], E. REGATTIERI[2], I. CORNACCHIA[3], P. MONTAGNA[4], E. DOUVILLE[5], M. CALDARA[1], G. CHIMIENTI[6], V. DE SANTIS[1]

[1]Department of Earth and Geoenvironmental Sciences, University of Bari, Italy.
[2]Institute of Geosciences and Georesources (IGG-CNR), Pisa, Italy.
[3]Institute of Environmental Engineering and Geoengineering, Roma, Italy.
[4]Institute of Polar Sciences (ICP-CNR), Bologna, Italy.
[5]Laboratory of Climate and Environmental Sciences (LSCE/IPSL), Gif-sur-Yvette, France.
[6]Department of Biosciences, Biotechnology and Environment, University of Bari, Italy.
alessia.logrieco@uniba.it

CLADOCORA CAESPITOSA AND *PINNA NOBILIS*: BIOTIC ARCHIVES TO RECONSTRUCT PAST AND PRESENT CLIMATE SCENARIO OF THE MEDITERRANEAN SEA

The Mediterranean Sea is a semi-enclosed basin hosting more than the 7% of global marine biodiversity. Despite this, it is among the areas most exposed to human pressure and climate change. The study of the "pristine" status of ecosystems and marine shallow habitats is used as a reference for their management and for the adoption of adequate mitigation strategies in current times. However, totally pristine habitats do not exist anymore in the Mediterranean. The Last Interglacial (LIG, ~129 to 116 ka ago) was a warm time interval that could be considered a modern analogue lacking the anthropogenic fingerprint and be a useful scenario for future climate change. It can be used to reconstruct a detailed and quantitative framework of key environmental variables sustaining non-anthropically modified Mediterranean shallow-water ecosystems. The traces of past and present climate features are indeed recorded in some biotic archives, whose geochemical properties reflect seawater parameters. For instance, the bivalve *Pinna nobilis* (Linnaeus, 1758) and the coral *Cladocora caespitosa* (Linnaeus, 1767) are endemic of the Mediterranean Sea and their stable oxygen isotopes and trace elements composition are useful proxies to reconstruct the paleoclimate, potentially tracing the history of the Mediterranean Sea from the Pliocene to today. In this study, we investigate trace elements in fossil specimens of *C. caespitosa* from marine terraces deposits of the LIG, to reconstruct paleo sea water temperatures occurring during the coral life. We further measured the ratio of the oxygen ($\delta^{18}O$) and carbon ($\delta^{13}C$) stable isotopes in modern specimens of *P. nobilis* from Mar Piccolo (Taranto, Italy) to reconstruct the relationship with modern seawater temperatures, that may allow to calibrate paleogeochemical data retrieved from fossil specimens to better define a LIG climate scenario.

S. LORENZINI[1,2], E. GABRIELLI[1,2], D. SEVESO[2,3],
L. APPOLLONI[1], C. LOMBARDI[1]

[1]Marine Environment Research Centre S. Teresa, ENEA, Pozzuolo di Lerici (SP), Italy.
[2]Department of Earth and Environmental Sciences (DISAT), University of Milano-Bicocca, Italy.
[3]MaRHE Center (Marine Research and High Education Center), Magoodhoo Island, Faafu Atoll, Maldives.
sofia.lorenzini00@gmail.com

RECRUITMENT, GROWTH, AND PHYSIOLOGICAL RESPONSES OF *OSTREA EDULIS* (LINNAEUS, 1758) RESIDENT POPULATION FROM THE GULF OF LA SPEZIA

Ostrea edulis (Linnaeus, 1758), commonly known as the European flat oyster, is a species native to Europe. As a keystone species, building extensive "beds" (*i.e.*, oyster reefs) along the continental coasts, *O. edulis* provides ecosystem services such as supporting, provisioning, and regulating. The Gulf of La Spezia (Ligurian Sea, Italy) hosts a commercial and military harbor with consistent marine and maritime activities, as well as Natural Regional Parks. *O. edulis* has been present in the area since 1800, but the high direct and indirect anthropogenic activities had seriously impacted the local population. As part of National Recovery and Resilience Plan projects, specifically RAISE (Ecosystem Innovation of Liguria) and National Biodiversity Centre (NBFC), this research provided data on the status of *O. edulis* resident population in the Gulf of La Spezia. From March 2024 to February 2025, monthly data on morphology, physiology (*i.e.*, respiration and calcification) and recruitment were collected. Morphological analysis revealed significant differences in the growth rate over time (wet weight: $p<0.001$), with the highest increase occurring in summer. The mortality rate in *O. edulis* showed a peak in August 2024 (17.7%), while a minimum value in November 2024 (1.8%). Physiological analysis showed a time-dependent response in the Total Alkalinity Difference ($p<0.001$), carbon budget ($p<0.001$), and CO_2 net flux ($p<0.001$), all decreasing over the study period. A high degree of individual variability was observed across time for all the parameters analyzed. Recruitment data showed the highest juvenile oyster count in November 2024 (n=130), followed by a decline until January 2025 (n=102), when the greatest oyster loss occurred. These data are new for *O. edulis* local population and represent the baseline for the restoration activities that will be conducted in the framework of ongoing PNRR projects.

I. MANCINI[1], C.N. BIANCHI[2], C. MORRI[2], A. AZZOLA[1,3], F. MASSA[1], P. POVERO[1], L. CUTRONEO[4], M. CAPELLO[4]

[1]Department of Earth, Environment and Life Sciences (DiSTAV), University of Genoa, Italy.
[2]Genoa Marine Centre, Stazione Zoologica Anton Dohrn, Genova, Italy.
[3]National Biodiversity Future Center (NBFC), Palermo, Italy.
[4]Physical Oceanography Laboratory, DiSTAV, University of Genoa, Italy.
ilamancini@yahoo.it

UPDATED THEMATIC MAPS OF BENTHIC HABITATS IN THE URBAN COASTAL AREA: NOVEL DISCOVERIES AND CONSERVATION IMPLICATIONS

Detailed knowledge on the distribution of vulnerable habitats is required for the effective management and the long-term conservation of coastal marine ecosystems. Thematic environmental mapping is a relatively recent tool, valuable for improving knowledge on marine ecosystems, for assessing their change over time, and for identifying intervention and territorial management needs. In 2023 the 'Atlas of marine habitat of Liguria' (scale 1:10000) was updated in the urban area of Genoa city (Ligurian Sea, NW Mediterranean), thanks to sea-truthing surveys by scuba and ROV diving (Remotely Operated Vehicles). These surveys were part of the environmental impact assessment plan requested for the construction of the new breakwater of the port of Genoa, one of the largest in the Mediterranean Sea and a major maritime traffic hub. This study aims at assessing the extent, seafloor integrity, and detailed distribution of benthic habitats prior to construction. Previously unmapped coralligenous outcrops were identified at a depth of 25-40 m close to the port. Rhodolith beds, formed by the accumulation of living and dead nodules of calcareous red algae on mobile substrates, which create structurally complex and biologically diverse habitats, have been found in the study area for the first time. The occurrence of the invasive alga *Caulerpa cylindracea* was reported on the updated maps, especially on biodetritic bottoms, although its distribution range and bottom cover have significantly reduced in recent years. An unknown submarine cave was also discovered. The updated thematic maps, integrated with sea-truth, are indispensable tools for the identification of those valuable habitats in need of protection in a urban context.

T. MARROCCO[1], C. CERRANO[1,2,3,4], S. PUCE[1], T. PULIDO MANTAS[1,2], C. ROVETA[1,2], B. CALCINAI[1]

[1]Dipartimento di Scienze della Vita e dell'Ambiente, Università Politecnica delle Marche, Ancona, Italia.
[2]National Biodiversity Future Center (NBFC), Palermo, Italia.
[3]Stazione Zoologica Anton Dohrn, Napoli, Italia.
[4]Fano Marine Center, Fano (PU), Italia.
t.marrocco@staff.univpm.it

I MICROHABITAT DEI BIOEROSORI

L'eterogeneità spaziale è un motore fondamentale della biodiversità e della stabilità degli ecosistemi. Gli organismi in grado di modificare il paesaggio marino bentonico possono essere suddivisi in ingegneri autogenici (quando la presenza fisica degli organismi crea la complessità dell'habitat) e allogenici (quando l'attività degli organismi crea la complessità dell'habitat). Entrambi i gruppi influiscono sulla produzione di servizi ecosistemici, ma mentre esiste un'ampia letteratura scientifica sugli ingegneri autogenici, le conoscenze sull'habitat creato dagli organismi allogenici, come i bioerosori, sono ancora scarse. Il presente studio si propone di comprendere meglio il ruolo dei bioerosori nella costruzione delle comunità bentoniche e, a questo scopo, tre tipi di substrati artificiali (mattoni forati e pieni) sono stati installati a una profondità di 8 m, lungo la costa del Conero (Ancona). I mattoni forati sono stati scelti per imitare il substrato naturale bioeroso dal mollusco bivalve *Lithophaga lithophaga* (Linnaeus, 1758), mentre i mattoni pieni sono stati utilizzati come controllo. Sono stati rilevati 97 taxa (28 sessili e 69 vagili). La maggior parte dei taxa appartiene agli Arthropoda (35), agli Annelida (30) e ai Mollusca (20), mentre solo pochi appartengono agli Cnidaria (4), ai Bryozoa (3), ai Porifera e ai Chordata (2 ciascuno), e agli Echinodermata (1). Sono state riscontrate differenze significative tra le tre tipologie di mattoni se si considera la comunità vagile, mentre non sono state riscontrate differenze nella comunità sessile. Questi dati evidenziano l'importanza dellecavità come microhabitat essenziali per mantenere la biodiversità, mentre la loro influenza sulla ricchezza di specie può essere in gran parte attribuita al miglioramento delle condizioni fisiche, alla riduzione delle forze idrodinamiche e all'intrappolamento/stabilizzazione dei sedimenti al loro interno, oltre che al loro utilizzo come rifugio.

C. MARTINO[1], A. BADALUCCO[1,2], A. TUNINETTI[3],
D. IACIOFANO[1], S. LO BRUTTO[1,2]

[1]Department of Earth and Marine Sciences (DiSTeM), University of Palermo, Italy.
[2]National Biodiversity Future Center (NBFC), Palermo, Italy.
[3]Department of Life Sciences and Systems Biology, University of Turin, Italy.
caterina.martino@unipa.it

TWO SICILIAN PORTS, TWO DIFFERENT FOULING COMMUNITIES: ANALYSIS OF NIS CHARACTERIZING FOULING PERACARIDA IN TRAPANI AND PALERMO

The introduction and spread of marine non-indigenous species (NIS) are considered major environmental threats to marine biodiversity. Due to their association to artificial floating or submerged structures, fouling communities commonly host the majority of peracarid NIS. Despite their critical ecological role, current literature does not address peracarid assemblages comprehensively. These assemblages serve as a vital trophic connection between primary producers and higher trophic levels, occupy diverse niches across ecosystems, and this superorder contains a significant number of NIS. The aim of this work is to inquire into the variability and dynamism of peracarid fauna in the key sites of the Palermo and Trapani ports, both highly anthropized recreational boating spots located in the centre of the Mediterranean and facing two marine protected areas, Ustica Island and Egadi Islands. We identified 734 peracarids belonging to 15 different species. Of these 15 species, 6 were either NIS or cryptogenic species. *Caprella scaura* Templeton, 1836 was abundant in both ports and surpassed the other predator, the NIS *Paranthura japonica* Richardson, 1909, likely due to its plasticity in feeding behaviour, being able to rely on filter-feeding as an adult instead of being limited to predatory tactics. The cryptogenic species *Jassa slatteryi* Conlan, 1990 was only found in the port of Trapani. This grazer is efficient in the creation of detritus. In its stead we found the detritivorous tubicolous amphipod *Eritchtonius brasiliensis* (Dana, 1853) in Palermo station. The highly invasive detritivorous, tubicolous NIS *Laticorophium baconi* (Shoemaker, 1934) was found in both sites, but with greater abundance in Trapani. *Chondrochelia savignyi* (Kroyer, 1842) was abundant in the port of Trapani, confirming its preference of greater water turnover. The sampled sites showed an ample variety of peracarid species occupying the available trophic niches of a community characterized by NIS suspension-feeders.

V. MARUSSO[1], B. DI LORENZO[1], F. BERTASI[1], L. GROSSI[1], S. LOMIRI[1], D. VANI[1], S. CERACCHI[1], C. VIRNO LAMBERTI[1], A. BONIFAZI[2], G. GIORGI[1], B. TRABUCCO[1]

[1]ISPRA, Roma, Italy.
[2]ARPA LAZIO, Roma, Italy.
veronica.marusso@isprambiente.it

PRELIMINARY DATA ON BENTHIC ASSEMBLAGE OF TRANSITIONAL WATERS IN A LAGOON OF THE NORTHERN ADRIATIC SEA

Transitional waters are important habitats for the ecological role they represent and for biodiversity richness; however, they are sensitive to natural and anthropogenic pressure responsible to species and individuals' number changes. Benthic assemblages are recognized as a good environmental descriptor because of their deep link with the seabed. Ten sampling points were collected in Laguna Vallona (Northern Adriatic Sea) in three different times: before, during and after an anthropogenic pressure. Benthic assemblages were collected using a box corer and samples were fixed and identified to the lowest taxonomic level possible. Univariate and multivariate analyses were carried out. Large heterogeneity among stations was observed during the whole studied period, with the presence of few species with high abundance, typical features of transitional water, such as the Polychaeta *Streblospio shrubsolii* (Buchanan, 1890), *Hediste diversicolor* (O.F. Müller, 1776) and the Crustacea *Gammarus insensibilis* Stock, 1966 and *Gammarus aequicauda* (Martynov, 1931). Statistical analyses revealed differences among the three surveys, each characterized by a dominant population composed by different species. In the surveys carried out before the human pressure a high number of species was observed mainly in Polychaeta and Crustacea taxa. In the samples collected during the pressure the high species number was observed in Polychaeta taxon, while in the last survey Crustacea and Polychaeta showed the highest values. Similar trend was observed in the abundance values. Comparing our study with similar studies performed in transitional waters, we realized that this is a very heterogeneous and complex environment, and the observed changes in community structure can often be caused also by natural events.

E. MELIADÒ[1,2], G. DENTI[1,2], L. PAPA[1,2], F. RUBINO[1,2],
G. SQUITIERI[3], G. FANELLI[1,2]

[1]CNR-IRSA, Talassografico "A. Cerruti", Taranto, Italy.
[2]National Biodiversity Future Center (NBFC), Palermo, Italy.
[3]Officina dell'Immagine, Taranto, Italy.
eleonora.meliado@irsa.cnr.it

TESTING OF ARTIFICIAL SUBSTRATES WITH HIGH COMPLEXITY FOR BIODIVERSITY RESTORATION IN MEDITERRANEAN 'URCHIN BARRENS'

In the Mediterranean, the phenomenon of "urchin barrens" is driven by the coexistence of *Paracentrotus lividus* and *Arbacia lixula*, two sea urchin species that, by grazing on algae and early developmental stages of invertebrates, prevent the recolonization of desertified rocky substrates. This ecological degradation can persist for decades, as observed in areas heavily impacted by the harvesting of the date mussel (*Lithophaga lithophaga*). In this context, the present pilot study, funded by the PNRR within the framework of the "National Biodiversity Future Center" (NBFC), aims to test new technologies for restoring biodiversity in degraded marine environments. The methodology involves the 3D printing of cement disks characterized by heterogeneous elements in terms of size and geometry, simulating the natural complexity of rocky surfaces. The study started placing these artificial substrates on vertical barren areas of the upper infralittoral zone (3-5 m depth) to assess their effectiveness in promoting biological recolonization. The working hypothesis is that disks with high structural complexity are more effective in restoring biodiversity than control disks with lower complexity, by limiting the predatory activity of *P. lividus* and *A. lixula* and facilitating algal growth and the development of benthic organisms beyond juvenile stages. The experimental site is located along the Ionian coast of the Gulf of Taranto, an area that has suffered significant biodiversity loss due to date mussel fishing, disrupting ecosystem balances. By monitoring the feeding behavior of sea urchins and algal recolonization it will be possible to evaluate the effectiveness of these innovative solutions over time, with the potential to apply them to other Mediterranean areas affected by biological desertification.

L. MORISCO[1], S. CARDONE[2], F. FARINA[2], D. VENTURA[1], G. MANCINI[1], M. PENNA[3], A. BELLUSCIO[1], G.D. ARDIZZONE[1], E. CASOLI[1]

[1]Dipartimento di Biologia Ambientale, Sapienza Università di Roma, Italia.
[2]Centro Interuniversitario di Biologia Marina ed Ecologia Applicata "G. Bacci" (CIBM), Livorno, Italia.
[3]Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA), Roma, Italia.
edoardo.casoli@uniroma1.it

IL RECUPERO ECOLOGICO DELLE COMUNITÀ BENTONICHE A SEGUITO DEL DISTURBO ANTROPICO: UN CASO STUDIO NEL MAR TIRRENO

La valutazione degli impatti del disturbo antropico sulla composizione e la struttura degli ecosistemi marini rappresenta un tema centrale nelle ricerche di biologia ed ecologia marina: al contrario, la capacità e i tempi di recupero dall'impatto rimangono tuttora poco investigati. Il presente contributo è finalizzato a valutare i *patterns* di ricolonizzazione e la capacità di recupero naturale delle comunità fotofile ed emisciafile dei fondali rocciosi entro i 30 m di profondità, a seguito dell'impatto dovuto al naufragio della nave Costa Concordia e delle successive attività di pulizia dei fondali. I campionamenti, condotti attraverso tecniche non distruttive, sono stati effettuati dal 2018 al 2023, in due siti impattati all'interno dell'area interessata dal naufragio e in un sito di controllo distante alcune centinaia di metri. Le osservazioni sono state condotte su due fasce batimetriche: una superficiale (10-15 m) e una profonda (20-30 m). I risultati evidenziano una ricolonizzazione veloce dei substrati defaunati e un recupero parziale delle comunità dei siti impattati rispetto alle condizioni del sito di controllo. L'analisi multivariata mostra differenze significative in termini di composizione e struttura delle comunità tra siti impattati e sito di controllo e in relazione alle fasce batimetriche. A 10-15 m di profondità, le differenze tra i siti tendono a ridursi progressivamente nel tempo; al contrario, a 20-30 m di profondità, la struttura delle comunità continua a presentare differenze anche nel 2023. Inoltre, in questa fascia batimetrica, i processi di insediamento allontanano la comunità dallo stato di equilibrio precedente al disturbo. Tale aspetto, soprattutto nel caso della colonizzazione di numerosi talli di *Sargassum vulgare* Agardh, 1820 sui fondali precedentemente dominati dal turf a *Phyllophora crispa* (Hudson) Dixon, 1964, appare evidente e necessita di ulteriori indagini.

S. NATALE[1], A.F. PERITORE[2], F. CAPPARUCCI[1], C. IARIA[1], F. MARINO[1]

[1]Department of Chemical, Biological, Pharmaceutical and Environmental Sciences, University of Messina, Italy.
[2]Department of Veterinary Sciences, University of Messina, Italy.
snatale@unime.it

ASSESSING THE IMPACT OF PFOS EXPOSURE ON OXIDATIVE STRESS AND TISSUE DAMAGE IN *RUDITAPES* SP. FROM THE CAPO PELORO LAGOON

Located at the northeastern corner of Sicily, the Lagoon of "Capo Peloro" is a transitional environment of high ecological importance. This ecotone is locally renowned for bivalve molluscs farming, mainly clams (*Ruditapes* sp.) and mussels (*Mytilus galloprovincialis*). Assessing the presence of emerging contaminants in production areas is crucial to ensure the safety of the final product for human consumption. For this reason, scientific research has recently focused on the potential adverse effects of these persistent pollutants on the health of ecosystems and consumers. In this study, we investigated the chronic toxicity and oxidative stress caused by perfluoroctanesulfonates (PFOS) exposure of specimens of *Ruditapes* sp. purchased from a local traders. The lethal concentration (LC_{50}) was experimentally determined (25.89 mg/L), and individuals (n=60) were subsequently exposed to PFOS at 22 °C, divided into one control tank (T1) and three experimental tanks (T2: 1mg/L; T3:10mg/L; T4: 20mg/L). After 15 days of exposure, samples of gills and digestive gland were collected for histological analysis to assess the potential damage caused by the contaminant. In addition, immunohistochemical techniques were applied to investigate the effects of PFOS on the immune system of clams. Molecular analyses were also performed on the same tissues extracted to determine the intensity of oxidative damage, using Malondialdehyde (MDA) assays for lipid peroxidation, Catalase assays for antioxidant system, and Nitrite assays for nitrosative stress. The results of histological and molecular analyses showed a dose-dependent pattern of reaction, particularly evident in the gill tissues of specimens from T3 and T4 tanks. This evidence suggests that PFOS exposure can induce significant physiological and biochemical changes in clam tissues, including alterations in cellular structures and defence mechanisms. Further analyses are undoubtedly required to better understand how the presence of these anthropogenic contaminants in the aquatic environments may affect the health of high-value commercial species such as clams.

D. OLIVA[1], A. PIRO[1], M. CARBONE[2], E. MOLLO[2], M. KUMAR[3,4], F. SCARCELLI[1], D.M. NISTICÒ[1], S. MAZZUCA[1]

[1]Laboratorio di Biologia e Proteomica Vegetale, Dipartimento di Chimica e Tecnologie Chimiche, Università della Calabria, Rende (CS), Italia.
[2]Istituto di Chimica Biomolecolare, Consiglio Nazionale delle Ricerche, Pozzuoli (NA), Italia.
[3]Central Queensland University, Gladstone Campus, School of Health, Medical and Applied Sciences, Coastal Marine Ecosystems Research Centre, Gladstone, Australia.
[4]Climate Change Cluster, University of Technology Sydney, Australia.
daniela.oliva@unical.it

EFFETTI DEI METABOLITI DI *CAULERPA* SUGLI *SHOOTS* APICALI E VERTICALI DI *POSIDONIA OCEANICA*: ANALISI FISIOLOGICA E MOLECOLARE

Le specie invasive di *Caulerpa* rilasciano metaboliti bioattivi che possono alterare la fisiologia della *Posidonia oceanica*, fanerogama endemica del Mar Mediterraneo. Questo studio ha esaminato le risposte fisiologiche e molecolari dei shoots apicali e verticali di *P. oceanica* all'esposizione di due metaboliti algali: caulerpenina (CYN) da *C. taxifolia* e caulerpina (CAU) da *C. cylindracea*. L'esposizione a 25 µM di CYN ha causato una mortalità del 90% nelle foglie adulte dei shoots apicali e ha inibito significativamente la formazione di nuove foglie nei shoots verticali, pur senza alterare il contenuto di clorofilla. Al contrario, 25 µM di CAU hanno stimolato la comparsa di foglie giovanili, ma hanno ridotto la crescita delle foglie adulte del 64% e compromesso il contenuto di clorofilla in entrambi i tipi di shoots. L'analisi proteomica ha rivelato una significativa riduzione delle proteine nei shoots apicali esposti a CYN, in particolare quelli coinvolti nella fotosintesi, nella risposta allo stress, nella segnalazione dei brassinosteroidi e nel metabolismo degli acidi grassi. CYN ha anche aumentato l'espressione della lattato deidrogenasi e della gliossalasi, interferendo con la segnalazione del calcio^{2+}/calmodulina. L'esposizione a CAU ha portato a una diminuzione dell'istone H4, ma ha incrementato l'abbondanza di proteine protettive, come la catalasi, la fenilalanina ammonio-liasi e la proteina Hsp70, attenuando il danno ossidativo. Nei shoots verticali, CYN ha stimolato la biosintesi degli acidi grassi, l'attività della lipossigenasi, le vie di fosforilazione e il metabolismo dello zolfo, mentre CAU ha inibito la metilazione e aumentato i livelli dell'istone H3. I shoots apicali hanno mostrato una maggiore sensibilità agli effetti tossici di CYN rispetto ai shoots verticali, mentre entrambi hanno dimostrato resilienza a CAU. Data l'importanza dei shoots apicali nella propagazione clonale, la loro maggiore vulnerabilità a CYN potrebbe contribuire al declino delle praterie di *P. oceanica* nelle aree invase da *C. taxifolia*. Questi risultati chiariscono i meccanismi molecolari e fisiologici alla base delle risposte delle fanerogame alle tossine prodotte dalle macroalghe invasive.

A. OPRANDI[1], M.P. FERRANTI[1,2], M. SEGARICH[3,4], V. PITACCO[5], A. FORTIČ[5], D. TRKOV[5], A. DAGNINO[6], D. CARACCIOLO[6]

[1]Department of Earth, Environment and Life Sciences (DiSTAV), University of Genoa, Italy.
[2]National Biodiversity Future Center (NBFC), Palermo, Italy.
[3]Shoreline Società Cooperativa, Trieste, Italy.
[4]Miramare Marine Protected Area, Trieste, Italy.
[5]National Institute of Biology (NIB), Ljubljana, Slovenia.
[6]Regional Agency for the Environmental Protection Liguria (ARPAL), Genova, Italy.
alice.oprandi@edu.unige.it

FIRST-YEAR MONITORING OF *PINNA NOBILIS* SURVIVAL IN THE WILD: THE LIFE PINNA PROJECT

The populations of the fan mussel *Pinna nobilis* Linnaeus, 1758 have experienced a severe decline throughout the whole Mediterranean basin since 2016. Following a large number of studies, a multi-factorial disease has been identified as the most likely cause of the increasing mass mortality events that have brought the species on the brink of extinction. In recent years, the critical situation has called for the implementation of international conservation projects in an attempt to reverse the negative trend. In this context, the European LIFE PINNA project (LIFE20 NAT/IT/001122) is supporting concrete actions for the restocking of *P. nobilis*. Among these, the installation of self-recruited individuals of *P. nobilis* (i.e. juveniles) collected by specific devices and mussel farms longlines in the northern Adriatic Sea, as well as of adult individuals, after having been used for reproduction in controlled conditions, is foreseen in pilot areas. This study reports on the survival of adult and juvenile individuals of *P. nobilis* installed at three coastal locations: Capo Mortola in the western Ligurian Sea, Miramare and the Slovenian coast in the northern Adriatic. At the Capo Mortola site, four adult individuals of *P. nobilis* survived out of a total of 10 individuals translocated (survival rate 40%). In Miramare, out of 53 specimens (38 juveniles and 15 adults), only three adults survived (survival rate 20%). Along the Slovenian coast, out of 20 juveniles, only one specimen survived (survival rate 5%). As observed in nature, juveniles exhibited reduced survival potential compared to adults. The average survival time at sea was higher in the Ligurian Sea (about 6 months) compared to the Adriatic Sea (3 months). As these are preliminary results, prolonged monitoring will be crucial to track the resilience of this endangered species and the future of *Pinna nobilis* populations in the Mediterranean.

S. PALATO[1], C. D'IGLIO[1], G. RANDAZZO[2,3], S. LANZA[2,3], S. SAVOCA[1,4], N. SPANÒ[1,4]

[1]Department of Chemical, Biological, Pharmaceutical and Environmental Sciences, University of Messina, Italy.
[2]Department of Mathematics, Computer Sciences, Physics and Earth Sciences, University of Messina, Italy.
[3]GeoloGIS s.r.l., Department of Mathematics, Computer Sciences, Physics and Earth Sciences, University of Messina, Italy.
[4]Sea in Health and Life s.r.l., Department of Chemical, Biological, Pharmaceutical and Environmental Sciences, University of Messina, Italy.
simon.palato@studenti.unime.it

CHARACTERIZATION OF SOFT BOTTOM COMMUNITIES IN OTRANTO CHANNEL (SOUTH ADRIATIC SEA)

The aim of this study is to describe, for the first time, the marine soft bottom habitats and the associated macrozoobenthic communities of the Otranto costal area (south-Adriatic, east Mediterranean Sea), analyzing the biotic diversity and its relationships with environmental factors. Sampling was carried out during autumn 2023, with a total of 49 stations, and a depth ranging between 30 and 105 meters. Soft bottom samples were collected from each station for macroozoobenthic, chemical, and granulometric characterization. Sea bottom was characterized by sand and coarse sediments near the coastline, and a uniform Silt-Clay and Clayey-Silt composition in offshore, below 50 m depth. A total of 60 species were identified, mainly belonging to Polychaeta (27 species), followed by Crustacea (9 species), Mollusca and Echinodermata (6 and 4 species, respectively). Polychaeta was, in general, the dominant group (both in species richness and abundance), with Capitellidae, Eunicidae and Lumbineridae as the families with the highest number of specimens. Four EUNIS habitats were identified: 1) Mixed sediment shores dominated by Capitellidae family; 2) Sublittoral coarse sediment including venerids bivalves; 3) Infralittoral fine sand with Polychaeta Nephtidae family; 4) Circalittoral muddy sand characterized by the presence of *Amphiura* spp. and *Nucula nitidosa*. The community structure analysis evaluated the alfa diversity in terms of a mean Margalef Index of 1.10, a mean Shannon Index of 0.34, and a mean Simpson Index of 0.70. Beta diversity was evaluated through a species abundance Bray-Curtis similarity matrix followed by Hierarchical Cluster analysis and Multidimensional Scaling (MDS), on the 49 stations, allowing the identification of 4 benthic assemblages with a 75% of similarity. This study represents a benchmark for future monitoring of soft bottom habitats on the South-Adriatic coast, providing data for future temporal changes evaluation.

M. PICCARDO[1], M. RENZI[1], A. PALLAVICINI[1], C. SPOTO[1], M. FAGGION[1], A. FALACE[1], S. CIRIACO[2], S. BEVILACQUA[1]

[1]Department of Life Sciences, University of Trieste, Italy.
[2]WWF Miramare MPA, Trieste, Italy.
manuela.piccardo@units.it

ASSESSING BIOLOGICAL EFFECTS OF BIOCHAR-BASED CONCRETE FOR MARINE ARTIFICIAL STRUCTURES

Biochar is a solid, porous, carbon-rich material, typically obtained from the pyrolysis of biomass, which has a broad range of applications. Recently, a wide interest has arisen in its potential use as a filler in building materials such as concrete. However, the possible effects on the marine biota associated with introducing biochar in concrete mixtures for constructing marine artificial structures remain unexplored. In this study, a field experiment was conducted to assess whether the development of marine sessile assemblages on artificial hard substrates could be influenced by the addition of biochar. Before the experiment, bioassays on biochar were carried out to assess toxicological effects on target marine organisms. Experimental tiles made of ordinary concrete and biochar-doped concrete with relevant concentration (5% and 10% by weight) were then placed at 2 m depth in three sites along the coast (N Adriatic) and colonization was investigated for six months (60, 120, and 180 days since immersion). Sessile assemblages on tiles were analyzed under magnification to estimate the % cover of taxa. Early colonization processes (7 days and 60 days since immersion) were investigated through metabarcoding of biofilm and early settlers on tiles. The ecotoxicological effects of raw biochar were not relevant for all target organisms. The structure of sessile assemblages on tiles significantly varied in time and among sites but consistently among substrates, indicating comparable colonization processes between ordinary concrete and biochar-doped concretes. Our findings do not sustain the hypothesis of potential negative effects of biochar addition in concrete for marine artificial structures and enlighten possible benefits related to carbon sequestration; however further studies are needed to clarify the pros and cons of introducing biochar materials in the marine environment.

L. PIVA[1], A. BANFI[1], M. TAMBURINI[2], N. ANCONA[2], P. PANZALIS[3], S. CARONNI[1]

[1]Dipartimento di Scienze dell'Ambiente e della Terra, Università di Milano-Bicocca, Italia.
[2]Acquario Civico e Stazione Idrobiologica di Milano, Italia.
[3]Area Marina Protetta Tavolara Punta Coda Cavallo, Olbia (SS), Italia.
l.piva3@campus.unimib.it

PRIME EVIDENZE SULLA PRESENZA DI UNA NUOVA VARIETÀ INVASIVA DI *CAULERPA PROLIFERA* (CHLOROPHYTA) IN MEDITERRANEO

Il genere *Caulerpa* comprende diverse macroalghe abbondanti in Mediterraneo, tra cui *Caulerpa taxifolia* (M. Vahl) C. Agardh, altamente invasiva nel bacino, e *Caulerpa prolifera* (Forsskål) J.V. Lamouroux, autoctona e non invasiva. Negli ultimi anni, tuttavia, in alcune zone del bacino, tra cui l'Area Marina Protetta Tavolara-Punta Coda Cavallo in Sardegna, si sta verificando una significativa espansione di *C. prolifera* che sta colonizzando ampie porzioni di substrato, anche in presenza di altre macroalghe e fanerogame, dimostrandosi invasiva. Le fronde osservate nelle nuove *patch* della macroalga, inoltre, appaiono più grandi e caratterizzate da una forma diversa dalle tipiche mediterranee, suggerendo che si stia diffondendo una nuova varietà invasiva di *C. prolifera*, come già accaduto recentemente per *C. taxifolia*. Obiettivo di questo studio è stato, quindi, acquisire i primi dati di dettaglio sul potenziale invasivo della succitata macroalga, confrontandone le performance sia con quelle dello *strain* tipico mediterraneo sia con quelle della congenere invasiva *C. taxifolia.* Allo scopo, è stato condotto un esperimento manipolativo in condizioni controllate presso l'Acquario Civico di Milano, nel corso del quale la performance delle macroalghe considerate è stata valutata in diverse condizioni ambientali (temperatura, salinità, pH, concentrazione dei principali nutrienti e intensità luminosa), considerandone i principali tratti funzionali (mortalità, numero di fronde per tallo, lunghezza delle fronde). Dai dati complessivamente raccolti, lo *strain* di *C. prolifera* in diffusione in Mediterraneo è apparso in grado di sopravvivere e crescere rapidamente in differenti condizioni ambientali, mostrandosi più tollerante non solo rispetto allo *strain* di *C. prolifera* tipico del bacino ma anche alla congenere *C. taxifolia*, di cui è noto l'elevato potenziale invasivo, anche in differenti condizioni ambientali. Questi risultati, seppur preliminari, sembrano confermare la diffusione in Mediterraneo di una nuova varietà della macroalga e, dato il suo potenziale invasivo, suggeriscono l'importanza di effettuare analisi genetiche finalizzate a confermarne la presenza.

I. PROVERA[1], M. DELARIA[2], P. PANZALIS[3], S. CITTERIO[2], S. CARONNI[2]

[1]Department of Integrative Marine Ecology, Stazione Zoologica Anton Dohrn, Naples, Italy.
[2]Department of Earth and Environmental Sciences, University of Milano-Bicocca, Italy.
[3]Marine Protected Area of Tavolara Punta Coda Cavallo, Olbia (SS), Italy.
sarah.caronni@unimib.it

IS *PATELLA FERRUGINEA* A SELECTIVE GRAZER? PRELIMINARY DATA ON CHANGES IN MICROPHYTOBENTHIC COMMUNITY STRUCTURE IN RELATION TO LIMPET FEEDING ACTIVITY

Microphytobenthos plays an important role as food sources for macrofauna in shallow water areas, and it is well known that its composition can affect grazers community structure. In contrast, the information on the effect of grazers pressure on the structure of microphytobenthic communities is limited. The aim of this study was to qualitatively and quantitatively characterize microphytobenthic communities in the presence of a *Patella ferruginea* population, in order to identify potential changes in their structure related to limpet feeding activity. To this aim, microphytobenthos samples were collected during summer along the coasts of Molarotto Island (Tavolara-Punta Coda Cavallo MPA, Sardinia), in two areas that were similar in terms of water flow, nutrient levels and sea surface temperature, but different in abundance of limpets. The abundance and composition of the microphytobenthic communities were evaluated by means of sample analysis using an inverted microscope. Moreover, the abundance of the limpet in the two areas was evaluated directly in the field by visual census. As expected, the microphytobenthic community was mainly composed of diatoms, dinoflagellates and cyanobacteria in both areas. However, its composition (in terms of genera) and abundance (in terms of cell densities) varied significantly in relation to *P. ferruginea*'s presence. Specifically, while dinoflagellate abundance was equal in both areas, cyanobacteria and especially diatoms were more abundant in areas with fewer limpets. Considering diatoms, *Berkeleya* and *Licmophora* spp. were not found in case of high density of the limpet. These results suggest a possible influence of *P. ferruginea* grazing activity on the structure of microalgae communities and provide a first indication of the dietary preferences of these limpets.

I. PROVERA[1], V.M. GIACALONE[2,3], J. PAZZAGLIA[1,3], E. DATTOLO[1,3], F. BADALAMENTI[3,4], L. MARÍN-GUIRAO[1,5]

[1]Department of Integrative Marine Ecology, Stazione Zoologica Anton Dohrn, Naples, Italy.
[2]Institute of Anthropic Impacts and Sustainability in Marine Environment (IAS), National Research Council (CNR), Torretta Granitola (TP), Italy.
[3]National Biodiversity Future Center (NBFC), Palermo, Italy.
[4]Institute of Anthropic Impacts and Sustainability in Marine Environment (IAS), National Research Council (CNR), Palermo, Italy.
[5]Centro Oceanográfico de Murcia (IEO, CSIC), San Pedro del Pinatar, Spain.
isabella.provera@szn.it

TEMPORAL DYNAMICS OF TRANSCRIPTIONAL MEMORY IN *POSIDONIA OCEANICA* SEEDLINGS

Seagrasses can develop stress memory through repeated exposure to environmental challenges, enhancing their resilience to future stressors. This process, known as stress hardening or priming, involves the activation of stress-responsive genes, enabling a more efficient response upon subsequent stress events (*i.e.*, transcriptional memory). However, this beneficial response can be temporary, as memory-resetting mechanisms may deactivate stress signalling pathways, restoring normal functioning. This study investigated the effect of heat-priming on the Mediterranean endemic seagrass *Posidonia oceanica*, focusing on transcriptional memory, its role in enhancing responses to repeated stress, and its temporal persistence. To assess this, *P. oceanica* seedlings were initially exposed to a heat-priming event and later subjected to a second heat-stress. Transcriptional profiles of control, primed, and non-primed seedlings were analysed at intervals of 1, 3, and 10 days after priming to determine the persistence of stress-induced gene expression. Results revealed distinct transcriptional activity between heat-primed and non-primed seedlings upon immediate re-exposure to stress (one-day lag-phase). Non-primed seedlings exhibited an acute reaction, characterized by a strong upregulation of stress-related genes, whereas primed seedlings prioritized growth and development-related pathways. However, as the lag-phase increased, the transcriptional changes induced by priming gradually declined, leading to a partial or complete return to baseline gene expression levels in primed seedlings. Consequently, the transcriptomic profile of primed and non-primed seedlings gradually converged and their responses to subsequent stress events became increasingly similar over time. These findings suggest that sustaining stress-induced gene expression in the absence of stress may be energetically costly, particularly during energy-demanding growth stages. While heat priming provides an initial advantage by preparing seedlings for future stress, its benefits gradually diminish over time, potentially limiting its long-term effectiveness.

P. PUTHOD[1], A. SICILIANO[1], C. PIGNALOSA[1], D. MONACO[1], A. CELENTANO[1], R. CARBONE[1], F. D'APICE[1], S. CAPONE[1], S. DE FILIPPO[2], S. LUBRANO LAVADERA[2]

[1]U.O. Mare ARPAC, Napoli, Italia.
[2]U.O. Lab. Reg. Mare, Dipartimento Provinciale di Napoli, ARPAC, Italia.
p.puthod@arpacampania.it

SPECIE NON INDIGENE E CRIPTOGENICHE NEI PORTI E NEI FONDALI DELLA CAMPANIA

L'introduzione di specie non indigene rappresenta una minaccia per la biodiversità del Mar Mediterraneo, e identificare nuove specie aliene e prevederne il potenziale invasivo è ancora una sfida aperta. In questo lavoro sono riportate le specie non indigene e criptogeniche identificate tra il 2018 e il 2024 durante le campagne di monitoraggio Marine Strategy (2008/56/CE) nella regione Campania, condotte da ARPAC. Le specie sono state individuate grazie ai monitoraggi relativi ai Moduli 3 e 9. Il fitoplancton è stato campionato con un retino a maglia da 20 µm e bottiglia Niskin, mentre il mesozooplancton con un retino a maglia da 200 µm. Il macrozoobenthos di substrato duro è stato raccolto tramite grattaggio di superfici su strutture portuali, mentre quello di substrato mobile con una benna van Veen (0,1 m², 16 L). In totale, sono state identificate 17 specie non indigene e 3 criptogeniche. Tra queste, nel fitoplancton: *Pseudo-nitzschia multistriata* (Takano, 1995) e *Ostreopsis ovata* (Fukuyo, 1981). Nel mesozooplancton: *Paracartia grani grani* (Sars G.O., 1904), *Pseudodiaptomus marinus* (Sato, 1913) e la zoea di *Percnon gibbesi* (H. Milne Edwards, 1853). Tra le 15 specie di macrozoobenthos vi sono: *Bugula neritina* (Linnaeus, 1758), *Caprella scaura* (Templeton, 1836), *Paraleucilla magna* (Klautau, Monteiro & Borojevic, 2004), *Paracerceis sculpta* (Holmes, 1904), *Styela plicata* (Lesueur, 1823), *Hydroides dirampha* (Mörch, 1863), *Mesanthura* cfr. *romulea* (Poore & Lew Ton, 1986), e *Penaeus aztecus* (Ives, 1891). Per *Penaeus aztecus* il dato è di prima segnalazione nel mare della Campania e, più ampiamente, nel Mar Tirreno Centrale, dove la specie era stata segnalata solo una volta nel 2019 a Capo Teulada, Sardegna. Questa segnalazione, assieme ai dati relativi alla distribuzione spaziale (coordinate geografiche), profondità, temperatura, salinità, e pH, possono incrementare le conoscenze sulla sua espansione nel Mar Mediterraneo.

A. RIVELA[1], F. BETTI[1], A. COSTA[1], F. ENRICHETTI[1,2,3], G. BAVESTRELLO[1,2,3], S. CANESE[4], G. GAY[5], M. BO[1,2,3]

[1]Dipartimento di Scienze della Terra, dell'Ambiente e della Vita, Università di Genova, Italia.
[2]Consorzio Nazionale Interuniversitario per le Scienze del Mare (CoNISMa), Roma, Italia.
[3]National Biodiversity Future Center (NBFC), Palermo, Italia.
[4]Stazione Zoologica Anton Dohrn, Roma, Italia.
[5]Fondazione Azionemare, Lugano, Svizzera.
rivela.andrea@yahoo.com

STUDIO DELLE DINAMICHE DELLA FAUNA PROFONDA ASSOCIATA A *REEF* DI *MADREPORA OCULATA* (LINNAEUS, 1758) NEL CANYON DI LEVANTE (MAR LIGURE) TRAMITE TELECAMERA *TIME-LAPSE*

I *reef* a coralli bianchi sono tra gli ecosistemi profondi a più elevata diversità grazie alla loro struttura tridimensionale complessa e all'elevata trofia. La fauna di questi ambienti è generalmente studiata tramite censimenti ROV puntiformi, mentre sono disponibili pochi dati su scale temporali più lunghe, ottenuti tramite lander dotati di telecamere *time-lapse*, in particolare senza esca. Questo studio si è focalizzato sulle dinamiche della fauna vagile e sedentaria associata a un *reef* vivente di *Madrepora oculata* (Linnaeus, 1758) situato nel Canyon di Levante (Mar Ligure orientale) a una profondità di 558 m. L'obbiettivo è di investigare, mediante l'utilizzo di un lander, la diversità epimegafaunale e la relazione tra le specie associate e la biocostruzione, considerando anche i parametri ambientali ottenuti *in situ* in maniera semi-quantitativa. Sono stati analizzati 618 video della durata di 5 secondi ciascuno, ottenuti su un arco di 64 giorni a intervalli di 2 ore. Il campo visivo, di circa 10 m^2, comprendeva sei zone a differente complessità dell'habitat (diviso in *canopy*, *rubble*, e acqua sovrastante). Sono state identificate 24 specie appartenenti a sei taxa (Nemertea, Polychaeta, Pycnogonida, Malacostraca, Echinoidea e Teleostei), di cui otto stanziali, 12 occasionali e 3 con *habitus* indefinito. Ittiofauna e crostacei sono risultati i due gruppi più ricchi e più frequentemente osservati, includendo anche target commerciali. Le specie hanno mostrato diverse preferenze per i tre livelli della stratocenosi e alcune hanno mostrato un comportamento plausibilmente territoriale per una specifica zona, legato a interazioni biotiche interspecifiche e alla complessità ambientale. *Bonellia viridis* ha mostrato dinamiche comportamentali significativamente influenzate da eventi turbiditici intensi. Questo studio contribuisce a una maggiore comprensione del funzionamento di ecosistemi profondi mediterranei carismatici come i *Cold Water Coral* (CWC) *reefs*, con importanti implicazioni per la loro conservazione.

C. ROBELLO[1,2], F. PELIZZA[1,2], M. ODDENINO[1], A. OPRANDI[1], I. MANCINI[1], G. LIGUORI[2], L.M. LEONE[3,4], L. PIAZZI[3,5], S. ACUNTO[3,4]

[1]Dipartimento di Scienze della Terra dell'Ambiente e della Vita (DISTAV), Università di Genova, Italia.
[2]One Ocean Foundation, Milano, Italia.
[3]International School for Scientific Diving ETS, Lucca, Italia.
[4]MAREA Studio Associato, Cecina (LI), Italia.
[5]CIBM, Livorno, Italia.
chiara.robello@edu.unige.it

TECNICHE DI TRAPIANTO A CONFRONTO: EFFICACIA DEI PICCHETTI PER L'ANCORAGGIO DELLE TALEE DI *POSIDONIA OCEANICA* (L.) DELILE

Le praterie di *Posidonia oceanica* sono ecosistemi fondamentali per la biodiversità marina e la stabilità dei fondali del Mediterraneo. Tuttavia, negli ultimi decenni, la crescente pressione antropica ha determinato una loro drastica regressione. Per contrastare questa tendenza, sono stati avviati diversi progetti di ripristino che mirano alla riforestazione di aree circoscritte del fondale marino. I trapianti di *P. oceanica* rappresentano una strategia promettente, ma la loro efficacia dipende dalle condizioni ambientali e dalla tecnica di utilizzata. In questo studio sono state confrontate due metodologie di ancoraggio delle talee: biostuoie in fibra di cocco con rete metallica e picchetti metallici. Entrambe le tecniche sono state testate in due siti distinti, antistanti le coste di Sanremo (Imperia, Liguria), caratterizzati da elevato idrodinamismo e da un substrato di matte morta. Il monitoraggio ha incluso la valutazione della sopravvivenza delle talee trapiantate e la densità dei fasci fogliari. I risultati confermano l'efficacia di entrambe le tecniche con percentuali di sopravvivenza superiori al 60%. Tuttavia, in linea con precedenti studi, nei primi mesi dall'impianto la sopravvivenza è risultata significativamente maggiore nei trapianti realizzati con i picchetti. Questo risultato potrebbe essere dovuto all'utilizzo di talee esclusivamente plagiotrope e alla maggiore efficienza iniziale del sistema di ancoraggio. Inoltre, le biostuoie risultano più esposte a fenomeni di ancoraggio illegale e possono essere scalzate in condizioni di forte idrodinamismo, compromettendo l'attecchimento delle piante. I risultati ottenuti evidenziano come la scelta della tecnica di trapianto debba essere adattata alle specifiche condizioni del sito per ottimizzare il successo del ripristino. In ambienti ad alto idrodinamismo o in praterie frammentate con piccole aree di matte morta, l'uso dei picchetti si è dimostrato molto efficace, dimostrando come la stabilizzazione meccanica delle piante, soprattutto nei primi mesi dopo il trapianto, rappresenti un fattore determinante per la loro sopravvivenza.

F. ROSANO[1], C. D'IGLIO[2], P. GALLI[1], N. SPANÒ[2,3], M. ALBANO[4], G. CAPILLO[2,3], S. SAVOCA[2,3]

[1]Department of Earth and Environmental Sciences (DISAT), University of Milano-Bicocca, Italy.
[2]Department of Chemical, Biological, Pharmaceutical and Environmental Sciences, University of Messina, Italy.
[3]Sea in Health and Life s.r.l., Department of Chemical, Biological, Pharmaceutical and Environmental Sciences, University of Messina, Italy.
[4]Department of Veterinary Sciences, University of Messina, Italy.

EXPLORING BRACHYURAN CRABS ECOLOGICAL ROLE IN MALDIVIAN CORAL REEFS: PRELIMINARY RESULTS FROM ECOCRAB PROJECT

The Maldives archipelago, located in the Indian Ocean, host one of the world's most biodiverse marine ecosystem, dominated by tropical coral reefs. These are characterized by a huge diverse assemblage of marine fauna, with a wide spectrum of species including Brachyuran crabs. Among these, those belonging to the superfamily Cryptochiroidea, and to the Grapsidae and Ocypodidae families, play a pivotal role in the maintenance of biodiversity and ecosystem stability. These decapods mainly inhabit the intertidal and subtidal coastal habitats, taking refuge among rocks, corals, and algae. While some species burrow into sandy substrates (as Ocypodidae) or inhabit the rocky littoral shore (as Grapsidae), those belonging to the Cryptochiroidea superfamily live associated with corals (inside domicile openings) and echinoderms. Here is presented the PhD research project ECOCRAB aiming to investigate the Brachyuran fauna inhabiting the coral reefs and littoral habitats of the Faafu atoll (Maldives archipelago). In two scientific surveys performed during the 2024, several coral reef sites near Magoodhoo island (Faafu atoll) were investigated through underwater visual census. Domicile openings of cryptochirids were visualized during SCUBA diving and photographed in situ. Samples of the colonized corals were collected and transported in "MaRHE Center" laboratory, where all the associated macrozoobenthic fauna were identified. The preliminary analyses on 38 of the collected coral samples showed the presence of 7 cryptochirids specimens belonging to four species, along with 60 other crustaceans, polychaetes, and bivalves. Given the increasing threats to coral reefs posed by climate change and human activities, the present research aims to improve the understanding of the ecology of the investigated brachyurans, and their role as potential bioindicators of reef health.

I. ROSSODIVITA[1], A. DECAMILLI[1], L. TRICERRI[1], E. CANUTI[2], U. PANTALEO[1], F. CARDINALI[3], V. CAPPANERA[4], M. PALMA[1]

[1]UBICA srl, Genova, Italy.
[2]European Commission - Joint Research Centre, Ispra (VA), Italy.
[3]MyWai srl, Sestri Levante (GE), Italy.
[4]Consorzio di Gestione Area Marina Protetta Portofino, Santa Margherita Ligure (GE) Italy.
ilaria@ubicasrl.com

MULTI-PARAMETRIC SURVEYS AS FUTURE DEVELOPMENT OF UNDERWATER HABITAT MONITORING: THE CASE STUDY ON THE *P. CLAVATA* FOREST AT SECCA ISUELA IN THE PORTOFINO MPA

Biodiversity in coralligenous habitat is enhanced by animal forests. In the Mediterranean Sea, it has been observed that gorgonian forests, such as those formed by *Paramuricea clavata*, are hindered by climate change and human activities. The vertical distribution of these long-lived, slow-growing, engineer species has decreased over the last few decades due to recurring mass mortality events, which affected the population recovery capability, jeopardising the distribution of the species, even in marine protected areas (MPAs). The ongoing changes in benthic communities are generally limited by scuba diving operative time and to a single or a few observed parameters. A more comprehensive survey approach would support a better understanding of the cause-and-effect relationship between water characteristics and benthic population health status. Within the Neptune project (Neural Rendering & Edge AI Platform for 4D synthetic Twins generation during Underwater Navigation & Exploration), funded under the PNRR Missione-4 Componente-2, an innovative approach to monitoring underwater habitats was developed using 3D reconstruction from images and water column parameters. This was achieved using an ad-hoc open-source probe developed within the OCEAN-PULSE project (Open-source Conductivity, Temperature, and Depth (CTD) system integrated with a Pulse-Amplitude Modulated (PAM) fluorometer), funded as an Exploratory Activity by the European Commission. The sensors were integrated into a Remote Operated Vehicle for data collection and tested at Secca Isuela in the Portofino MPA (Ligurian Sea, Italy). Real-time data on temperature, pH, salinity, and dissolved oxygen, along with recorded 6K resolution videos, were streamed online to a server and stored on a multilayer timeline. The data were then processed to generate 3D reconstructions of the scanned area, integrated with the monitored water column parameters. The density of *P. clavata* and morphometrics of each detected colony (*i.e.*, maximum height, surface area) were calculated and compared with data from underwater photogrammetry scanning at the same site in 2021.

M.B. SARTI[1], L. DI PAOLA[1], G. CARUSO[2], C. SERANGELI[3,4]

[1]Faculty of Science and Technology for Sustainable Development and One Health, Unit of Chemical-Physics Fundamentals in Chemical Engineering, Università Campus Bio-Medico of Rome, Italy.
[2]Institute of Polar Sciences, National Research Council, Messina, Italy.
[3]AGC98 Srl, Rome, Italy.
[4]Antica Acquacoltura, Pratovecchio-Stia (AR), Italy.
agc@agc98.net

BLUE CRAB (*CALLINECTES SAPIDUS*) AS A SOURCE OF BIOACTIVE COMPOUNDS: HOW TO TURN A PROBLEM INTO A RESOURCE

The invasive species threaten biodiversity in seas and oceans, combining their action with overfishing and climate change. An enlightening example is the blue crab (*Callinectes sapidus*), whose presence in the Mediterranean Sea endangers marine ecosystems and impairs coastal economies. Commercial valorization of invasive species may leverage their population's control: the higher the value given to the unit mass, the more effective will be their control. The central idea of this work is that blue crab is a valuable source of bioactive molecules with a biotechnological potential that might find applications in several industrial fields. We developed a blue crab valorization path based on the identification of high-value bioactive compounds (carotenoproteins) and tracing the industrial exploitation in the biorefinery paradigm, to reach the goal of near-zero waste. α-crustacyanin, the carotenoprotein present in the crab shells, is a complex of eight heterodimers, β-crustacyanin, in turn carrying two molecules of astaxantin. To better frame the applications of bioactive compounds from blue crab shells, we carried out a computational analysis (molecular docking) of the activity of astaxantin in inhibiting the main protease (Mpro) of SARS-CoV 2, the virus responsible for the COVID-19 pandemics. We found that the astaxantin exerts a strong inhibition ability and forms a stable complex with the Mpro. These promising preliminary results encourage further exploration to verify the formulation of a therapeutic strategy for COVID-19 using blue crab carotenoprotein.

F. SCARCELLI[1], A. PIRO[1], C. SPADARO[1], A. IENCO[2], V. OSSO[1], P. GIOVANNELLI[1], S. MAZZUCA[1]

[1]Laboratorio di Biologia e Proteomica Vegetale, Dipartimento di Chimica e Tecnologie Chimiche, Università della Calabria, Rende (CS), Italia.
[2]Dipartimento di Agraria, Università di Reggio Calabria, Italia.
faustino.scarcelli@unical.it

COMUNITÀ EPIFITICHE DI *POSIDONIA OCEANICA*: DIFFERENZE TRA I SOTTO-BACINI TIRRENICO E IONICO LUNGO LA COSTA CALABRESE

I sotto-bacini Tirrenico e Ionico del Mediterraneo occidentale e orientale sono separati dallo Stretto di Messina, che si estende lungo la penisola calabrese. Queste due aree ospitano regioni biogeografiche distinte, caratterizzate da significative variazioni nei parametri idrologici e nelle biocenosi. In questo contesto, il presente studio ha valutato la variazione spazio-temporale delle comunità epifitiche che colonizzano le foglie di *Posidonia oceanica* in diversi siti appartenenti ai due sotto-bacini e allo Stretto di Messina. È stata osservata una maggiore biomassa e copertura epifitica nelle praterie ioniche rispetto a quelle tirreniche, indipendentemente dalla stagione. L'analisi dei gruppi morfo-funzionali degli epifiti ha evidenziato distinzioni significative nella struttura delle comunità tra i due sotto-bacini e lo Stretto di Messina. Le Rhodophyta incrostanti sono risultate essere il gruppo predominante in tutti i campioni, con una maggiore prevalenza nei siti ionici. Inoltre, le Ochrophyta e i Briozoi filamentosi sono stati più abbondanti nei siti ionici rispetto a quelli tirrenici. Durante le diverse stagioni, le tre principali categorie funzionali (Rhodophyta incrostanti, Briozoi incrostanti e Idrozoi) hanno mostrato variazioni minime nella copertura nei siti tirrenici, mentre nei siti ionici si sono osservate fluttuazioni più marcate, con una minore abbondanza degli idrozoi nei mesi estivi. Complessivamente, l'analisi delle comunità epifitiche su foglie raccolte ai margini della prateria ha rivelato una maggiore copertura e un aumento del numero di gruppi funzionali rispetto a quelle campionate all'interno della prateria stessa. Ciò evidenzia l'importanza della posizione del campionamento all'interno della prateria per il monitoraggio della dinamica epifitica. Questi risultati confermando il ruolo degli epifiti come indicatori ecologici, permettendo di discriminare la diversità tra i due sotto-bacini e su scala locale lungo le coste calabresi. Il sito dello Stretto di Messina ha mostrato variazioni uniche che richiedono ulteriori approfondimenti e indagini più dettagliate.

A. SCHIAVO, J. AGUILO-ARCE, R. TRANI, C. LONGO

Department of Biosciences, Biotechnologies and Environment, University of Bari Aldo Moro, Italy.
a.schiavo2@phd.uniba.it

A NEW EVENT OF SPONGE DISEASE IN THE SOUTHERN ADRIATIC SEA: FIRST RECORDED MASS MORTALITY OF *PETROSIA* (*PETROSIA*) *FICIFORMIS* ALONG THE POLIGNANO A MARE COAST

Mass mortalities of marine benthic invertebrates have been increasingly reported in the Mediterranean Sea in recent years. The factors driving sponge diseases remain largely unknown, although correlations with both high and low temperatures have been documented. While identifying the exact causes is challenging, environmental stress is likely to compromise sponge health, making them more vulnerable to disease. Various microorganisms have been suggested as potential causative agents. Sponge diseases typically start with bleached patches, followed by necrosis and skeletal exposure. The progression varies with sponge size and consistency, spreading within weeks or months. To the best of our knowledge, 21 mortality events of *Petrosia (Petrosia) ficiformis* (Poiret, 1789) have been reported in the Mediterranean Sea between 1979 and 2020. The present study documents the first mass mortality event of such species along the Polignano a Mare (BA) coasts in the Southern Adriatic Sea. During autumn 2024 bleached specimens of *P. ficiformis* were observed at Cala Paura creek. A 50-meter-long transect was conducted along the right wall of the creek at a depth of 6–10 m. Each specimen was photographed using a GoPro HERO 10, with a metric scale included to calculate the bleached/pigmented area. Image analysis was performed using ImageJ-win64 software. The specimens were classified into seven bleaching categories based on the percentage of the bleached area: None (N, 0%), Low (L, <25%), Moderate (M, 25-50%), High (H, 50-75%), Severe (S, 75-99%), and Total (T, 100%). Overall, 102 specimens were counted, of which almost half showed total bleaching (100%). The S category comprises 25.5% of the specimens, while the L, M, and H categories include a range of specimens from a minimum of 7% to a maximum of 10%. Only two specimens showed no signs of bleaching. Although high temperatures have previously been identified as the cause of mass mortality events in this species, further investigation is needed to determine whether microorganisms were also involved.

S. SCIBELLI[1], M. MUTALIPASSI[2,3], I. DI CAPUA[3,4], N. RUOCCO[5], V. ZUPO[6]

[1]Ecosustainable Marine Biotechnology Department, Stazione Zoologica Anton Dohrn, Naples, Italy.
[2]Integrative Marine Ecology Department, Stazione Zoologica Anton Dohrn, Naples, Italy.
[3]National Biodiversity Future Center (NBFC), Palermo, Italy.
[4]Marine Organism Taxonomy Core Facility (MOTax), Stazione Zoologica Anton Dohrn, Naples, Italy.
[5]Ecosustainable Marine Biotechnology Department, Stazione Zoologica Anton Dohrn, Calabria Marine Centre, Amendolara (CS), Italy.
[6]Ecosustainable Marine Biotechnology Department, Stazione Zoologica Anton Dohrn, Ischia Marine Center, Ischia (NA), Italy.
sebastiano.scibelli@szn.it

UNVEILING THE HIDDEN IMPACT: HOW NOTHODELPHYD COPEPOD AFFECTS REPRODUCTION AND DEVELOPMENT IN *CIONA ROBUSTA* (HOSHINO & TOKIOKA, 1967)

Copepods are among the most abundant and diverse marine crustaceans, and they display a spectrum of ecological roles, from free-living organisms to symbionts and parasites. Among them, the Nothodelphydes are typically associated to solitary and compound ascidians. Many Nothodelphyid species are commensals, inhabiting the pharynx or atrium of ascidian hosts and, presumably, sharing the food material brought in by the host. This study investigates the impact of copepods on the reproductive and developmental fitness of the ascidian *Ciona robusta*, assessing egg production, hatching success, larval settlement, and juvenile growth along with survival, through controlled laboratory experiments. Results revealed significant negative impacts of copepods on several reproductive parameters of *C. robusta*. Ascidians showed reduced hatching ($p<0.0001$) and larval settlement rates ($p=0.001$) compared to non-infested counterparts. Post-larval offspring from infested parents exhibited consistently impaired growth, including significant width and length reduction, as well as reduced growth rates, during a 30-day experiment. Interestingly, infested parental *C. robusta* were significantly larger than non-infested ones ($p=0.006$). Consequently, a potential size-selective infestation strategy, which could amplify population-level impacts could not be excluded. These findings challenge the traditional view of Nothodelphyids as a benign commensal, highlighting its potential role as a subtle but impactful parasite affecting host reproductive success and offspring fitness. Given the prominence of *C. robusta* as a model organism in marine biological research, the implications of these interactions might extend beyond the ecological interest, significantly influencing experimental reliability and aquaculture practices. Further investigations will be essential to elucidate the mechanisms behind these effects, the actual seasonal frequency and the spatial distribution of these organisms and to develop strategies for mitigating infestation impacts in natural populations.

P. SORO[1], R. MIROGLIO[1], F. SINI[1], S. FERRANDO[2], F. MACCARONI[1], M. FAIMALI[1], C. GAMBARDELLA[1]

[1]Istituto per lo Studio degli Impatti Antropici e Sostenibilità in Ambiente Marino (IAS), Consiglio Nazionale delle Ricerche (CNR), Genova, Italia.
[2]DISTAV, Università di Genova, Italia.
chiara.gambardella@cnr.it

EFFETTI DELLE ANOMALIE TERMICHE SUI PRIMI STADI DI SVILUPPO DEL RICCIO DI MARE *PARACENTROTUS LIVIDUS* (LAMARCK, 1816)

Nell'ultimo secolo le anomalie termiche sono diventate sempre più intense e frequenti, esponendo gli organismi a uno stress in grado di impattare diversi aspetti biologici, come lo sviluppo e la riproduzione. Vista l'elevata sensibilità dei primi stadi di sviluppo dei ricci di mare agli stress ambientali, la temperatura potrebbe influenzare il processo di embriogenesi, lo sviluppo e la sopravvivenza delle larve. Pertanto, lo scopo di questo studio, svolto nell'ambito del progetto PRIN 2022 UNDER PRESSURE, è stato quello di studiare gli effetti dell'incremento di temperatura su una specie chiave del Mar Mediterraneo: il riccio di mare *Paracentrotus lividus*. I primi stadi di sviluppo (gameti, zigoti, embrioni) sono stati esposti a tre temperature differenti (18 °C, 21 °C, 24 °C) al fine di valutare il successo della fecondazione, la morfologia ed eventuali anomalie dello sviluppo nelle larve (echinoplutei), rispettivamente dopo 20 minuti e 72 ore. I risultati non evidenziano alcun impatto sulla capacità di fecondazione, ma effetti sullo sviluppo larvale. Nello specifico, tra 18 °C e 21 °C si è verificato un aumento significativo della distanza tra le braccia postorali e un corpo più largo, suggerendo una parziale tolleranza di *P. lividus* a moderati aumenti di temperatura. Per tutti gli stadi esposti, la temperatura più elevata (24 °C) ha avuto un impatto significativo sullo sviluppo, inducendo la comparsa di anomalie scheletriche e una riduzione della lunghezza delle braccia postorali. In conclusione, questo studio contribuisce a chiarire gli effetti e i potenziali adattamenti dei primi stadi di sviluppo del riccio di mare *P. lividus* esposti a temperature particolarmente elevate come accade durante i fenomeni di *heatwaves*.

P. STIPCICH[1,2], C. ARENA[1,2], G. CECCHERELLI[2,3], R. DONADIO[1,2], C. JIMENEZ[4], V. RESAIKOS[4], E. VITALE[1,2], S. FRASCHETTI[1,2]

[1]Department of Biology, University of Naples Federico II, Italy.
[2]National Biodiversity Future Centre (NBFC), Palermo, Italy.
[3]Department of Chemical Physical Mathematical and Natural Sciences, University of Sassari, Italy.
[4]Enalia Physis Environmental Research Centre, Nicosia, Cyprus.
patrizia.stipcich@unina.it

SEAGRASS LEAF BLEACHING DOES NOT AFFECT THE PLANT PHOTOPROTECTIVE MECHANISMS

Seagrasses are vulnerable to climate change and mass mortalities have been already recorded. However, photoprotective mechanisms through photopigments rearrangement, have been detected to avoid photoinhibition and photooxidative stress. *Posidonia oceanica,* endemic to the Mediterranean Sea, is not unique in this regard. Leaf bleaching has been recorded but how it affects seagrass viability is still unknown. Through a cross-transplantation between depths in Cyprus, the role of temperature and irradiance in bleaching was investigated. Changes in bleached area and photopigment contents were analyzed after transplantation. Unexpectedly, after three months, leaf bleaching did not increase when plants were transplanted to a different depth from the origin (*e.g.,* from 10 to 30 m). Rather, higher bleaching was found when cuttings were kept at their origin depth (*e.g.,* 10 to 10 m). Photopigment rearrangement at different light and temperature conditions indicated the usual activation of photoprotective mechanisms, showing that the plants can respond to environmental stressors while leaf bleaching occurs. Understanding this phenomenon became pivotal to predict the future of *P. oceanica*.

R. TOTA[1], A. COSMA[2,3,4], S. SCAPINELLO[1], M. BERTOLINO[2,4], F. ANDREONE[1]

[1]Museo Regionale di Scienze Naturali, Torino, Italia.
[2]DISTAV, Università di Genova, Italia.
[3]DiSTeM, Università di Palermo, Italia.
[4]National Biodiversity Future Center (NBFC), Palermo, Italia.
alessandra.cosma@unipa.it

RIDURRE IL GAP NELLO STUDIO DELLE COLLEZIONI DEI MUSEI ITALIANI DI STORIA NATURALE: IL CASO DEI PORIFERA E CNIDARIA DI TORINO

I phyla dei Porifera e degli Cnidaria rappresentano due dei più antichi gruppi, ancora esistenti, di Metazoi. Nonostante tre secoli di ricerca, le specie descritte per entrambi i gruppi costituiscono solo una parte di quelle che si ritiene esistano attualmente in natura. I musei naturalistici rappresentano a questo riguardo un'importantissima fonte di informazioni: attraverso le collezioni sia storiche sia recenti qui depositate, è possibile condurre indagini sistematiche e ottenere dati che contribuiscono ad arricchire la conoscenza scientifica del mondo naturale. Il presente lavoro, in corso di svolgimento, vede la collaborazione tra il Museo Regionale di Scienze Naturali di Torino (MRSN) e l'Università di Genova, al fine di aggiornare le informazioni e le determinazioni relative alle collezioni storiche dei Poriferi e degli Cnidari, appartenenti all'Università di Torino e oggi gestite e collocate all'interno del MRSN. Le collezioni contano rispettivamente oltre 250 e 650 esemplari, conservati sia a secco sia in liquido. L'importanza di queste raccolte è avvalorata dalla presenza di numerosi *tipi*, provenienti dalle Antille e descritti da Duchassaing de Fonbressin e Michelotti a metà '800, dalla collezione del Laboratorio di Biologia Marina di Rapallo istituito da Camerano, Peracca e Rosa a fine '800 e dalla collezione di cnidari liguri di Lucia Rossi. Il lavoro prevede il controllo dello stato di conservazione degli esemplari, la revisione delle informazioni disponibili a essi associati, incluso il loro aggiornamento nomenclatoriale, ed è finalizzato alla realizzazione e alla pubblicazione dei cataloghi aggiornati, fornendo dati e informazioni che possono contribuire in modo rilevante allo studio di questi gruppi. Le collezioni rappresentano oggi risorse indispensabili nella determinazione tassonomica e nella conservazione della biodiversità. La collaborazione con università e altri enti di ricerca rimane cruciale affinché esse possano essere utilizzate come fonte di conoscenza per nuove ricerche, costituendo un importante lascito per studiosi, ricercatori e generazioni future.

V. VELLANI[1,2], S. KOLAREVIĆ[3], M. KRAČUN KOLAREVIĆ[3], E. MONTALBETTI[4,5,6], T. ARAMINI[7], E. BRIVIO[7], M. BONANOMI[7], D. GAGLIO[7], V. PITACCO[8], S. DAVIDE[4,5,6], S. BEVILACQUA[1,2], M. RENZI[1,2], A. RAMŠAK[8]

[1]Dipartimento di Scienze della Vita, Università di Trieste, Italia.
[2]Consorzio Nazionale Interuniversitario per le Scienze del Mare (CoNISMa), Roma, Italia.
[3]Dipartimento di Idroecologia e Protezione delle Acque, Istituto per la Ricerca Biologica "Siniša Stanković" – Istituto Nazionale della Repubblica di Serbia, Università di Belgrado, Serbia.
[4]Dipartimento di Scienze della Terra e dell'Ambiente, Università di Milano-Bicocca, Italia.
[5]MaRHE Center (Marine Research and High Education Center), Isola di Magoodhoo, Atollo di Faafu, Maldive.
[6]National Biodiversity Future Center (NBFC), Palermo, Italia.
[7]Istituto di Bioimmagini e Sistemi Biologici Complessi (IBSBC), Consiglio Nazionale delle Ricerche (CNR), Segrate (MI), Italia.
[8]Istituto Nazionale di Biologia, Stazione di Biologia Marina, Pirano, Slovenia.
verdiana.vellani@phd.units.it

GENOTOSSICITÀ E CARATTERISTICHE METABOLOMICHE DEL CORALLO MEDITERRANEO *CLADOCORA CAESPITOSA* (ANTHOZOA, SCLERACTINIA) DURANTE UNA *HEAT WAVE*

Cladocora caespitosa (Linnaeus, 1767), conosciuta anche come madrepora cuscino mediterranea, è una specie endemica zooxantellata tra i principali biocostruttori del Mediterraneo. *C. caespitosa* è particolarmente vulnerabile ai cambiamenti globali, in particolare all'aumento della temperatura del mare. Nel Mar Mediterraneo sono stati registrati eventi di mortalità di massa di questa specie, e diversi episodi di sbiancamento rilevati anche nel Golfo di Trieste. Per questo motivo, sarebbe interessante approfondire la conoscenza dei meccanismi e dei processi metabolici che si verificano durante questi eventi. Per studiare la risposta allo stress termico, colonie di *C. caespitosa* sono state sottoposte a una heat wave di 15 giorni in acquario, simulando una curva di aumento di temperatura che rispecchia le anomalie termiche registrate nell'Alto Adriatico in estate. Durante l'esposizione sono stati effettuati campionamenti multipli (dopo 5, 10 e 15 giorni). La risposta allo stress termico è stata valutata mediante cambiamenti nei modelli di espressione genica e valutando i danni al DNA con il comet assay. Entrambi i metodi non erano mai stati applicati prima su coralli mediterranei. Sono state riscontrate differenze significative tra i due trattamenti rispetto al danno genetico, sebbene non consistenti nel tempo e con una certa variabilità all'interno della popolazione. I risultati del comet assay indicano che le colonie sottoposte a heat wave presentavano una percentuale significativamente più alta di danni al DNA rispetto al controllo dopo cinque giorni di esposizione. Sono stati invece riscontrati segni di recupero (con diminuzione del danno genetico) con il procedere dell'esperimento. Inoltre, la metabolomica ha evidenziato le modifiche dell'attività dei metaboliti nel corso di una heat wave. Questo studio fornisce nuove evidenze sulla risposta di *C. caespitosa* all'aumento delle temperature, evidenziandone la sensibilità ai cambiamenti climatici ma anche la capacità di adattamento nel tempo.

POSTER DEL COMITATO GESTIONE E VALORIZZAZIONE DELLA FASCIA COSTIERA

F. ACAMPA[1,2,3,4], F. COLLOCA[5], E. FABBRIZZI[2,3], S. GIAKOUMI[6], S. MORO[5]

[1]Department of Earth and Marine Sciences, University of Palermo, Italy.
[2]National Biodiversity Future Center (NBFC), Palermo, Italy.
[3]Department of Biology, University of Naples Federico II, Italy.
[4]WSense s.r.l., Rome, Italy.
[5]Department of Integrative Marine Ecology, Stazione Zoologica Anton Dohrn, Rome, Italy.
[6]Department of Integrative Marine Ecology, Stazione Zoologica Anton Dohrn, Palermo, Italy.
francesca.acampa@unipa.it

BALANCING MARINE CONSERVATION AND REGIONAL USES: A TOOL-BASED ASSESSMENT OF POTENTIAL OECMs IN CAMPANIA (WESTERN MEDITERRANEAN)

The maritime area of the Campania Region (Western Mediterranean) hosts numerous sites of ecological and cultural interest. However, it is also under considerable pressure from human activities, many of which remain inadequately regulated, underscoring the urgent need for more targeted conservation efforts. In this context, Other Effective area-based Conservation Measures (OECMs) – areas that contribute to biodiversity conservation without a formal Marine Protected Area (MPA) status – emerge as a promising yet underestimated tool with significant potential for safeguarding marine biodiversity and resources. This study applies a novel decision-support tool, developed within the EU-funded MarinePlan Project (HORIZON-CL6-2021-BIODIV-01-12), to assess marine sites in Campania for potential OECM designation. The tool employs a Multi-Criteria Decision Analysis (MCDA) approach based on scientific literature and expert knowledge, aligning with the criteria set by the Convention on Biological Diversity (CBD) and expanding on the guidance of the International Union for Conservation of Nature (IUCN). Its quantitative ranking system prioritizes sites objectively, considering their conservation value, management feasibility, and social acceptability. By integrating both ecological and socioeconomic factors, the proposed tool effectively balances biodiversity conservation with other sectoral uses, providing a flexible solution where formal MPAs may not be feasible. During the initial screening, seven sites within Campania waters, including archaeological, military, and fishery-restricted areas were evaluated against the OECM criteria. Of these, five emerged as viable candidates for further consideration by stakeholders and government authorities. Incorporating OECMs into MPA networks strengthens National Marine Spatial Planning (MSP) and supports the achievement of the EU's "30 by 30" biodiversity target, addressing a pressing conservation gap in the Mediterranean, where existing efforts fall short. Recognizing and protecting these areas as OECMs is not only a conservation priority, but also a crucial step toward ensuring the long-term resilience and sustainability of marine ecosystems and the communities that depend on them.

R. APPARETE[1], M. MONSERRAT[1], J. CIMINI[1,2], M. CHIANTORE[1,2,3], C. PAOLI[1,2,3], P. VASSALLO[1,2,3]

[1]Consorzio Nazionale Interuniversitario per le Scienze del Mare (CoNISMa), Roma, Italia.
[2]DISTAV, Università di Genova, Italia.
[3]National Biodiversity Future Center (NBFC), Palermo, Italia.
riccardo.apparete@gmail.com

QUANTIFICARE IL RESTAURO MARINO: IL RUOLO DELL'ANALISI EMERGETICA NELLE FASI PRELIMINARI DEL PROGETTO OCEAN CITIZEN

Il progetto OCEAN CITIZEN, finanziato dalla Commissione Europea, mira a sviluppare un modello innovativo e sostenibile per il restauro degli ecosistemi costieri, con un focus sulla rigenerazione delle foreste marine, algali ed animali. In questo lavoro, particolare attenzione è stata rivolta alle foreste di *Gongolaria abies-marina* (S.G. Gmelin) Kuntze 1891 campionate nel sito di Punta Blanca, Tenerife (Spagna). Il Work Package 5 (WP5) del progetto si concentra sulla valutazione del capitale naturale e del livello di sostenibilità del restauro attraverso l'analisi emergetica. Le attività iniziali hanno perseguito due obiettivi principali: identificare i passaggi necessari per sviluppare il bilancio biofisico del sistema naturale (necessario per il computo del capitale) e di raccogliere dati sulle risorse messe a disposizione dall'ambiente e sui componenti del capitale stesso. L'analisi emergetica rappresenta un approccio chiave per quantificare il valore dei sistemi naturali, traducendo tutti i flussi di energia e materia in un'unità comune, il *Solar Emergy Joule* (sej), facilmente traducibile in termini monetari attraverso la sua conversione in *Emergy Euro* (eM€). L'analisi emergetica consente di stimare il costo di generazione di un sistema naturale e il valore della sua esistenza. La prima fase dell'analisi riguarda la caratterizzazione del sistema naturale prima degli interventi di *restoration*, valutando la biomassa di organismi bentonici algali e animali. Le informazioni chiave includono l'area occupata dagli habitat e la biomassa specifica per specie o gruppi funzionali. Inoltre, l'analisi emergetica considera i flussi di risorse ambientali, come radiazione solare, vento, precipitazioni, maree e calore geotermico come elementi del budget energetico del sistema che concorrono al suo valore biofisico. L'approccio adottato dal WP5 permetterà di quantificare gli impatti del restauro, colmando il divario tra valutazioni biofisiche ed economiche, e fornendo strumenti per la gestione sostenibile degli ecosistemi marini.

I. AZZENA[1], C. LOCCI[1,2], N. PASCALE[1,2,3], I. DEPLANO[2], R. SENIGAGLIA[1], E. BATISTINI[4], D. CARACCIOLO[5], M.P. FERRANTI[6], S. CIRIACO[4,7], D. GRECH[8], A. LICONTI[9], A. OPRANDI[6], V. PITACCO[10], F. SCARPA[2], M. CASU[1], D. SANNA[2]

[1]Dipartimento di Medicina Veterinaria, Università di Sassari, Italia.
[2]Dipartimento di Scienze Biomediche, Università di Sassari, Italia.
[3]Dipartimento di Scienze Chimiche, Fisiche, Matematiche e Naturali, Università di Sassari, Italia.
[4]Shoreline Soc. Coop., Trieste, Italia.
[5]Agenzia Regionale per la Protezione dell'Ambiente Ligure (ARPAL), Genova, Italia.
[6]Dipartimento di Scienze della Terra, Ambiente e Vita (DISTAV), Università di Genova, Italia.
[7]WWF Fondazione, Area Marina Protetta di Miramare, Trieste, Italia.
[8]IMC - International Marine Centre, Torregrande (OR), Italia.
[9]OutBe, Chiavari (GE), Italia.
[10]Marine Biology Station Piran, National Institute of Biology, Piran, Slovenia.
iazzena@uniss.it

SEGNALI DAL PASSATO PER LA SOPRAVVIVENZA FUTURA: LA STORIA EVOLUTIVA DI *PINNA NOBILIS* TRA STRESS AMBIENTALI E PRESSIONI UMANE

Pinna nobilis, bivalve iconico ed endemico del Mar Mediterraneo, ricopre un ruolo cruciale come ingegnere ecosistemico. Nel corso dell'ultimo secolo, la specie ha affrontato gravi minacce, inizialmente legate al sovrasfruttamento e all'inquinamento, e successivamente a eventi di mortalità di massa che hanno portato la specie sull'orlo dell'estinzione. Questo studio ha analizzato 119 sequenze del gene mitocondriale COI, provenienti da campioni storici (1700, 1920, 1970, 1990) e moderni (anni 2000), compresi esemplari sopravvissuti alla recente pandemia. L'analisi di sequenze antiche è stata resa possibile grazie alla standardizzazione di un protocollo per l'estrazione del DNA a partire da campioni di ghiandola del bisso risalenti a oltre un secolo, permettendo di ricostruire con un dettaglio senza precedenti la storia evolutiva di *Pinna nobilis*. Le analisi filogenetiche e filogeografiche condotte su questo ampio dataset, che include anche le sequenze presenti su GenBank, hanno rivelato due principali origini temporali per la variabilità genetica della specie: (i) un gruppo di linee moderne discese da antenati di *Pinna nobilis* risalenti a circa 2,5 milioni di anni fa, e (ii) un gruppo più ampio derivante dalla radiazione adattativa del Pleistocene, avvenuta circa 1,5 milioni di anni fa. Inoltre, lo studio ha rivelato come *Pinna nobilis* si sia adattata evolutivamente alle principali sfide affrontate nell'ultimo secolo, come il sovrasfruttamento, l'inquinamento e i cambiamenti ambientali. I risultati mettono in evidenza un'elevata resilienza della specie, probabilmente supportata da caratteri genetici risalenti al Pleistocene. La persistenza di tali caratteri dipende dalla capacità di conservare gli individui che li possiedono, in un numero che, seppur basso, possa garantire il reclutamento della specie.

C. CALABRESE[1,2], D. ARDUINI[1], C. GRAVILI[1], E. QUARTA[1], G. PORTACCI[3], A. GIANGRANDE[1,2,4]

[1]DiSTeBA, Università del Salento, Lecce, Italia.
[2]National Biodiversity Future Center (NBFC), Palermo, Italia.
[3]IRSA-CNR, Taranto, Italia.
[4]CoNISMa, Unità locale di ricerca Università del Salento, Lecce, Italia.
claudio.calabrese@unisalento.it

CAMBIAMENTO, BIODIVERSITÀ E IMPLICAZIONI ECONOMICHE

I molluschi bivalvi hanno un ruolo rilevante nel funzionamento degli ecosistemi e nell'economia della società, rappresentando il sostentamento economico ed energetico per gran parte della popolazione, e contribuendo anche al sequestro di grandi quantità di anidride carbolica. Il sistema del Mare di Taranto era una delle zone più importanti d'Europa per la produzione di *Mytilus galloprovincialis* Lamarck, 1819, e la mitilicoltura era una delle principali attività economiche della popolazione locale. Dal 2006 si è osservata una diminuzione della produzione, accompagnata da un calo della qualità del prodotto. Negli ultimi anni, inoltre, si sono verificate diverse mortalità di massa di mitili a causa delle ricorrenti ondate di caldo estivo che hanno compromesso la produzione anche per il 2025. Contemporaneamente, si è osservata un'enorme espansione della specie aliena *Pinctada radiata* (Leach, 1814). La crescita di *M. galloprovincialis* è stata studiata per quattro cicli dal 2021 al 2024, in varie condizioni che potessero mitigare l'effetto della temperatura: a) nelle vicinanze di un impianto di maricoltura; b) lontano dall'impianto; c) in condizioni superficiali (reste a 5 metri); d) in condizioni di maggiore profondità (reste a 10 metri). Nello stesso periodo è stato studiato l'accrescimento dell'ostrica aliena in collettori sospesi posizionati nello stesso sistema long line. Le temperature estive proibitive hanno portato alla morte di quasi tutti i mitili prima che venisse raggiunta la taglia di commercializzazione in qualsiasi tipologia di allevamento. Nello stesso periodo di studio, invece, la specie introdotta *P. radiata* ha avuto un evento riproduttivo che ha comportato un reclutamento eccezionale. Questa specie, che ha un picco riproduttivo nel periodo estivo e raggiunge la taglia di commercializzazione in circa un anno e mezzo, presenta buone caratteristiche organolettiche e se adeguatamente gestita, potrebbe rappresentare una grande promessa per il futuro della molluschicoltura.

F. CERCIELLO[1], F. RENDINA[1], A. ELEFANTE[1,2], A. FALACE[3], E. BUONOCORE[1]

[1]Dipartimento di Scienze e Tecnologie, Università di Napoli Parthenope, Italia.
[2]Dipartimento di Scienze Ambientali, Informatica e Statistica, Università di Venezia Ca' Foscari, Italia.
[3]Dipartimento di Scienze Della Vita, Università di Trieste, Italia.
filomenacerciello92@gmail.com

CONTABILITÀ AMBIENTALE DELLE FORESTE ALGALI DI *CYSTOSEIRA SENSU LATO* NELL'AREA MARINA PROTETTA DI SANTA MARIA DI CASTELLABATE (SA)

Le foreste macroalgali di *Cystoseira sensu lato (s.l.)* sono tra gli ecosistemi più complessi e produttivi delle coste rocciose del Mar Mediterraneo. Esse offrono rifugio e risorse trofiche a numerosi organismi e forniscono servizi ecosistemici essenziali, tra cui il sequestro del carbonio e la protezione delle coste. Inoltre, la loro presenza è un indicatore di una buona qualità ambientale e di stabilità ecosistemica. Tuttavia, negli ultimi decenni, queste formazioni algali hanno subito un drastico declino in molte aree del Mediterraneo principalmente a causa di impatti antropici, come l'urbanizzazione costiera e l'inquinamento delle acque. Questo studio è parte integrante del progetto europeo LIFE "REEForest", finalizzato al restauro di *Cystoseira s.l.* nell'Area Marina Protetta (AMP) di Santa Maria di Castellabate. È stato applicato un modello di contabilità ambientale per calcolare il valore biofisico del capitale naturale (CN) dell'habitat roccioso subtidale, sia nei siti donatori che in quelli riceventi coinvolti nelle attività di ripristino. Questo approccio consente di quantificare gli stock biotici di CN e rappresenta la base per la successiva valutazione dei flussi di servizi ecosistemici e degli impatti associati al loro sfruttamento. I risultati mostrano che il valore di CN nei siti donatori di Punta Licosa è pari a $9{,}83 \cdot 10^{11}$ sej/m^2 mentre nei siti riceventi di Punta Pagliarola raggiunge $1{,}13 \cdot 10^{12}$ sej/m^2. Queste differenze riflettono le caratteristiche ambientali delle due aree, nonché i diversi regimi di protezione all'interno dell'AMP. Studi futuri saranno orientati a valutare se l'aumento della complessità strutturale, legato alle attività di ripristino di *Cystoseira* s.l. in zona A, comporterà un incremento dei valori di CN. In conclusione, questo studio evidenzia la rilevanza ecologica degli habitat a *Cystoseira s.l*. e il valore della contabilità ambientale come strumento per la pianificazione di strategie efficaci di protezione, conservazione e restauro a lungo termine.

S. D'AMBROS BURCHIO[1], S. COMIS[1], M. MARCELLI[2], A. FALACE[1,3]

[1]Department of Life Sciences, University of Trieste, Italy.
[2]Department of Ecological and Biological Sciences, University of Tuscia, Viterbo, Italy.
[3]National Biodiversity Future Center (NBFC), Palermo, Italy
sara.d'ambrosburchio@phd.units.it

ENHANCING MACROALGAL FOREST RESTORATION THROUGH INTEGRATED ALGACULTURE STRATEGIES

Macroalgal forests dominated by *Cystoseira sensu lato* are undergoing severe declines due to anthropogenic stressors and climate change. Active restoration is essential, as natural recovery is often limited by dispersal constraints and habitat fragmentation. This study refines the well-established *ex situ* recruitment of *Cystoseira s.l.* by integrating mesocosm-based cultivation with outdoor algaculture to enhance scalability and cost-effectiveness. We tested three experimental conditions with varying durations of indoor and outdoor culture to assess their effects on seedling growth and resilience post-outplanting. Performance was evaluated using key growth metrics, including percent cover, thallus length, and photosynthetic efficiency. Our results indicate that an optimized process balancing resource efficiency and seedling development can be achieved by shortening the controlled mesocosm phase while maintaining high resilience in the field. Specifically, for *Ericaria amentacea* (C. Agardh) Molinari & Guiry, a 12-day indoor culture followed by suspended outdoor algaculture, both supplemented with nutrient supply, yielded satisfactory outcomes. Seedling physiological performance was comparable to longer mesocosm cultivation periods (21 days), with slightly lower initial coverage that recovered over time after outplanting on rocky shores. In contrast, shorter laboratory phases (≤5 days) resulted in low photosynthetic efficiency, reduced seedling coverage, and smaller seedling clumps, leading to poor resilience and no recovery post-outplanting. These findings suggest that integrating indoor and outdoor algaculture into restoration protocols can significantly enhance the scalability of macroalgal forest recovery by reducing the resource and labor-intensive indoor phases. This approach is particularly relevant in the face of climate change, where shifts in *Cystoseira s.l.* reproductive phenology, including shorter fertility periods, pose challenges to restoration feasibility. By enabling multiple culture cycles within a constrained reproductive timeframe, this strategy enhances the effectiveness of *Cystoseira s.l.* restoration efforts, contributing to the conservation of key Mediterranean marine habitats.

I. DENTAMARE[1,2], V. LAURIA[2], U. GRANDE[2,3], M. CALABRÒ[3], E. BUONOCORE[2], P.P. FRANZESE[2], E.C. SABATELLA[1]

[1]Institute for Research on Population and Social Policies (IRPPS), National Research Council (CNR), Salerno, Italy.
[2]International PhD Programme/UNESCO Chair "Environment, Resources and Sustainable Development", Department of Science and Technology, Parthenope University of Naples, Italy.
[3]Institute for Marine Biological Resources and Biotechnology (IRBIM), National Research Council (CNR), Mazara del Vallo (TP), Italy.
ilaria.dentamare@gmail.com

ASSESSING THE ECOSYSTEM SERVICES OF *POSIDONIA OCEANICA* BANQUETTES ALONG SOUTHERN AND NORTH-WESTERN COAST OF SICILY: IMPLICATIONS FOR SUSTAINABLE COASTAL MANAGEMENT SEA

Coastal ecosystems provide essential ecosystem services (ES), including shoreline protection, nutrient cycling, carbon sequestration, and habitat provision. However, human pressures and coastal management practices often overlook these services in favor of aesthetic or economic considerations. Particularly noteworthy is the management of banquettes formed by the accumulation of dead leaves from *Posidonia oceanica* (L. Delile, 1813) along Mediterranean coastlines. *Posidonia oceanica* banquettes act as natural barriers, dissipating wave energy and reducing coastal erosion. Furthermore, they represent a significant stock of carbon and nutrients derived from highly productive seagrass meadows. However, in tourist areas, these banquettes are often perceived as a nuisance and removed from beaches, typically transported in landfills. This practice exacerbates coastal erosion, generates high management costs, and contributes to greenhouse gas emissions through the release of CO_2 and CH_4 during decomposition. The goal of this study was recording banquettes along Southern and North-western coast of Sicily (Italy) and assessing the potential loss of natural capital stocks and ES they provide, due to their removal from beaches. We tested the hypothesis that the banquettes removal compromises ES provisioning, increasing costs associated with replacing these services. GPS coordinates, accumulation thickness, length, and width were recorded to determine the volume and surface area of each strand. In addition, the concentration of nutrients and chemical elements in the samples of *Posidonia oceanica* banquettes was determined through laboratory analysis. Our study aimed to highlight the need to adopt sustainable management practices that recognize the ecological value of *Posidonia oceanica* banquettes and the importance for their protection.

C. FACCA[1], M. BOSCHIERO[1], S. NATIN[1], S. REDOLFI BRISTOL[1], F. RICCATO[2], P. FRANZOI[1]

[1]DAIS, Ca' Foscari University of Venice, Italy.
[2]Laguna Project s.n.c, Mestre (Ve), Italy.
facca@unive.it

CALLINECTES SAPIDUS DISTRIBUTION ALONG A LAGOON-SEA TRANSECT IN THE NORTHERN ADRIATIC SEA

Callinectes sapidus is one of the most invasive species in the Mediterranean area with significant impact on local biodiversity and traditional fishing activities. Its abundance and distribution along Mediterranean coasts are increasing, and it is necessary to define management plans in order to control the population and to exploit its potential commercial value. In part of the native range (northern America), the species is well-known, and, in Chesapeake Bay (Eastern United States), it represents up to two-thirds of the fishing income, while in the North Adriatic, it represents a major threat with serious socio-economic impacts. Blue crab harvesting was carried out from June to September 2023 approx. every fortnight, using three types of traps in the shallow areas of Chioggia (North Adriatic Sea): two sites were located inside the lagoon, one at the estuary of the Brenta river and one at sea close to the coast. Each specimen was measured, weighted and sexed. In the considered period, 504 specimens were collected (359 males and 145 females) and the highest harvest was in July (114 males and 46 females). The captures per site were recorded as follow: at the estuary of the Brenta river 181 crabs; in the lagoon (sum of two sites) 212 crabs; at the sea 111 ones. Females were 37% of the total catch at the estuary of the Brenta river and at sea, while they represented 20% of total catch within the lagoon. Moreover, at the estuary specimens were significantly smaller than the ones at sea. The data allowed to verify the most efficient trap type and to study the blue crab population structure.

L. FARINA[1], A. AZZOLA[1,2], C.N. BIANCHI[1,3], I. LAVARELLO[4], C. MORRI[1,3], C. VALERANI[4], F. RUGGERI[1,2], I. RIGO[1], B. GHISALBERTI[5], C. PAOLI[1,2,5]

[1]DISTAV, Dipartimento di Scienze della Terra, dell'Ambiente e della Vita, Università di Genova, Italia.
[2]National Biodiversity Future Center (NBFC), Palermo, Italia.
[3]Genoa Marine Centre (GMC), Stazione Zoologica Anton Dohrn, Genova, Italia.
[4]Area Marina Protetta delle Cinque Terre, Riomaggiore (SP), Italia.
[5]Consorzio Nazionale Interuniversitario per le Scienze del Mare (CoNISMa), Roma, Italia.
5272608@studenti.unige.it

ANALISI DIACRONICA E COROLOGICA DELL'HABITAT CORALLIGENO: VARIAZIONI FUNZIONALI IN CONSEGUENZA DEL CAMBIAMENTO CLIMATICO

Il cambiamento climatico rappresenta una delle principali minacce per la biodiversità del Mediterraneo, comportando effetti multipli tra cui l'invasione di specie termofile alloctone; la loro presenza, unitamente al riscaldamento della temperatura del mare, è all'origine del fenomeno noto come "tropicalizzazione". Il coralligeno rappresenta uno degli habitat marini mediterranei più colpiti da tale fenomeno. Questo habitat è caratterizzato da elevata complessità e biodiversità, presentando uno strato basale biogeno (dominato da alghe calcaree), sul quale si insediano numerosi invertebrati sessili, negli strati sovrastanti. Queste caratteristiche conferiscono a questo habitat circalitorale la capacità di fornire funzioni essenziali per il mantenimento dell'ecosistema marino. La sua rilevanza ecologica e conservazionistica è riconosciuta da normative europee, come Direttiva Habitat (92/43/CEE) e Marine Strategy Framework Directive (2008/56/CE). Il presente studio si focalizza sul monitoraggio diacronico delle comunità coralligene nel sito di Punta Mesco, situato all'interno dell'Area Marina Protetta delle Cinque Terre (Liguria, Italia), grazie alla disponibilità di dati raccolti sin dal 1961. Sono state analizzate tre stazioni a diverse profondità (20 m, 30 m e 40 m), nelle quali è stata stimata la copertura percentuale delle specie osservate. Queste ultime sono state suddivise in gruppi corologici sulla base del loro areale geografico. Inoltre, tramite l'utilizzo dell'analisi emergetica, è stato quantificato il valore del capitale naturale associato alle comunità coralligene osservate alle diverse profondità. L'analisi emergetica è un approccio donor-side che quantifica le risorse che l'ambiente ha dovuto investire per produrre un determinato stock di biomassa e mantenere la struttura trofica e la funzionalità del sistema indagato. L'analisi delle variazioni nel tempo e alle diverse profondità della copertura percentuale dei differenti gruppi corologici, del loro contributo al valore complessivo del capitale naturale e il trend diacronico di quest'ultimo, fornisce un'informazione chiave per valutare gli effetti del cambiamento climatico su questo prezioso habitat marino costiero.

B. GHISALBERTI[1], I. LAVARELLO[2], C. VALERANI[2], V. GAZALE[3], A. ZANELLO[3], L. FARINA[1,4], I. RIGO[4], F. RUGGERI[4,5], P. VASSALLO[1,4,5], C. PAOLI[1,4,5]

[1]Consorzio Nazionale Interuniversitario per le Scienze del Mare (CoNISMa), Roma, Italia.
[2]Area Marina Protetta delle Cinque Terre, Riomaggiore (SP), Italia.
[3]Area Marina Protetta Isola dell'Asinara, Porto Torres (SS), Italia.
[4]Dipartimento di Scienze della Terra, dell'Ambiente e della Vita (DISTAV), Università di Genova, Italia.
[5]National Biodiversity Future Center (NBFC), Palermo, Italia.
S5051300@studenti.unige.it

IMPATTO DEI CAMBIAMENTI CLIMATICI SULLA FAUNA ITTICA ALL'INTERNO DI DUE AREE MARINE PROTETTE MEDITERRANEE

L'impatto del cambiamento climatico, con conseguente aumento delle temperature del mare, può mettere a rischio la fauna ittica del Mediterraneo, incrementando il tasso di mortalità e favorendo l'insediamento di nuove specie aliene tropicali con la potenziale occupazione, da parte di queste ultime, delle nicchie ecologiche di specie endemiche. L'obiettivo principale di questo studio consiste nel valutare la vulnerabilità delle specie ittiche rispetto a questi due aspetti. L'analisi, avviata e finanziata nell'ambito della Direttiva del Ministero della Transazione Ecologica numero 22053 del 2022, rivolta agli enti parco nazionali e alle aree marine protette per l'indirizzo "delle attività dirette alla conservazione della biodiversità", è stata applicata alle Aree Marine Protette (AMP) delle Cinque Terre e dell'isola dell'Asinara. Lo studio si concentra su specie individuate con censimenti ottenuti tramite *visual census* e dati derivanti dal monitoraggio dell'attività di pesca ricreativa e professionale. Per le specie ittiche, la cui presenza è stata rilevata all'interno delle AMP, sono stati ricavati range di temperatura preferenziali tramite analisi bilbiografica. Parallelamente sono state estratte, attraverso l'analisi di dati satellitari, le temperature del mare all'interno delle AMP considerate e relative alla situazione attuale e a tre decadi future (2030-2040, 2060-2070, 2090-2100). Per quanto concerne le decadi future, per ciascuna, sono stati presi in considerazione tre diversi scenari socioeconomici (SSP) relativi ai cambiamenti climatici, secondo quanto proposto dall' IPCC (Gruppo intergovernativo di esperti sul cambiamento climatico). La ricerca proseguirà approfondendo l'analisi ed espandendola allo studio di ulteriori variabili ambientali, come salinità, profondità e quantità di ossigeno disciolto nell'acqua, produttività primaria e livello trofico di ogni specie. Questo permetterà di valutare, in modo più completo, la vulnerabilità delle specie considerate e formulare strategie di mitigazione e adattamento.

V. GIUSSANI[1], D. OTTONELLO[1], S. ALBANESE[1], D. CARACCIOLO[1], F. GARIBALDI[2], M. BONIFAI[2], N. PUSSINI[3], E. FONTANESI[4], D. ASCHERI[4], G. CALOGERO[5], E. PIGNATA[5], L. CASTELLANO[6]

[1]Regional Agency for the Environmental Protection Liguria (ARPAL), Genova, Italy.
[2]DISTAV, University of Genoa, Italy.
[3]CREDIMA-Istituto Zooprofilattico Sperimentale del Piemonte, Liguria e Valle D'Aosta, Savona, Italy.
[4]Delfini del Ponente APS, Imperia, Italy.
[5]Menkab APS, Savona, Italy.
[6]Acquario di Genova – Costa Edutainment SpA, Genova, Italy.
valentina.giussani@arpal.liguria.it

LIGURIA: NEW NESTING AREA FOR *CARETTA CARETTA* (LINNAEUS, 1758)

Liguria is the northernmost region of the western Mediterranean Sea recently interested by the nesting of *Caretta caretta*. The first *Caretta caretta* hatchlings were found in Finale Ligure (SV) in 2021, a sea turtle laying eggs was observed in Levanto in 2022 and 5 nests were monitored in 5 different sites in western Liguria in 2024. Following verification by qualified personnel and the involvement of the local administrations, monitoring activities were started for the collection of environmental data (*e.g.* temperature near the chamber, granulometry) for the protection of the nesting area. Concurrently, weather and sea forecast bulletins of the neighbouring coastal areas were drawn up, to coordinate management activities. The nests laid at the beginning of summer in the municipalities of Laigueglia and Arma di Taggia recorded an average temperature of 27.4 and 27.1 °C and a high hatching rate of 89% and 92% Respectively. Nests laid after mid-July, specifically in the municipalities of Alassio (21 July), Finale Ligure (3 August) and Pietra Ligure (13 August) had a hatching rate of 0%, probably due to the repeated storms and the drop in temperature that occurred starting from mid-September. The study of this new nesting area is of great interest for understanding the reasons behind the expansion of the species' and evaluating the necessary measures to preserve its habitat. In this frame the GLIT (Gruppo Ligure Tartarughe), composed by Acquario di Genova, ARPAL, University of Genova and IZS was created, with the aim of managing and protecting nesting sites, coordinating the activities of the different stakeholders and collecting scientific data.

C. LOCCI[1,2], I. AZZENA[1], N. PASCALE[1,2,3], I. DEPLANO[2], R. SENIGAGLIA[1], G. DONATO[4], A. LUNETTA[5,6], I.A. GATÍ[7], A. SPINELLI[8], S. GIACOBBE[7], F. SCARPA[2], M. CASU[1], D. SANNA[2]

[1]Dipartimento di Medicina Veterinaria, Università di Sassari, Italia.
[2]Dipartimento di Scienze Biomediche, Università di Sassari, Italia.
[3]Dipartimento di Scienze Chimiche, Fisiche, Matematiche e Naturali, Università di Sassari, Italia.
[4]Dipartimento di Scienze Biologiche, Geologiche e Ambientali, Università di Catania, Italia.
[5]Dipartimento di Scienze Biologiche, Geologiche e Ambientali (BIGEA), Università di Bologna, Italia.
[6]Istituto per le Risorse Biologiche e le Biotecnologie Marine (IRBIM), Consiglio Nazionale delle Ricerche (CNR), Sezione di Messina, Italia.
[7]Dipartimento di Scienze Chimiche, Biologiche, Farmaceutiche e Ambientali, Università di Messina, Italia.
[8]Research Department, Fundación Oceanográfic de la Comunitat Valenciana, Oceanográfic, Ciudad de las Artes y las Ciencias, Valencia, Spain.
c.locci3@phd.uniss.it

INDAGINI GENETICHE SULL'ESPANSIONE DI *PINNA RUDIS* NEL MEDITERRANEO A SEGUITO DEL DECLINO DI *PINNA NOBILIS*

Pinna rudis, comunemente nota come "nacchera spinosa", è una specie congenerica del bivalve endemico del Mar Mediterraneo *P. nobilis*. Nonostante la sua distribuzione Atlanto-Mediterranea, *P. rudis* è meno comune nel bacino del Mediterraneo, dove occupa principalmente le regioni più calde della parte sud-occidentale. A differenza di *P. nobilis*, che predilige fondali sabbiosi e praterie di posidonia, *P. rudis* si insedia tipicamente su substrati rocciosi, probabilmente a causa della competizione interspecifica con *P. nobilis*. Studi recenti hanno mostrato che, sebbene le popolazioni mediterranee di *P. rudis* siano limitate, esse risultano stabili. A seguito della mortalità di massa di *P. nobilis*, *P. rudis* sembra essersi espansa nelle nicchie ecologiche lasciate libere dalla sua congenerica, suggerendo un possibile cambiamento nella distribuzione della specie a causa della ridotta competizione. In questo contesto, è stato condotto uno studio sulla variabilità genetica di *P. rudis* nel Mediterraneo. Sono state effettuate indagini filogeografiche e filogenetiche tramite l'analisi del gene mitocondriale Citocromo c Ossidasi subunità I (COI). I risultati preliminari suggeriscono che *P. rudis* e *P. nobilis* siano specie sorelle (sister species), e che le due specie si sarebbero differenziate in allopatria da un antenato comune di origine Atlantica. Questo studio rappresenta il primo lavoro estensivo sulle popolazioni di *P. rudis* nel Mediterraneo. I risultati ottenuti sono cruciali per lo sviluppo di strategie di gestione della specie, considerando che *P. rudis* sta progressivamente colonizzando gli habitat un tempo occupati da *P. nobilis* e sono stati riportati eventi di ibridazione tra le due specie, con ibridi resistenti alla malattia responsabile della mortalità di massa di *P. nobilis*.

M. MISTRI, C. MUNARI

Department of Chemical, Pharmaceutical and Agricultural Sciences, University of Ferrara, Italy.
michele.mistri@unife.it

THE HIDDEN BIODIVERSITY OF THE LIDI DI COMACCHIO

The Lidi di Comacchio are seaside resorts south of the Po Delta, with a monotonous, sandy-silty coastline. Tecnoreef® artificial barriers, each made up by 6 pyramids, were immersed, in June 2022, in the gaps between pre-existing breakwaters at Lido Scacchi and Lido Pomposa, 2 northern Adriatic seaside locations near Comacchio. In order to evaluate the possible increase in biodiversity due to the new habitat provided by the submerged structures, a 1-yr monitoring was carried out. The monitoring program followed a BACI design and was carried out by two underwater operators using complementary techniques: "grattage" of standard surfaces (25x25 cm) and digital still photography for the benthos, and visual census for fish fauna. The same monitoring procedure was repeated on control breakwaters at the same depth (about 3 m). In September 2023, a year after their immersion, the pyramids were found to be completely colonized by a rich and diverse benthic community. A considerable (up to 10 cm thick) secondary organogenic substrate had developed, consisting of an intricate three-dimensional structure of tubes of various species of Polychaetes, and a conspicuous community of Molluscs and Cnidarians. Along the vertical profile of the submerged pyramids, a gradient of species was observed, with mussels colonizing the more superficial areas, while reefs of *Sabellaria spinulosa* Leuckart, 1849 were dominant in the deeper areas. The three-dimensional structure of the pyramids, the presence of holes and the different inclinations of the module plates enrich the artifact itself with cavities and crevices, within which a number of fish species have found their habitat. A total of 90 taxa were recorded, compared to the 52 recorded at the adjacent control breakwaters. The submerged pyramids act as powerful biodiversity attractors: our results confirm the ecological importance of submerged artificial structures in areas characterized by flat and soft bottoms.

M. ODDENINO[1], L. MINUTO[1], F. PELIZZA[1,2],
C. ROBELLO[1,2], M. MONTEFALCONE[1,3]

[1]Department of Earth, Environment and Life Sciences (DiSTAV), University of Genoa, Italy.
[2]One Ocean Foundation, Milano, Italy.
[3]National Biodiversity Future Center (NBFC), Palermo, Italy.
murieloddenino@gmail.com

TEMPORAL DYNAMICS OF *POSIDONIA OCEANICA* MEADOWS IN THE CAPO MORTOLA MARINE PROTECTED AREA

Meadows of *Posidonia oceanica* (L) Delile in the Mediterranean Sea are undergoing a progressive decline due to the combined effects of direct local pressures and indirect global change. In the northwestern Mediterranean up to 56% of these meadows have already been lost, reflecting the declining trajectories of European seagrasses since 1869. This regression favors the colonization by substitute species, such as the invasive green algae of the genus *Caulerpa*, which, having a lower engineering capacity than *P. oceanica*, lead to profound structural and functional changes in coastal ecosystems. In the Capo Mortola Marine Protected Area (Western Ligurian Sea), the comparison of data collected along a historical depth transect surveyed in 1987 and later revisited in 2002 and 2024, allowed to assess the change in the health status of the *P. oceanica* meadow over time. A decline has been observed between 1987 and 2002, mainly due to the appearance of *Caulerpa taxifolia* (Vahl) C. Agardh, which has been known to spread along the western coast of Liguria since 1992. However, recent monitoring in 2024 showed that the density of the meadow has remained constant since 2002 and that *C. taxifolia* has disappeared. Despite the initial decline, the meadow of Capo Mortola has indeed maintained a good conservation status in the last decades. Our results are consistent with recent studies that suggest potential resilience of *P. oceanica* meadows under favorable conditions. Although our findings might suggest a possible recovery, only with long-term monitoring we will be able to confirm this positive trend.

I. OLIVÉ[1], M. RIECHERS[2], N. LAZZARI[3], A.J. CASTRO[4]

[1]Stazione Zoologica Anton Dohrn, Naples, Italy.
[2]Thünen Institute of Baltic Sea Fisheries, Rostock, Germany.
[3]Cross-Research in Environmental Technologies (CRETUS), University of Santiago de Compostela, Spain.
[4]Department of Biology and Geology, The Andalusian Centre for the Evaluation and Monitoring of Global Change (CAESCG), University of Almería, Spain.
irene.olive@szn.it

HUMAN-NATURE RELATIONS AS PATHWAYS FOR CONNECTING PEOPLE AND SEAGRASSES

Worldwide, coastal areas are facing several pressures associated to human actions, which seriously compromise the functioning of these systems and the variety of ecosystem services and other nature's contributions to people they provide. To understand the different social-ecological contexts and to drive sustainability transformations in coastal habitats, interdisciplinary cross-sectoral approaches are required together with effective communication strategies. Here we present an initiative, started from the EuroMarine foresight workshop Pathgrass, aimed at developing and implementing socio-ecological approaches in seagrass-dominated coastal systems. The Pathgrass workshop gathered a multidisciplinary research community of experts on seagrass, social-ecological systems, and social sciences to promote a collective reflection on human-seagrass connections/interactions. The final aim is to advance into sustainability and integrated management of coastal systems. In particular, Pathgrass initiative aims to identify (dis)connection points between human and seagrasses; understand the causes of the (dis)connection; and foster people-seagrasses connectedness. Here we present the results obtained from the workshop showing how people relate to segrass meadows at different dimensions. Further steps of this initiative will develop common conceptual frameworks and social-ecological sustainability models to be implemented in seagrass-dominated coastal systems.

N. PASCALE[1,2,3], I. AZZENA[1], R. SENIGAGLIA[1], M. CAMPOLMI[4], M. CASU[1]

[1]Dipartimento di Medicina Veterinaria, Università di Sassari, Italia.
[2]Dipartimento di Scienze Biomediche, Università di Sassari, Italia.
[3]Dipartimento di Scienze Chimiche, Fisiche, Matematiche e Naturali, Università di Sassari, Italia.
[4]Servizio Pesca e Acquacoltura, Assessorato Agricoltura e Riforma Agro-pastorale, Cagliari, Italia.
npascale@uniss.it

IL PROGETTO REGIONALE GRANCHIO BLU: CONTROLLO E GESTIONE PER LA SALVAGUARDIA DELLA BIODIVERSITÀ NELLE LAGUNE DELLA SARDEGNA

Il granchio blu, *Callinectes sapidus* Rathbun 1896 è una specie invasiva originaria delle coste atlantiche del Nord America e giunta nel bacino Mediterraneo nel XX secolo. A causa della significativa minaccia di questo alieno alla biodiversità e alle attività socioeconomiche, in particolare nelle aree costiere, la Regione Sardegna in collaborazione con i due Atenei universitari (Sassari e Cagliari) ha stilato un Progetto regionale mirato alla cattura e quantificazione del granchio blu e di altre specie aliene nelle aree lagunari in concessione demaniale. Il piano operativo progettuale prevede 9 attività che hanno lo scopo di collezionare esemplari di granchio blu in 13 distretti lagunari sardi nell'arco di un biennio. I dati ottenuti renderanno possibile lo studio degli aspetti biologici ed ecologici della specie. Le lagune vengono attualmente campionate tramite l'utilizzo di nasse disposte in triplette (TCU) e posizionate lungo il gradiente salino dei bacini. Per ogni laguna, al termine della raccolta di campioni, verrà effettuato uno studio della struttura di popolazione, del periodo riproduttivo, e delle zone a maggior concentrazione di esemplari e di femmine ovigere. Inoltre, verrà sviluppato un modello predittivo che integrerà tutti i dati disponibili biotici e abiotici per predire fluttuazioni di abbondanza della specie nel tempo. L'Università di Sassari condurrà specificamente analisi del DNA ambientale (eDNA) analizzando il contenuto stomacale dei granchi: attraverso questo approccio molecolare sarà possibile determinare la dieta del granchio blu utilizzando una metodica altamente sensibile per lo studio delle interazioni trofiche e dell'impatto in termini di predazione sulla biodiversità lagunare e sulle attività di pesca e acquacoltura. L'analisi molecolare consentirà, inoltre, la ricerca della presenza del virus CSRV1 in Sardegna. I risultati attesi dal progetto: 1) quantificare l'abbondanza del granchio blu nelle lagune sarde; 2) conoscere la sua biologia ed ecologia; 3) condurre attività di comunicazione volte alla sensibilizzazione degli operatori del settore ittico 4) fornire informazioni alle autorità regionali competenti per orientare future strategie di gestione ed eradicazione della specie aliena.

F. RUGGERI[1,2], V. ASNAGHI[1,2], M. CHIANTORE[1,2], F. PELIZZA[1,3], C. PEZZILLI[1], I. RIGO[1], C. ROBELLO[1,3], P. VASSALLO[1,2,4], C. PAOLI[1,2,4]

[1]DISTAV, University of Genoa, Italy.
[2]National Biodiversity Future Center (NBFC), Palermo, Italy.
[3]One Ocean Foundation, Milano, Italy.
[4]National Inter-University Consortium for Marine Sciences (CoNISMa), Roma, Italy.
francesca.ruggeri@unige.it

POSIDONIA OCEANICA MEADOWS RESTORATION PROCESS: A SUSTAINABILITY ASSESSMENT

Restoration ecology is an evolving science that provides models, methodologies, and supporting tools for the restoration of ecosystems and its application process. Even if restoration includes economic, political, and management evaluations and embraces social goals, such as education, volunteerism, and a general improvement of the human-nature, its main focus is ecological. To assess the restoration of ecosystems from an ecological point of view, it is necessary to use a system approach, able to evaluate not only benefits to the restored ecosystem but also resources invested by other ecosystems to perform the restoration. The aim of this work is to evaluate the effectiveness and sustainability performances of the restoration process realised within the MARES project (NBFC) for the *Posidonia oceanica* ecosystem. This research was performed through emergy analysis, an environmental accounting method based on thermodynamics and introduced in the 1980s by Howard Odum. Emergy takes into account all the resources used for the fullfillment of a process, quantifying them in a unique unit of measure: the equivalent solar energy used to generate them (sej). For each stage of the restoration, an inventory of resources employed was obtained through interviews with project developers. The resources that contribute most to the total requirement resulted electricity, metals, manpower but also vegetal material from the donor meadow. Among accounted resources, about 75% are not renewable. The total physical cost of the intervention, including monitoring after the implantation, is 1.78E+15 sej considering 131 planted seedlings. It corresponds to 1.31E+13 sej/seedling. Results from this kind of evaluations allow: 1) making the restoration processes less impactful as possible 2) improving future interventions, reducing impacts and bettering performance 3) comparing different intervention options 4) communicating the importance of conservation effort of restored ecosystems.

A. TROCCOLI[1], S. DASTOLI[2], A. CARDILLO[2], M. CONTI[2], L. SINAPI[2], M. ZUCCHETTA[3], L. NICOLETTI[2]

[1]Istituto Universitario di Studi Superiori di Pavia (IUSS), Italia.
[2]Istituto per la Protezione e la Ricerca Ambientale (ISPRA), Roma, Italia.
[3]Istituto di Scienze Polari (ISP-CNR), Mestre (VE), Italia.
aurora.troccoli@iusspavia.it

UN APPROCCIO *FUZZY LOGIC* PER IL CALCOLO DEL RISCHIO ECOLOGICO DEGLI HABITAT COSTIERI DELLA REGIONE SARDEGNA RELATIVO ALLA PERICOLOSITÁ DI INONDAZIONE

I cambiamenti climatici attualmente in corso comportano un incremento degli eventi estremi lungo le coste, determinando un aumento di inondazioni, erosione costiera, perdita di habitat e, in molte aree, la salinizzazione delle acque sotterranee e del suolo, minacciando sia le risorse umane che gli ecosistemi. Le aree costiere basse del Mediterraneo sono particolarmente vulnerabili a tali impatti, e tra queste la Sardegna, la seconda isola più grande del Mediterraneo, risulta essere una delle zone a più alto rischio, con una particolare criticità lungo la costa occidentale. In questo contesto alcuni dei siti di nidificazione delle tartarughe *Caretta caretta* potrebbero essere compromessi. Il progetto Life Turtlenest, cofinanziato dal programma europeo LIFE, mira a proteggere i siti di nidificazione della tartaruga marina sulle coste mediterranee di Italia, Spagna e Francia. Il presente studio propone lo sviluppo di un modello a scala regionale del Rischio Ecologico degli habitat costieri. L'analisi si concentra su 76 habitat dei 93 totali cartografati da Carta della Natura Sardegna presenti in fascia costiera, distribuiti su un'area totale di 3.423 km². Il modello è stato costruito combinando tali habitat costieri con metriche di paesaggio, quali indici di diversità e connettività, e con scenari di pericolosità di inondazione derivati da dati di *Earth Observation* (EO). La metodologia adottata è stata integrata con la tecnica della *Fuzzy Logic*, utile per gestire l'incertezza legata ai dati ecologici complessi e migliorare l'accuratezza delle valutazioni, considerando che i sistemi naturali sono caratterizzati da transizioni graduali piuttosto che da categorie rigide. A ogni patch viene assegnato un valore, sempre compreso tra zero e uno. I risultati confermano che gli habitat più a rischio sono le lagune e le spiagge, a dimostrazione della elevata vulnerabilità alle inondazioni di questi habitat costieri a bassa elevazione che, in determinate condizioni, possono provocarne modifiche importanti. Questo lavoro mira a fornire un modello che sia uno strumento utile ai fini di una gestione sostenibile delle zone costiere permettendo una individuazione delle aree più esposte e contribuendo allo studio degli habitat di nidificazione delle tartarughe *Caretta caretta*, in un contesto di cambiamenti climatici in continua evoluzione.

A. UGOLINI[1], S. RENZI[1], A. RUSSO[1], A. D' ALESSANDRO[1], S. CIATTINI[2], S. CHIDEH SOLIMAN[3], A. NISTRI[4], D. CAVALIERI[1]

[1]Department of Biology, University of Florence, Italy.
[2]Department of Chemistry, University of Florence, Italy.
[3]Faculté des Sciences, Université de Djibouti Republic.
[4]Museo di Storia Naturale "La Specola", University of Florence, Italy.
alberto.ugolini@unifi.it

MICROBIAL COMMUNITIES' COMPOSITION OF SUPRALITTORAL AND INTERTIDAL SEDIMENTS IN TWO EAST AFRICAN BEACHES (DJIBOUTI REPUBLIC)

Sandy beaches ecosystems represent key ecotonal zones between terrestrial and marine environments. Sand represents a complex habitat hosting bacteria and fungi that are actively involved in the carbon and in geochemical cycles and could be indicators of beach health, monitoring impact of human activities. Here, we evaluated the bacterial and fungal diversity in two different tropical sandy beaches from Republic of Djibouti, Africa, from a rural (Sagallou-Kalaf, SK, siliceous) and an urban area (Siesta Plage, SP, calcareous), reflecting different anthropic pressure. Sand samples were collected from each locality during diurnal low tide along transects perpendicular to the coastline, ranging from -5 m (towards the sea) to +5 m (towards the land) with one-meter intervals, establishing point 0 where material had been deposited by the preceding high tide. Genomic DNA was extracted, and metagenomic sequencing of bacterial (V3-V4 16S rRNA) and fungal (ITS2) biomarkers was performed. Results showed that bacterial communities are significantly different both according to the sampling site (rural SK vs. urban SP) and, within each sampling site, to the different sampling points along the transect. Instead, for fungal communities, significance was reached only comparing the different sampling points along the transect within each sampling site. This suggests that the fungal community is possibly influenced by physical-chemical variables (e.g. humidity, salinity, temperature). Interestingly, bacterial community of SK resulted dominated by the genera *Escherichia-Shigella*, *Staphylococcus*, and *Bifidobacterium*, typically associated with human microbiota, but also with anthropogenic activities like farming, which is practiced in this area. In addition, differential abundance analysis showed a positive selection, among others, of the genus *Hoeflea*, associated with oil-degradation, in SP (below the high tide line), that could reflect the near port activities in this urban area. These finding suggest that bacterial communities could be influenced by anthropogenic activities and/or sediment composition.

POSTER DEL COMITATO NECTON E PESCA

B. AGUS[1,2], R. CANNAS[1], L. CARUGATI[1], E.COLUCCIA[1], S. DI CRESCENZO[1], A. SABATINI[1], D. CUCCU[1]

[1]Department of Life and Environmental Sciences, University of Cagliari, Italy.
[2]Stazione Zoologica Anton Dohrn, CRIMAC, Calabria Marine Centre, Department of Integrative Marine Ecology (EMI), Amendolara (CS), Italy.
blondine.agus@unica.it

PRELIMINARY EVALUATION OF *SEPIA OFFICINALIS* (LINNAEUS, 1758) SPAWNING ON OCTOPUS TRAPS IN SARDINIA

It is known that the common cuttlefish lays its eggs by anchoring them with filaments on natural substrates and sometimes on artificial supports such as gear, mainly traps. Exposure of the gear to the sun as well as daily cleaning operations result in the loss of eggs that die without having completed development. With the aim of assessing the phenomenon, monitoring was undertaken of 150 traps used during octopus fishing carried out between February and July 2023 by a boat of the south-western Sardinian small fishery. The presence of eggs laid on the traps was found from February to May with a higher frequency in April (5.3 %) and March (4 %). The eggs, varying in number from 21 to 205, were black pigmented, flask-shaped, gelatinous in consistency and with an average size of 0.82±0.15 cm. To recover the eggs and prevent their loss, 22 clutches attached to the traps were monitored at sea by setting the traps inside stainless steel 'nursery' cages. 95% of these eggs within 30-82 days hatched into paralarvae (1.22±0.10 cm) that were released from the cage. Some eggs accidentally detached from the support were placed freely inside the cages, but did not complete development. In conclusion, the rigid structure of octopus traps constitutes a valid support for the cuttlefish spawning and it seems to be essential that the eggs stay attached to complete their development.The frequency of spawining of octopus traps observed in this case on a single boat, would indicate greater proportions if extended to all the boats that fish with traps.

S. BIANCARDI[1], M. SBRANA[2], A. LIGAS[2], A. MASSARO[3], C. MUSUMECI[2], C. VIVA[2], C. PRETTI[2]

[1]Consiglio per la Ricerca in Agricoltura e l'Analisi dell'Economia Agraria (CREA), Centro di Ricerca Ingegneria e Trasformazioni Agroalimentari, Monterotondo (RM), Italia.
[2]Consorzio per il Centro Interuniversitario di Biologia Marina ed Ecologia Applicata (CIBM), Livorno, Italia.
[3]Aplysia, Ricerche Applicate all'Ecologia e alla Biologia Marina, Livorno, Italia.
sara.biancardi2@gmail.com

SELETTIVITÁ DEL TRAMAGLIO NELLA PESCA DELLA SEPPIA, *SEPIA OFFICINALIS*, LINNAEUS 1758, E DELLA TRIGLIA DI SCOGLIO, *MULLUS SURMULETUS*, LINNAEUS 1758

A partire dal 2023 il CIBM ha condotto nelle acque toscane uno studio che ha permesso di valutare la selettività del tramaglio nei confronti di due importanti risorse della fascia costiera sfruttate attivamente dalle marinerie artigianali locali: la seppia e la triglia di scoglio. Sono stati sperimentati due tipi di tramaglio che differivano esclusivamente per le dimensioni delle maglie del pannello interno: rispettivamente 50 mm e 62 mm di maglia stirata. Le prove sperimentali sono state condotte secondo un disegno di campionamento standardizzato, alternando pezze di misura di maglia differenti lungo tutto il calo. Per entrambe le specie sono stati raccolti un numero di esemplari significativo per le due combinazioni di maglia. Sugli individui catturati è stata rilevata la lunghezza (LM) e la circonferenza massima (Cm) del mantello nel caso della seppia, la lunghezza totale (LT) e le circonferenze alle branchie (Ch) e massima del corpo (Cm) nel caso della triglia. La selettività è stata stimata con il metodo indiretto di Sechin, che ipotizza per le reti da posta una selettività espressa da una funzione gaussiana strettamente correlata alle modalità di cattura per imbrocco alla circonferenza massima del corpo (ramo sinistro della curva) e alla circonferenza alle branchie (ramo destro della curva). La forma gaussiana descrive la selettività del tramaglio nei confronti della triglia di scoglio soprattutto nel caso della maglia più piccola (50 mm). Nel caso della maglia più grande si osserva anche una ritenzione di esemplari più piccoli di quelli che teoricamente dovrebbero essere catturati con la modalità imbrocco. Nel caso della seppia, il fattore di ritenzione determinante è risultato la circonferenza massima del mantello. Per questa specie la selettività è stata descritta solo dal ramo ascendente della gaussiana, in quanto le due maglie sperimentate non hanno esercitato una selezione sugli esemplari di maggiore dimensione.

A. BILARDI[1], C. D'IGLIO[1], N. SPANÒ[1,2], P. GALLI[3], M. ALBANO[4], S. FAMULARI[1], G. CAPILLO[1,2]

[1]Department of Chemical, Biological, Pharmaceutical and Environmental Sciences, University of Messina, Italy.
[2]Sea in Health and Life s.r.l., Department of Chemical, Biological, Pharmaceutical and Environmental Sciences, University of Messina, Italy.
[3]Department of Earth and Environmental Sciences (DISTAT), University of Milano-Bicocca, Italy.
[4]Department of Veterinary Sciences, University of Messina, Italy.
antonino.bilardi@studenti.unime.it

INTER-SPECIFIC MORPHOLOGICAL DIFFERENCES OF THE THREE OTOLITHS PAIRS IN SEVEN MARINE TELEOST SPECIES FROM MALDIVES ARCHIPELAGO (INDIAN OCEAN)

Otoliths features are widely investigated to study taxonomy, ecology, paleontology, and biology of teleost. They are crystalline calcium carbonate structures found in the vertebrates' inner ear, and, in teleost, they represent a permanent life history record. Their intra and interspecific differences in morphology and shape are under the genetic and environmental influences. The scientific community has been primarily focused on *sagittae*. Consequently, the knowledge base on *asterisci* and *lapilli* is limited and fragmented, with a lack of scientific literature and descriptive data. This study aims to investigate the inter-specific differences in morphometry, morphology and shape of *sagittae*, *asterisci* and *lapilli* from teleost inhabiting the coastal areas of the Maldives Archipelago. One hundred and forty specimens, belonging to 7 species (*Caesio xanthonota, Lutjanus gibbus, Caranx sexfasciatus, Dipterygonotus balteatus, Gymnocaesio gymnoptera, Pterocaesio pisang* and *Selar crumenophthalmus*) with different life habits, were obtained in 2024 from the Malé fish market. Once transported in the MaHRE center laboratory (Magoodhoo Island), the three otoliths' pairs were extracted to analyze their overall morphology and shape. They were photographed, and the binarized images were analyzed using shape-R package to perform shape and morphometrical analyses. Results highlighted the interspecific variability of *sagittae*, *asterisci* and *lapilli*, related to the different bathymetric distributions, feeding strategies and life habits of the studied species. This research provides, for the first time on the studied species, data on otoliths inter-specific variability and mean shape. These are essential for the ecomorphological investigations on these understudied teleosts, also providing useful know-how suitable for stock assessments. Moreover, improve the knowledge base on *lapilli* and *asterisci* can provide fundamental information for adaptative convergence studies. In this way, it will be possible to give new insight on the Indian Ocean teleosts' species for conservation and management porpoises.

T. DELLI CARRI, A. COSTA, F. BETTI

DISTAV, Università di Genova, Italia.
tommasodellicarri44@gmail.com

CARATTERIZZAZIONE DELL'ITTIOFAUNA ASSOCIATA A DUE FAD (*FISH AGGREGATING DEVICES*) IN MAR LIGURE

L'attrattività di oggetti naturali o antropici, presenti in mare aperto, nei confronti di pesci costieri e pelagici è nota da tempo: queste strutture vengono genericamente indicate come FAD (*Fish Aggregating Devices*). Nonostante in diverse aree del Mediterraneo questo fenomeno associativo sia stato tradizionalmente sfruttato dai pescatori per incrementare le catture di specie di interesse commerciale, la comunità ittica che frequenta i FAD risulta nel complesso poco studiata. Questo studio ha avuto lo scopo di verificare il ruolo di FAD di due boe (a 1,8 e 1,5 km di distanza dalla costa su un fondale di 80 e 90 m, rispettivamente) nel Golfo di Genova (Mar Ligure). Il monitoraggio è avvenuto tramite visual census dalla superficie a 15 m di profondità per un periodo complessivo di 10 mesi. È stata rilevata la presenza di una comunità ittica composta complessivamente da 9 specie (2 associate e 7 aggregate), già registrate da un censimento condotto sulla boa ODAS a 30 miglia dalla costa nella stessa area nel 1994. È stata inoltre evidenziata una ricorrenza nei pattern spaziali e temporali di frequentazione dei FAD da parte delle diverse specie oltre alla frequentazione preferenziale di batimetrie differenti a seconda del periodo. La ricorrenza delle stesse specie al di sotto di strutture diverse e di specie già censite in periodi precedenti sotto oggetti simili, suggerirebbe che la comunità ittica associata ai FAD in Mar Ligure, nonostante si tratti di un ambiente effimero, risulti ecologicamente ben strutturata. I risultati del presente studio favoriscono la comprensione dei cicli vitali di specie poco note, prevalentemente di interesse commerciale, rappresentando un tassello importante nella gestione e protezione della fauna ittica mediterranea.

L. DE VINCENZIS[1], P. BATTAGLIA[2,3], E. ASCIUTTO[2,3,4], F. CARDONE[3,5], P. CONSOLI[2], V. COSTA[1], A. GIOVA[2,6], G. MILISENDA[7], V. PALUMMO[1,7], D. PICA[1], E. SALVATI[3,5], F. STENICO[8], T. ROMEO[3,9,10], S. GRECO[11]

[1]Department of Integrative Marine Ecology (EMI), Stazione Zoologica Anton Dohrn, CRIMAC, Calabria Marine Centre, Amendolara (CS), Italy.
[2]Department of Integrative Marine Ecology (EMI), Stazione Zoologica Anton Dohrn, Sicily Marine Centre, Messina, Italy.
[3]National Biodiversity Future Center (NBFC), Palermo, Italy.
[4]Department of Earth and Marine Sciences, University of Palermo, Italy.
[5]Department of Integrative Marine Ecology (EMI), Stazione Zoologica Anton Dohrn, Napoli, Italy.
[6]Department of Chemical, Biological, Pharmaceutical and Environmental Sciences, University of Messina, Italy.
[7]Department of Integrative Marine Ecology (EMI), Stazione Zoologica Anton Dohrn, Sicily Marine Centre, Palermo, Italy.
[8]Department for Research Infrastructures for marine biological resources (RIMAR), Marine Robotics Technology Implementations (ITR), Stazione Zoologica Anton Dohrn, CRIMAC, Calabria Marine Centre, Amendolara (CS), Italy.
[9]Department of Biology and Evolution of Marine Organisms, Stazione Zoologica Anton Dohrn, Sicily Marine Centre, Messina, Italy.
[10]National Institute for Environmental Protection and Research, Milazzo (ME), Italy.
[11]University of Gastronomic Sciences of Pollenzo, Bra (CN), Italy.
ludovica.devincenzis@szn.it

CHARACTERIZATION OF FISH DIVERSITY THROUGH ROV SURVEYS IN AN UNEXPLORED DEEP-SEA AREA OF THE CENTRAL MEDITERRANEAN SEA

Research expeditions by means of remoted operated vehicles (ROVs) or submersibles are the most effective tool for the study of deep-sea habitats, biodiversity and communities. This study provides the first detailed description of the composition and depth distribution of a demersal deep-sea fish assemblage in the northern Ionian Sea (Mediterranean). Since the study area was selected as a potential location for the establishment of an offshore wind farm, results will provide a baseline for impact assessment and management advice. Overall, 20 ROV transects were performed for a total length of 99.13 linear km and about 180 hours of HD ROV footage (depth range 640-1248 m). Data were clustered and analysed per depth stratum. A total of 23 families and 44 fish taxa were recorded and the average density was 0.88 ind/km^2. The most abundant family was Macrouridae (49.9%), followed by Nettastomidae (15.5%), Myctophidae (10.6%), Notacanthidae (8.7%), and Ipnopidae (4.7%). A similar proportion was observed in each depth stratum, although some differences were found (e.g. Ipnopidae increased their abundance in relation to depth). *Nezumia aequalis* (Günther, 1878) and *N. sclerorhynchus* (Günther, 1878) reached together a percentage abundance of 37.8%. Abundance values were also higher for *Nettastoma melanura* Rafinesque, 1810 (15.2%), *Hymenocephalus italicus* Giglioli, 1884 (8.7%) and *Notacanthus bonaparte* Risso, 1840 (8.5%). The results of ROV surveys have shown that this non-invasive methodology is useful for updating our knowledge about deep-sea species, which are often considered rare due to a lack of routine investigations beyond a certain depth, in areas not considered by scientific monitoring (*e.g.*, MEDITS) or not exploited by fisheries.

S. FAMULARI[1], A. CARNEVALE[1], M. ALBANO[2], C. D'IGLIO[1], G. CAPILLO[1,3], S. SAVOCA[1,3]

[1]Department of Chemical, Biological, Pharmaceutical and Environmental Sciences, University of Messina, Italy.
[2]Department of Veterinary Sciences, University of Messina, Italy.
[3]Sea in Health and Life srl, Department of Chemical, Biological, Pharmaceutical and Environmental Sciences, University of Messina, Italy.
serfamulari@unime.it

BRACKISH BRIDGES: HOW THE CAPO PELORO LAGOON SUPPORTS THE POPULATION OF *LITHOGNATHUS MORMYRUS* (SPARIDAE)

Coastal brackish lagoons are highly productive ecotones that support key processes and provide important ecological services. Several teleost species benefit from nutrient richness and structural complexity during critical phases of their life cycle, using coastal lagoons as nursery areas. This study focuses on a species of high ecological and commercial interest, *Lithognathus mormyrus* (Linnaeus, 1758), which is widely distributed throughout the Mediterranean basin. From October 2022 to October 2023, visual census surveys were conducted monthly along 300-meter-long linear transects located in the Natural Oriented Reserve "Laguna di Capo Peloro" (Messina - Italy). Observational data were collected within the brackish pond known as Faro Lake and two adjacent stretches of sea (Ionian and Tyrrhenian Sea), which communicate with the lake through natural and artificial canals. Specimens were recorded and counted by underwater video documentation, and water surface temperature was contextually measured. Data visualization and statistical analysis were performed using different packages of RStudio software. A negative binomial distribution model was applied to assess correlations between the number of adults and juveniles, water temperature, and the seasonal opening of the canal connecting Faro Lake to the Tyrrhenian Sea. Results showed a significant ($p<0.05$) increase in adult presence within the lake during summer, coinciding with canal opening and higher temperatures. The peak of juveniles' recruitment was noted in autumn and winter after canal closure, suggesting a migratory influx from the sea into the lagoon during the breeding season. Understanding the structures and dynamics of teleost populations in transitional environments is crucial to implement conservation strategies and sustainable management of fishery resources. The results presented here provide valuable insights into the connection between marine and brackish habitats, highlighting the importance of the latter in the life cycle of *L. mormyrus* in the Tyrrhenian Sea, and contributing to the broader knowledge of Mediterranean coastal ecosystems.

G. GALASSO, C. TURCO, P. MAIORANO, G. D'ONGHIA, L. SION

Dipartimento di Bioscienze, Biotecnologie e Ambiente, Università di Bari Aldo Moro, ULR CoNISMa Bari, Italia.
gabriele.galasso@uniba.it

SPECIE TERMOFILE NON INDIGENE IN UN MEDITERRANEO SEMPRE PIÙ CALDO: IL CASO DI *SPHOEROIDES PACHYGASTER* NEL MAR IONIO NORD-OCCIDENTALE

Nel Mar Mediterraneo, negli ultimi decenni, è stato registrato un aumento di specie tropicali e sub tropicali, tra cui il pesce palla liscio *Sphoeroides pachygaster* (Müller & Troschel, 1848), specie tropicale originaria dell'Oceano Atlantico. Questa specie è stata segnalata per la prima volta nel 1979, diffondendosi dapprima nel versante occidentale e successivamente in tutto il bacino. Nel Mar Ionio nord-occidentale il pesce palla liscio è stato segnalato per la prima volta nel 1991 lungo il versante ionico calabro e, negli ultimi decenni, la sua presenza è stata sempre più ricorrente. Il presente lavoro analizza i dati di *S. pachygaster* provenienti dalle campagne sperimentali di pesca a strascico (1991-2024) effettuate, nell'ambito di progetti nazionali e internazionali, nel Mar Ionio nord-occidentale. Sono stati catturati 79 individui di *S. pachygaster* tra 66 e 400 m di profondità, prevalentemente lungo il versante ionico calabro e siciliano. Per ciascun esemplare sono stati rilevati la lunghezza totale (LT) in millimetri (mm), il peso (P) in grammi (g), il sesso e lo stadio di maturità delle gonadi. In particolare sono stati identificati 21 maschi (115-368 mm LT; 47-1282 g), 56 femmine (115-370 mm LT; 43-1717 g) e 2 esemplari indeterminati (92-105 mm LT; 20-33 g). Le frequenti catture di *S. pachygaster* (1991-2024), insieme all'incremento della lunghezza media osservata nel tempo e alla presenza di individui per la maggior parte sessualmente maturi, indicherebbe la presenza di una popolazione stabile di pesce palla liscio caratterizzata soprattutto da riproduttori. Tale evidenza potrebbe essere correlata all'aumento della temperatura e della salinità registrato nell'area d'indagine, negli utimi decenni, contestualmente al riscaldamento dell'intero Mediterraneo.

C. GERVASI[1], S. SAVOCA[1,2], G. CAPILLO[1,2], M. ALBANO[3]

[1]Department of Chemical, Biological, Pharmaceutical and Environmental Sciences, University of Messina, Italy.
[2]Sea in Health and Life srl, Department of Chemical, Biological, Pharmaceutical and Environmental Sciences, University of Messina, Italy.
[3]Department of Veterinary Sciences, University of Messina, Italy.
claudio.gervasi@unime.it

ARTIFICIAL LURES-*SEPIA OFFICINALIS* (LINNAEUS, 1758) INTERACTIONS: INSIGHTS FROM SOCIAL MEDIA FISHING VIDEOS

Understanding how cephalopods' body patterns change in different contexts contributes to the knowledge of their communication, mimicry, and physiological responses to external stimuli. Particularly, *Sepia officinalis* (Linnaeus, 1758) shows complex body patterning modulated by chromatophores, which can be used to deduce behavioral states. In this context, studying the behavior of cephalopods during fishing action could provide valuable insights into their sensory ecology, hunting strategies, and stress responses. This study aims to analyze the hunting behavior, preferred baits, and body patterning of *S. officinalis* during interactions with artificial lures by collecting and analyzing publicly available underwater videos from social media platforms (YouTube, Instagram, and Facebook). This strategy provides a unique opportunity to observe *S. officinalis* in its natural environment under real fishing conditions, offering information hard to obtain in laboratory experiments. After the first phase of video screening, a collection of 80 videos were selected based on three predefined criteria related to the *S. officinalis* hunting action: search, attack and escape. The analysis focused on identifying body pattern changes associated with these behaviors. Additionally, an assessment of the influence of bait color, related to environmental factors such as water transparency and bottom type, was proposed. The detected alterations of body patterning were principally correlated with cuttlefish size. Preference for bait color, potentially influenced by environmental factors, showed pink as the most predominant, followed by orange, red, blue, white, and yellow. The most frequently observed body patterns during fishing interaction were the Intense Zebra, the Stipple and the Disruptive. The use of social media videos highlights the potential of this approach in behavioral research by enabling large-scale data collection in specific environmental conditions. This approach expands knowledge about the ethology of *S. officinalis* and offers practical applications for cephalopod recreational fisheries, conservation, and experimental management.

E. MELIADÒ[1,2], S. LIBRALATO[3], R. CARLUCCI[4], G. MADAGHIELE[4], C. MANNARINI[4], F.P. DE LUCA[4], G. CIPRIANO[4], G. DENTI[1,2], P. RICCI[4]

[1]CNR-IRSA, Talassografico "A. Cerruti", Taranto, Italia.
[2]National Biodiversity Future Center (NBFC), Palermo, Italia.
[3]OGS, Sezione di Oceanografia, Trieste, Italia.
[4]Dipartimento di Bioscienze, Biotecnologie e Ambiente, Università di Bari, Italia.
eleonora.meliado@irsa.cnr.it

ANALISI DELLE PRIME STATISTICHE DELLA PESCA IN ITALIA DA NUOVE FONTI STORICHE (1927-1943)

La nascita delle statistiche sulla pesca in Italia è strettamente legata alle politiche economiche del regima fascista (1922-1943), durante il quale i dati furono utilizzati come strumento fondamentale di pianificazione dell'economia nazionale che puntava all'autosufficienza alimentare. In questo contesto si svilupparono i primi tentativi di applicare metodologie analitiche scientifiche, nonché la creazione di istituti di ricerca e laboratori dedicati alla raccolta di informazioni dettagliate sulla pesca. Per la diffusione dei dati raccolti, furono pubblicate riviste di settore come "La Pesca Italiana" (1941-1943) e "Il Corriere della Pesca" (1927-1943), sconosciute alla letteratura scientifica attuale. Le prime statistiche di pesca, corredate da aneddoti e fotografie, riguardavano aspetti inerenti all'andamento dell'industria conserviera, alle dinamiche dei mercati di distribuzione e al declino di alcune tecnologie di pesca. Un primo esempio riguarda l'indagine del tonnellaggio velico e a motore che venne censito per la prima volta tra il 1924 e il 1929. Il calo della vela (da 191.000 a 141.000 tonnellate), e l'aumento dei piroscafi (da 26.468 a 112.123 tonnellate) portò all'emanazione nel 1934 di una nuova legge sulla pesca che introdusse premi in denaro per incentivare la costruzione di nuovi motopescherecci per la pesca a strascico. L'analisi preliminare dei bollettini di sbarcato (luglio-dicembre) nei 207 mercati ittici attivi nel 1927, mostra una pubblicazione sistematica quindicinale del dato e una classificazione delle specie ittiche in categorie di I, II e III qualità; separatamente da alici, sarde e lacerti. La maggiore produzione ittica proveniva dalla Sicilia (7590,9 Q.li), Puglia (6238,7 Q.li) e Marche (3833,7 Q.li). Le specie più diffuse erano le triglie e i merluzzi (I qualità), polpi e seppie (II qualità) e "fritturella" (III qualità). La documentazione statistica presente in letteratura grigia può contribuire alla comprensione storica dell'evoluzione del settore ittico. Emerge dai dati un cambiamento sull'uso degli incentivi nel settore della pesca negli ultimi 80 anni, passando dal promuovere l'acquisto dei motopescherecci alla demolizione della flotta.

S. NOÈ[1,2], F. STENICO[3,4], F. CARDONE[1,2], A. TERLIZZI[1,2,5,6], A. AIELLO[2,7], C. BONAVIRI[1], T.J. WILLIS[1,2]

[1]Integrative Marine Ecology Department, Stazione Zoologica Anton Dohrn, Naples, Italy.
[2]National Biodiversity Future Center (NBFC), Palermo, Italy.
[3]Research Infrastructures for Marine Biological Resources Department (RIMAR) - Technological Implementation & Marine Robotics (ITR), Stazione Zoologica Anton Dohrn, Rome, Italy.
[4]Stazione Zoologica Anton Dohrn, CRIMAC, Calabria Marine Center, Amendolara (CS), Italy.
[5]Department of Life Sciences, University of Trieste, Italy.
[6]National Inter-University Consortium for Marine Sciences (CoNISMa), Rome, Italy.
[7]DiSTeM, University of Palermo, Italy.
simona.noe@szn.it

NON-DESTRUCTIVE SAMPLING METHODS: NOVEL AND EFFECTIVE TOOLS TO DETECT THE SIX-GILLED SHARK *HEXANCHUS GRISEUS* IN THE GULF OF NAPLES

Deep-sea and mesophotic ecosystems are among the most extensive habitats in the world. However, data availability on their biodiversity is still limited in many regions and mostly based on fishery catch data. *In-situ* observations, conducted through video systems, have been proven to be crucial non-invasive innovative technologies in the exploration of the difficult-to-access deep-sea and its inhabiting organisms. This study provides for the first time *in-situ* observations of the bluntnose sixgill shark *Hexanchus griseus* Bonnaterre 1788 in the Gulf of Naples by using non-destructive sampling methods. The combined use of Baited Remote Underwater Video (BRUV) and Remotely Operated Vehicle (ROV) allowed us to document the occurrence of *H. griseus* in a newly explored and highly diverse habitat dominated by black corals, in the mesophotic zone of the Gulf of Naples, along with some novel behavioural observations. Seven individuals of different sex and size were recorded through the BRUV systems within the same area c. 100 m distant from the black coral forest. Four of these individuals were detected in May 2024 during a consecutive three-day survey and three more individuals were observed in October 2024 within the same day. In addition, four individuals of *H. griseus* were observed swimming over the complex substrate of the black coral forest during two ROV surveys conducted in 2020 and 2021, respectively. Such frequent encounters suggest a high density population of bluntnose sixgill sharks in the area, where highly diverse habitats, dominated by black coral forests, can likely sustain many key components of organismal life histories, including those of *H. griseus*. This information contributes to improve our understanding of fish diversity in the mesophotic zone of the Gulf of Naples and identify future priority habitats for marine biodiversity and functionality as well as for the conservation of large apex predators, such as *H. griseus*.

C. PORCU[1], E. AROFFO[1], BELLODI[1,2], A. MULAS[1],
R. PORCEDDU[1], M.C. FOLLESA[1]

[1]Department of Life and Environmental Sciences, University of Cagliari, Italy.
[2]Department of Integrated Marine Ecology, Calabria Marine Center, Stazione Zoologica Anton Dohrn (SZN), Amendolara (CS), Italy.
cristina.porcu@unica.it

REPRODUCTION OF ANGLERFISH (*LOPHIUS BUDEGASSA* SPINOLA AND *LOPHIUS PISCATORIUS* LINNAEUS) FROM SARDINIAN SEAS

In the Mediterranean Sea, the black anglerfish (*Lophius budegassa* Spinola, 1807) and white anglerfish (*L. piscatorius* Linnaeus, 1758) are significant components of commercial by-catch in bottom trawling. Despite their commercial importance, knowledge on biology, ecology and population dynamics are scattered. In this study, gonadal morphology and reproductive biology of these species were considered by examining 236 *L. budegassa* (14-80 cm) and 189 *L. piscatorius* (22-106 cm) specimens collected between 2015 and 2024 at depths ranging from 30 to 669 m during the Mediterranean International Trawl Survey (MEDITS) and commercial hauls. Both species displayed typical features of the Lophiiformes Order, with testes being tubular and bean-shaped, and ovaries forming a single, flattened tube. The sex ratio (F:M) was close to 1 for *L. piscatorius* (χ^2=0.21, p>0.05), while males outnumbered females in *L. budegassa* (χ^2=5.20, p<0.05). The determination of spawning period, mainly based on pre-spawning and spent females, because of the low number (white anglerfish) or absence (black anglerfish) of spawning females, suggests a spawning period from winter to summer for black anglerfish and from summer to autumn for white anglerfish. The low or absence of spawning females suggests that both species might migrate to areas or depths not sampled in this study. This could be due to the short duration of the maturity stage, though pre-spawning females were found in small numbers for both species. Further research is needed to test this hypothesis and to refine female maturity estimations. This information is essential for an accurate assessment and management of stocks exploited by fisheries in the central-western Mediterranean Sea.

P. SARTOR[1], B. AGUS[2], L. RUSSO[1], M. SARTINI[3], C. VIVA[1], D. CUCCU[4]

[1]Consorzio per il Centro Interuniversitario di Biologia Marina ed Ecologia Applicata (CIBM), Livorno, Italy.
[2]Stazione Zoologica Anton Dohrn, CRIMAC, Calabria Marine Centre, Department of Integrative Marine Ecology (EMI), Amendolara (CS), Italy.
[3]Aplysia, Ricerche Applicate all'Ecologia e alla Biologia Marina, Livorno, Italy.
[4]Department of Life and Environmental Sciences, University of Cagliari, Italy.
sartor@cibm.it

ON THE OCCURRENCE OF *OCTOPOTEUTHIS SICULA* RÜPPELL, 1844 (CEPHALOPODA: OCTOPOTEUTHIDE) IN THE WESTERN MEDITERRANEAN

The deep-water *Octopoteuthis sicula* Rüppell, 1844 is a meso-bathypelagic Cephalopod with a wide geographical distribution, also including some areas of Mediterranean Sea. The overall knowledge on this species is still limited due to the scarce catches, often limited to occasional events. Two specimens of *O. sicula* were found in 2012 and 2024 in the by-catch of the bathyal commercial otter trawl fishery targeting red shrimps, in the waters off Sardinia and Liguria (western Mediterranean), at depths of 568 and 470 m, respectively. The two specimens, measuring 17.7 and 15.3 cm in Dorsal Mantle Length and weighting 680 g and 273 g, respectively, were fully mature males. Morphometric and meristic data was collected for both individuals. In particular, as preliminary data from the Mediterranean Sea, a detailed description, with photos of the reproductive apparatus, as well as the number (1158 in the first specimen, 975 in the second) and the average length (14.7 mm, range 12.2-16.2 mm; 14.1 mm ± 13.5-15.0, in the two specimens, respectively) of spermatophores present inside the two Needham'Sacs are provided. The peculiarity of the males of this species is the long terminal organ or penis (65 and 72 mm in the two samples, respectively), that extends beyond the mantle cavity. This note contributes to increase the knowledge of the reproductive strategy of males of this species in the Mediterranean Sea, that includes the transfer by penis of *spermatangia* (discharged spermatophores) in the mantle tissue of the females. Such characteristics, common to other Cephalopods, seem to be a strategy to guarantee the reproductive success in a deep-water environment.

M. SBRANA[1], F. DE CARLO[2], A. LIGAS[1], C. VIVA[1], I. ROSSETTI[2], C. PINTO[3], P. SARTOR[1], C. PRETTI[1]

[1]Consorzio per il Centro Interuniversitario di Biologia Marina ed Ecologia Applicata (CIBM), Livorno, Italia.
[2]Aplysia, Ricerche Applicate all'Ecologia e alla Biologia Marina, Livorno, Italia.
[3]Dipartimento di Scienze della Terra, dell'Ambiente e della Vita (DISTAV), Università di Genova, Italia.
sbrana@cibm.it

ESPERIMENTI DI SELETTIVITÁ DELLA RETE A STRASCICO DI FONDO NELLA PESCA DEL GAMBERO VIOLA, *ARISTEUS ANTENNATUS* (RISSO, 1816) NEL MAR LIGURE

Nell'ambito del progetto Ecoefishent, finanziato nell'ambito del programma UE-Horizon 2020, sono stati sperimentati attrezzi da pesca più selettivi allo scopo di ridurre lo scarto e migliorare il pattern di sfruttamento delle specie commerciali nella pesca professionale a strascico. Nel 2024 è stato svolto uno studio sperimentale coinvolgendo la marineria di Santa Margherita Ligure che sfrutta con reti a strascico il gambero viola, *Aristeus antennatus* (Risso, 1816), un'importante risorsa del mar Ligure. In accordo con i pescatori locali sono stati messi a fuoco gli obiettivi della sperimentazione, mirata non solo a ridurre lo scarto ma anche a limitare le catture di individui piccoli di gambero viola per migliorare lo stato di sfruttamento dello stock. Oltre a valutare l'impatto delle reti utilizzate dai pescatori (sacco con maglia a losanga di 50mm, DM50), sono state sperimentate altre due reti con sacchi rispettivamente con maglia da 50mm quadra (SM50) e 60mm a losanga (DM60). DM50 è risultata poco selettiva e solo il 6% degli esemplari di gambero viola appartenenti alla III categoria commerciale (lunghezza del carapace inferiore a 35 mm) sono riusciti a fuggire. Tale percentuale è aumentata in modo significativo nelle configurazioni DM60 (59%) e SM50 (72%). In queste due configurazioni si è osservata anche la fuga di esemplari appartenenti alla II categoria commerciale: il 42% del totale delle catture di questa categoria per il DM60 e il 32% per l'SM50. I risultati preliminari indicano quindi che l'uso di maglie più grandi al sacco può essere una valida opzione per migliorare lo sfruttamento di *A. antennatus* nell'area.

F. TIRALONGO[1,2,3], A. ZAMBETTI[3], B. DIMICHINO[3], F. GIOVANNELLI[3], P. BAIATA, P. PIGNALOSA[3]

[1]Department of Biological, Geological and Environmental Sciences, University of Catania, Italy.
[2]Ente Fauna Marina Mediterranea, Avola (SR), Italy.
[3]Bluechain a.r.l., Torre del Greco (NA), Italy.
francesco.tiralongo@unict.it

TRAP-LINE: AN INNOVATIVE FISHING METHOD FOR MEDITERRANEAN SWORDFISH FISHERIES

Effective management of Mediterranean swordfish (*Xiphias gladius* Linnaeus, 1758) fisheries demands accurate monitoring of fishing practices to ensure sustainability and reduce ecological impacts. Between April and August 2024, a new fishing gear termed "trap-line," a novel entangling method differing significantly from traditional hook-based longlines, was tested onboard a commercial longline vessel operating in the Mediterranean under strict scientific data collection protocols. This gear, composed of concentric monofilament rings equipped with artificial bait, showed promising preliminary results. Approximately 33% of the total fishing gear deployed consisted of trap-lines, yet these accounted for over 50% of commercially viable swordfish catches, indicating notably higher catch-per-unit-effort (CPUE) compared to traditional hooks. Additionally, trap-lines demonstrated improved size selectivity, capturing fewer undersized swordfish (only 15% of undersized catches) than hooks. Significantly lower bycatch rates (only 4.2%) were recorded for trap-lines compared to hooks (95.8%), with most bycatch individuals released alive due to minimal physical harm. Comprehensive scientific data collection ensured the reliability of recorded results, providing a robust basis for evaluating the gear's efficiency and ecological impact. These preliminary findings suggest the trap-line gear represents an efficient, selective, and potentially environmentally responsible alternative to traditional fishing methods, reducing operational costs by eliminating natural bait and significantly lowering impacts on non-target marine species. Further studies and scientific data collection programs are recommended to confirm the sustainability benefits and facilitate regulatory recognition of this innovative fishing method within Mediterranean swordfish fisheries. However, given the overall increase in swordfish catches associated with trap-line use, additional research and detailed analyses are required, and new management strategies will be essential to sustainably regulate the use of this fishing gear.

E. TOMASSETTI[1], A. MASCOLI[1], A. SANTOJANNI[2], G. CHEMELLO[1], G. GIOACCHINI[1], S. COLELLA[2]

[1]Laboratory of Developmental and Reproductive Biology (DiSVA), Università Politecnica delle Marche, Ancona, Italy.
[2]Institute for Marine Biological Resources and Biotechnology (IRBIM), National Research Council (CNR), Ancona, Italy.
sabrina.colella@cnr.it

REPRODUCTIVE TRAITS AND MACROSCOPIC ASSESSMENT OF OVARIAN DEVELOPMENT IN *SOLEA SOLEA* FROM THE ADRIATIC SEA: PRELIMINARY RESULTS

The common sole, *Solea solea* (Linnaeus, 1758), is a demersal flatfish of high ecological and commercial value in the Mediterranean, particularly in the Adriatic Sea (GSA 17). Understanding its reproductive biology is crucial for effective management and conservation. This study aimed to investigate key aspects of the species' reproductive biology and assess the gonadal development in females through the ovaries examination. Monthly sampling was conducted in 2019 off the coast of Ancona (Adriatic Sea) and ovaries were classified macroscopically following the Brown-Peterson's (2011) criteria. The reproductive cycle was determined by analysing the monthly distribution of ovarian developmental stages. The sex ratio was assessed across sampling months and size classes, revealing a female-biased population. Spawning occurred from autumn to winter and the estimated length at first maturity (L_{50}) for females was 22.98 cm. Macroscopic evaluation of ovaries presented posed challenges, particularly in differentiating between developing and regenerating stages, due to the lack of distinctive external features. This highlights that histological validation is essential, especially in pre- and post-spawning periods. Reproductive studies on the common sole in the central Adriatic Sea are scarce, and existing data are often outdated. A comparison of the macroscopic L_{50} from this study with previous research reveals a declining trend over time, which may be influenced by food availability, fishing pressure and climate change, and could potentially indicate an adaptive reproductive strategy, although further studies are required. This work represents a preliminary study of the macroscopic reproductive traits of common sole in the central Adriatic Sea and provides update insights into its reproductive biology. It offers an useful tool for identifying the spawning period, that could be strengthened by an histological validation for a more accurate evaluation of the reproductive cycle.

G. VECCARI[1], M. FOURNIEZ[2], D. GIORDANO[1], A. PERDICHIZZI[1], E. ARMELI-MINICANTE[1], D. SALVATI[1], F.M. VENEZIANO[1,3], A. SCIPILLITI[4], P. RINELLI[1], A. PROFETA[1]

[1]Istituto per le Risorse Biologiche e le Biotecnologie Marine (CNR-IRBIM), Messina, Italia.
[2]Ecole Nationale Supérieure des Sciences Agronomiques de Bordeaux Aquitaine, Gradignan, France.
[3]Dipartimento di Scienze Biologiche, Geologiche e Ambientali (BIGEA), Università di Bologna, Italia.
[4]Dipartimento di Scienze Chimiche, Biologiche, Farmaceutiche ed Ambientali, Università di Messina, Italia.
graziano.veccari@irbim.cnr.it

HOTSPOT E DINAMICA SPAZIALE DEI GIOVANILI DI *GALEUS MELASTOMUS* RAFINESQUE, 1810 NEL TIRRENO CENTRO-MERIDIONALE

L'individuazione di aree nursery di popolazioni di specie demersali rappresenta un'informazione fondamentale per la valutazione degli stock e per fornire consigli ai gestori nel quadro dell'approccio ecosistemico alla pesca. A tale scopo, questo studio ha come obiettivo quello di analizzare la frazione giovanile del boccanera *Galeus melastomus* Rafinesque, 1810 attraverso l'identificazione di possibili aree di aggregazione e di valutare la loro persistenza nel tempo. L'analisi si basa sui dati raccolti nella GSA10 (Tirreno Centro-Meridionale) durante le campagne di pesca a strascico sperimentale MEDITS svolte tra il 2017 ed il 2021. La prima coorte è stata identificata con il metodo di Bhattacharya (TropFishR) ed è stata definita una taglia di cut-off al di sotto della quale considerare gli individui giovanili. Questo ha permesso di calcolare gli indici di densità delle reclute (IDR: R/km^2) annuali e di identificare gli hotspot nelle aree con IDR cumulativo >60%, generando mappe annuali tramite GIS. La persistenza degli hotspot è stata valutata attraverso il tasso di sovrapposizione delle celle di una griglia di 10 km², per analizzare la stabilità delle aree di aggregazione. Sono stati catturati 609 individui tra 15 e 657 m di profondità. Il valore medio di cut-off calcolato è di 250 mm di lunghezza totale. Le stime annuali degli IDR totali mostrano una tendenza in diminuzione (R^2=0,6101), con valori da 85,83 R/km² (2017) a 42,20 R/km² (2021), con il picco nel 2018 a 107,63 R/km². La persistenza di nursery non è stata osservata in specifiche aree. Questi risultati suggeriscono che la popolazione potrebbe essere sottoposta a una forte pressione antropica o ambientale. Pertanto, l'identificazione degli hotspot di aggregazione dei giovanili di *Galeus melastomus* è fondamentale per la conservazione della specie e per la sostenibilità dell'ecosistema marino.

F. VIGNATI[1], C. PINTO[1], L. LANTERI[1], G. ROPPO VALENTE[1],
G. TERENZIANI[2], F. GARIBALDI[1]

[1]Department of Earth, Environmental and Life Sciences, University of Genoa, Italy.
[2]Marine Animal Conservation and Public Engagement, Stazione Zoologica Anton Dohrn, Napoli, Italy.
federico.vignati@gmail.com

FIRST ESTIMATION OF GROWTH PARAMETERS FOR *ZU CRISTATUS* (LAMPRIFORMES)

The scalloped ribbon fish (*Zu cristatus* Bonelli, 1819) (Lampriformes, Trachipteridae) inhabits temperate and tropical waters worldwide and has been recorded throughout the Mediterranean Sea, particularly in the western basin. Despite its wide distribution, knowledge of the biology and ecology of this species remains limited due to its elusive nature. The introduction of mesopelagic longlines for swordfish fishing in the Ligurian Sea in 2010 led to a shift in by-catch composition compared to surface longlines. This allowed the collection, from August 2013 to June 2024, of 62 adult specimens (20 males and 42 females) with standard length (SL) ranging from 57 cm to 106 cm. All specimens were caught at depths between 100-600 m. An additional juvenile specimen measuring 26.5 cm SL of indeterminate sex, was found stranded. The primary aim of this study was to calculate the growth curve for this species. Age determination was conducted by counting growth bands on the vertebral body treated with an alizarin red solution. The combination between samples from the literature (juvenile individuals) and our age reading (n=60), enabled the estimation of the von Bertalanffy growth curve parameters *($L\infty=94.36$ cm, $k=0.61$, $T_0=-0.17$).* The maximum estimated lifespan of the species was eight years for both males and females. The gonadosomatic index (GSI) of females was also analysed revealing a reproductive peak between late June and early July. This study provides a significant contribution to the understanding of the biology of this "rare" species, expanding on previously documented aspects such as meristic and morphological characteristics. Additionally, it confirms that reproduction occurs throughout the summer. Age determination of 60 individuals covering a wide range of lengths has allowed the first estimation of a growth curve for this species.

POSTER DEL COMITATO PLANCTON

G. CARUSO[1], A. SPECCHIULLI[2], F. AZZARO[1], F. DECEMBRINI[1], G. MAIMONE[1], A.C. RAPPAZZO[1,3], C. CAROPPO[4,5]

[1]Institute of Polar Sciences (ISP), National Research Council (CNR), Messina, Italy.
[2]Institute for Marine Biological Resources and Biotechnology (IRBIM-CNR), Lesina (FG) Italy.
[3]Department of Environmental Sciences, Informatics and Statistics, Ca' Foscari University of Venice, Italy.
[4]Water Research Institute (IRSA-CNR), Taranto, Italy.
[5]National Biodiversity Future Center (NBFC), Palermo, Italy.
carmela.caroppo@cnr.it

MICROBIAL COMMUNITY DIVERSITY AND ORGANIC MATTER TURNOVER IN COASTAL MEDITERRANEAN SITES: THE MARINE STRATEGY FRAMEWORK DIRECTIVE MONITORING PLANS

In aquatic ecosystems, the microbial assemblage is a major actor in the degradation and mineralization of organic matter, that have relevant implications on the functioning of biogeochemical cycles. Enzymatic hydrolysis of organic substrates is the first step in organic matter turnover, recycling the nutrients supporting further cell biomass production. Within the Marine Strategy Framework Directive, this microbial parameter could help to better define the descriptor D5 (Eutrophication), contributing with the other physico-chemical ones to a more complete assessment of the Good Environmental Status (GES). During summer 2016, sampling activities were performed to monitor the distribution, abundance and activity patterns of microbial communities in the Southern Adriatic Sea and the Ionian Sea. Enzyme activity rates varied between 0.0039 and 0.784 nmol/l/h for leucine aminopeptidase (LAP), between 0.0049 and 1.596 nmol/l/h for β-glucosidase (b-GLU), and between 0.0098 and 2.084 nmol/l/h for alkaline phosphatase (AP). Peak values were found for the three enzymes in Pantelleria station as well as at Agrigento (LAP), and Gela (LAP and AP). Microbial metabolism showed decreasing vertical trends and decreasing gradients moving from the westernmost towards the easternmost Mediterranean station (Agrigento *versus* San Cataldo stations). B-GLU and AP activities were quite homogenous in the studied areas. Micro-phytoplankton community abundance was rather low, ranging from 563 to 381.7 x 10^3 cells l^{-1}, with an average value of 48.2±75.1 x 10^3 cells l^{-1}. Regarding its vertical distribution, high values were found at surface and deep chlorophyll maximum depths. The community appeared quite heterogeneous in the investigated stations, with higher percentages of dinoflagellates (59.7% of total abundance), followed by diatoms (21.1%) and other taxa (19.3%) contributing with comparable values. The integrated study of trophic and microbial variables confirmed the suitability of these parameters as descriptors of ecological quality status.

C. DI MARINO[1,2], F. BOLINESI[1,2], L. LICCIARDI[1,2], E. SERINO[1,2], O. MANGONI[1,2]

[1]Dipartimento di Biologia, Università di Napoli Federico II, Italia.
[2]National Biodiversity Future Center (NBFC), Palermo, Italia.
claudio.dimarino@unina.it

ANALISI DEI TRATTI FUNZIONALI DELLA COMUNITÀ FITOPLANCTONICA IN HABITAT COSTIERI CARATTERIZZATI DALLA PRESENZA DI FORESTE A *PARAMURICEA CLAVATA*

Il presente lavoro rientra nell'ambito del progetto PNRR – CN5 - Spoke 1 – Mapping and Monitoring actions to preserve marine ecosystem biodiversity and functioning, ed è incentrato sullo studio del trofismo di due sistemi costieri caratterizzati dalla presenza di foreste Gorgonacei di *Paramuricea clavata,* Risso 1827. Questa specie, cosiddetta habitat-former del coralligeno mediterraneo, grazie alla sua complessa struttura tridimensionale forma foreste in grado di modulare le condizioni ambientali, favorendo così un'elevata biodiversità locale. Lo studio si concentra con particolare attenzione alle interazioni tra la colonna d'acqua ed i popolamenti bentonici alle foreste associati. A tal fine è stata analizzata la struttura chimico-fisica della colonna d'acqua in relazione alle caratteristiche della comunità fitoplanctonica, prendendo in considerazione i tratti funzionali relativi alle classi dimensionali (micro-, nano- e pico-fitoplancton) ed ai rapporti pigmenti: clorofilla-a in quanto validi indicatori delle condizioni ambientali. I campionamenti sono stati effettuati ad ottobre 2023 presso Castel Sardo, Santa Teresa di Gallura e Tavolara (Sardegna) e giugno/novembre 2023 in corrispondenza dell'area del Banco di Santa Croce e Punta Pizzaco (Campania). Per siti Campani, i dati evidenziano la presenza di un marcato termoclino nel mese di giungo a 10 m di profondità, con concentrazioni di biomassa fitoplanctonica di circa 0.5 µg/l e la dominanza della classe pico- che rappresenta il 50% della comunità. A novembre invece i primi 30 m della colonna d'acqua risultano essere omeotermi (~21 °C), mentre a 40 m il valore registrato è 18.27 °C. La classe dominante risulta essere la micro-fitoplanctonica, con una netta dominanza delle diatomee come evidenziato dal rapporto fucoxantina:clorofilla-a. Per i siti Sardi, la temperatura nei primi 30 m risultava essere di 22.5±0.5 °C, con una netta diminuzione sullo strato fondo (17.52 °C). La comunità fitoplanctonica presentava una maggiore variabilità chemiofunzionale, con la dominanza della taglia pico-fitoplanctonica e valori di biomassa <0.2 µg/l.

E. HOULIEZ[1], M.S. MENTE[1], A. PASSARELLI[2], E. SCALCO[1], D. SARNO[1,3], T. ROMEO[3,4], L. ROSELLI[1,3]

[1]Stazione Zoologica Anton Dohrn, Napoli, Italy.
[2]Stazione Zoologica Anton Dohrn, Portici (NA), Italy.
[3]National Biodiversity Future Center (NBFC), Palermo, Italy.
[4]Stazione Zoologica Anton Dohrn, Messina, Italy.
leonilde.roselli@szn.it

IMAGING FLOWCYTOBOT IN THE MEDITERRANEAN SEA: AUTOMATED PLANKTON OBSERVATIONS AND TRAIT-BASED CLASSIFIER

Traditionally, for scientific or monitoring purposes, phytoplankton biodiversity patterns and dynamics are studied by manually collecting water samples and observing them under a microscope in the laboratory. Taxonomists or analysts can identify and quantify plankton taxa at different hierarchical levels, depending on their degree of expertise and the equipment available. However, this microscopy-based monitoring is labor intensive and time consuming. For this reason, sample collection is often conducted on weekly or monthly timescales that are not always adequate for detecting rapid shifts in plankton communities. To address this problem, new technologies are increasingly being used to automate plankton sampling, counting and identification. One of them is the Imaging FlowCytobot (IFCB), a submersible instrument that combines flow cytometry with high-resolution imaging to enable the continuous and automated acquisition of images and features of individual plankton cells. The IFCB can collect up to 30,000 images per hour. Due to this volume of data, manual identification of the images rapidly becomes impractical. Consequently, efforts must be dedicated to pair the IFCB with machine learning algorithms (classifiers) to automate the identification and classification of the images. We are developing both, a taxonomic and a trait-based classifier. To our knowledge, it is the first time that such type of classifiers is developed in the Mediterranean Sea. Considering traits is important because plankton morpho-functional traits influence their fitness affecting their growth (nutrient and light acquisition) and loss processes (sinking, grazing and parasitic interactions). The aim of this contribution is to offer an overview of the IFCB, present the first results of our classifiers and discuss the challenges associated with the deployment of this new technology in the Mediterranean Sea.

G. LIGUORI[1], Y. CAROTENUTO[1], G. DALL'OLMO[2], D. CIANELLI[3], L. CIANNELLI[1]

[1]Department of Integrative Marine Ecology, Stazione Zoologica Anton Dohrn, Naples, Italy.
[2]National Institute of Oceanography and Applied Geophysics (OGS), Trieste, Italy.
[3]Department of Research Infrastructures for Marine Biological Resources, Stazione Zoologica Anton Dohrn, Naples, Italy.
gianluca.liguori@szn.it

ICHTHYOPLANKTON BIODIVERSITY AND DISTRIBUTION IN THE SOUTH-CENTRAL TYRRHENIAN SEA: AN INTEGRATED MORPHOLOGICAL, GENETIC, AND OCEANOGRAPHIC ANALYSIS

Ichthyoplankton assemblages in the South-Central Tyrrhenian Sea (SCTS) remain poorly characterized despite the region's ecological and economic significance as a major Mediterranean fishing area, and the historical tradition of ichthyoplankton taxonomy in the Gulf of Naples. This basin exhibits heterogeneous physical dynamics, complex bathymetry, and diverse biological assemblages, all of which are influenced by both local and remote (regional to larger-scale) forcing factors. This study aims to describe the ichthyoplankton assemblages near two submarine canyons in the SCTS—the Dohrn Canyon in the Gulf of Naples and the Cuma Canyon in the Gulf of Gaeta—by integrating morphological and molecular analyses with oceanographic modelling approaches. Sampling was conducted across three years (2022-2024) using a 60-cm Bongo plankton net. Morphological identification of larvae was complemented with DNA barcoding to refine species discrimination, particularly among cryptic and closely related taxa. Additionally, Lagrangian particle tracking models were employed to simulate larval transport pathways and assess the influence of regional circulation patterns on larval dispersal. Environmental parameters at sampling stations were recorded using a CTD multiparametric probe to contextualize physical influences on larval distribution. The combined morphological, genetic, and oceanographic approaches provide novel insights into ichthyoplankton biodiversity and seasonal dynamics in the SCTS. Our results show a strong seasonal change in assemblages, with pelagic species dominating during the summer months and demersal and mesopelagic species dominating in winter. This seasonal variability is also reflected in particle tracking, which shows predominantly northwestward trajectories in winter and southeastward trajectories in summer. These findings highlight the seasonal shifts in the ichthyoplankton community. This integrative methodology enhances taxonomic resolution, improves our understanding of larval dispersal processes, and supports ecological assessments critical for fisheries management in the Mediterranean.

L. MAGNONE[1], R. APPARETE[2], S. MAGOZZI[1,2], M. CASTELLANO[1], F. MASSA[1], E. OLIVARI[1], P. VASSALLO[1,2], P. POVERO[1,2]

[1]Dipartimento di Scienze della Terra dell'Ambiente e della Vita (DISTAV), Università di Genova, Italia.
[2]Consorzio Nazionale Interuniversitario per le Scienze del Mare (CoNISMa), Roma, Italia.
lorenzo.magnone@edu.unige.it

STIME DI BIOMASSA E BIOVOLUME DELLO ZOOPLANCTON OTTENUTE ATTRAVERSO L'INTELLIGENZA ARTIFICIALE: CASO STUDIO NEL SITO LTER PROMONTORIO DI PORTOFINO

Lo zooplancton esercita un ruolo fondamentale negli ecosistemi marini. I dati di biomassa per i principali gruppi tassonomici e/o funzionali dello zooplankton sono di fondamentale importanza per comprendere il funzionamento del comparto pelagico ed informare i modelli ecosistemici e food web, che forniscono informazioni sui possibili meccanismi alla base della variabilità osservata del sistema. Tuttavia, questi dati sono scarsamente disponibili, e la loro generazione richiede competenze tassonomiche approfondite e tempi prolungati. In questo studio abbiamo applicato strumenti che possono integrare l'intelligenza artificiale (IA), quali ZooSCAN ed EcoTaxa, per stimare biomassa e biovolume del mesozooplancton (0-200 um) nel sito LTER Promontorio di Portofino in tre periodi negli anni 2023-2024. L'analisi mediante IA ha mostrato elevata ripetibilità e una riduzione dei tempi di processamento dei campioni. Sebbene inizialmente fossero presenti classificazioni errate, il processo di apprendimento della IA, integrato con la metodologia classica, ha portato ad un miglioramento nel riconoscimento automatico degli organismi. Il biovolume è stato stimato da immagini acquisite attraverso lo ZooSCAN, utilizzando algoritmi che analizzano forma e dimensioni degli organismi. La biomassa è stata calcolata a partire dal biovolume applicando fattori di conversione gruppo-specifici, ricavati dalla letteratura. I risultati hanno evidenziato una buona correlazione tra la biomassa zooplanctonica stimata con AI e il peso secco misurato della frazione 0-200 um, evidenziando che lo zooplancton rappresenta la componente più abbondante nella frazione 0-200 um. Le discrepanze riscontrate possono essere relazionate alla presenza di detrito e fitoplancton inclusi nel peso secco ma non nell'analisi con IA, a causa dell'assenza di fattori di conversione appropriati. Le stime di biomassa e biovolume generate con IA possono portare ad una migliore caratterizzazione del comparto pelagico, specialmente in termini di componente zooplanctonica vs. detritica, e offrono dati fondamentali per i modelli ecosistemici, supportando la comprensione dei cambiamenti a lungo termine nei processi ecologici.

S. MAGOZZI[1,2], M.R.D. COBAIN[3], M. CASTELLANO[1], L. MAGNONE[1], F. MASSA[1], E. OLIVARI[1], C.N. TRUEMAN[4], K.M.M. MACKENZIE[5], P. POVERO[1,2]

[1]Dipartimento di Scienze dell'Ambiente, della Terra e della Vita, Università di Genova, Italia.
[2]National Biodiversity Future Center (NBFC), Palermo, Italia.
[3]Department of Biological and Environmental Science, University of Jyväskylä, Finland.
[4]School of Ocean and Earth Science, University of Southampton, UK.
[5]Unité Halieutique Manche Mer du Nord, Lab. Ressources Halieutiques, Ifremer, Boulogne-sur-Mer, France.
sarah.magozzi@unige.it

VARIABILITÁ NELLE FONTI DI PRODUZIONE ALLA BASE DELLE RETI TROFICHE PELAGICHE – IMPRONTE ISOTOPICHE DEL CARBONIO NEGLI AMMINOACIDI

Lo zooplancton è un componente chiave degli ecosistemi pelagici. Esso partecipa all'esportazione ed al sequestro del carbonio a livello globale. I modelli biogeochimici, tuttavia, presentano incertezze riguardo la sua ecologia trofica, in particolare il contributo della produzione primaria vs. produzione secondaria microbica. Il metodo del fingerprinting, basato su impronte caratteristiche degli isotopi stabili del carbonio negli amminoacidi tra gruppi di produttori, è particolarmente efficace per affrontare questa problematica. In questo studio, abbiamo applicato il fingerprinting per stimare i contributi proporzionali di fonti di carbonio autotrofe marine, microbiche e materia organica di origine terrestre al sostentamento della rete trofica dello zooplancton nel sito LTER Promontorio di Portofino nel 2023-2024. Le analisi hanno riguardato le frazioni <20, 20-200 e <200 µm, ed il mesozooplancton misto e gruppi funzionali, valutando la variabilità stagionale e con la profondità. Nonostante un aumentato contributo della produzione secondaria microbica nello zooplancton estivo, specialmente batterivori e detritivori, e nelle frazioni <20 e <200 µm, tutti i campioni erano dominati da fonti di carbonio di origine microalgale o batterica autotrofa. Questo risultato suggerisce che, nel sito di studio, la produzione primaria rimane la principale fonte di carbonio per lo zooplancton, anche in estate quando questa è più bassa, sottolineando la stabilità del ruolo dello zooplancton di catturare carbonio recentemente fissato ed esportarlo in profondità. Le stime basate sul fingerprinting dei contributi relativi di composti essenziali del carbonio sintetizzati da fonti autotrofe vs. eterotrofe diventeranno sempre più importanti con i cambiamenti climatici e ambientali che perturbano i pathways biochimici, potenzialmente favorendo canali energetici alternativi. Il fingerprinting può essere applicato in contesti ambientali differenti per identificare i meccanismi alla base della variabilità nell'assimilazione proporzionale dell'energia, e questa conoscenza valorizzata per predire il flusso di carbonio ed i canali di energia in sistemi non campionati e/o per l'oceano futuro.

E. MONTUORI[1], G. KOPP[1,2], C. LAURITANO[1]

[1]Department of Ecosustainable Marine Biotechnology, Stazione Zoologica Anton Dohrn, Naples, Italy.
[2]Marine Biology Research Group, Ghent University, Belgium.
chiara.lauritano@szn.it

PROMISING ANTIPROLIFERATIVE ACTIVITY OF MARINE HAPTOPHYTA *DIACRONEMA LUTHERI* AGAINST HUMAN LUNG CANCER CELLS

Marine microalgae are photosynthetic eukaryotic organisms that contribute at the 40% of the global productivity. Recently, there has been a growing interest from the scientific community in the search for natural compounds with potential applications in the field of cancer therapy, due to the high incidence of cancer in the population. Marine microalgae are attractive sources of compounds with biological activity thanks to their great biodiversity in terms of species, compounds produced and thanks to the possibility to growing them in large quantities and in eco-sustainable way. The aim of the present study was to evaluate the biological activity of marine Haptophyta *Diacronema lutheri* (formerly known as *Pavlova lutheri*). We used a solid phase extraction method (SPE) to obtain pre-purified fractions from the *D. lutheri* raw extract. According to the protocol used, these fractions were enriched of amminoacids and saccharides (fraction A), nucleosides (fraction B), glycolipids and phospholipids (fraction C), sterols and free fatty acid (fraction D) and triglycerides (fraction E), respectively. Both raw extract and fractions were tested against normal human immortalized keratinocytes HaCaT and human lung carcinoma Calu-1 cells for cytotoxicity and antiproliferative activity using MTT standard assay. Results showed that the active fractions on Calu-1 cells were the fraction C and fraction D. These promising extracts and fractions will be further considered for chemical identification of bioactive components and mechanism of action investigation on human cells at gene and protein levels.

G. MOTTA[1,2], V. OLMO[1], L. XAMIN[1], F. PETRUZZELLIS[1,3], G. BACARO[1], D. IUDICONE[2], S. BEVILACQUA[1,4]

[1]Dipartimento di Scienze della Vita, Università di Trieste, Italia.
[2]Stazione Zoologica Anton Dohrn, Napoli, Italia.
[3]Dipartimento di Biologia, Università di Padova, Italia.
[4]Consorzio Interuniversitario per le Scienze del Mare (CoNISMa), Roma, Italia.
gregorio.motta@phd.units.it

RELAZIONI IDIOSINCRATICHE TRA HEATWAVES MARINE E ANOMALIE DI CLOROFILLA-*A* NEL MAR ADRIATICO (MAR MEDITERRANEO) NEGLI ULTIMI DUE DECENNI

Nell'oceano aperto, in aree tropicali e temperate, le heatwaves marine (MHWs) sono state associate a una riduzione della concentrazione di Clorofilla-*a* (Chl-*a*). Alle alte latitudini, le anomalie termiche sembrano invece favorire picchi di produzione fitoplanctonica. Tuttavia, ad oggi, i potenziali impatti delle MHWs sulla produzione primaria nelle aree costiere e nelle regioni marine eterogenee restano incerti. Per approfondire questa dinamica abbiamo analizzato dati satellitari modellizzati a lungo termine relativi alla temperatura superficiale e alla concentrazione di Chl-*a* nel Mare Adriatico, un bacino semi-chiuso caratterizzato dalla compresenza di ambienti costieri e di mare aperto. I risultati evidenziano una forte dipendenza tra Chl-*a* e le MHWs, con anomalie sia negative che positive di Chl-*a* strettamente legate alle anomalie termiche, seguendo però correlazioni dirette o inverse a seconda delle aree del bacino. Lungo la costa occidentale e in aree caratterizzate da bassa profondità dell'Adriatico settentrionale e centrale, una maggiore frequenza, intensità e durata delle MHWs è associata a un'alternanza tra picchi di Chl-*a* e periodi di concentrazioni estremamente basse, suggerendo forti oscillazioni nella produzione primaria con fioriture fitoplanctoniche improvvise seguite da fasi di scarsa produttività. Al contrario, nelle aree più profonde e lontane dalla costa, in particolare nell'Adriatico meridionale, l'intensità, durata e la frequenza delle MHWs risultano inversamente correlate alle anomalie positive di Chl-*a*, indicando una riduzione della biomassa fitoplanctonica negli strati superficiali e una conseguente diminuzione del flusso di materia organica verso il fondale. Un eventuale aumento della durata e dell'intensità delle MHWs potrebbe quindi alterare significativamente i pattern di produzione primaria, con effetti potenzialmente estesi sia alle zone costiere che pelagiche. L'eterogeneità delle risposte osservate nell'Adriatico sottolinea la necessità di studi mirati per comprendere meglio queste interazioni nei sistemi marini complessi, in modo da sviluppare strategie di gestione efficaci per mitigare le conseguenze ecologiche e socioeconomiche dell'aumento delle anomalie termiche.

A. PENNA[1], C. MAZZOLI[1], S. CAPELLACCI[1], G. RAVERA[1], G. FAMIGLINI[2], G. PRIOLI[3], A. SPAGNOLO[4], S. CASABIANCA[1]

[1]Department of Biomolecular Sciences, University of Urbino, Italy.
[2]Department of Pure and Applied Sciences, University of Urbino, Italy.
[3]M.A.R.E. S.c. a r.l., Cattolica (RM), Italy.
[4]Institute of Marine Biological Resources and Biotechnologies (CNR-IRBIM), Ancona, Italy.
silvia.casabianca@uniurb.it

PHYTOPLANKTON COMMUNITY AS AN ECOLOGICAL DRIVER POTENTIALLY AFFECTING THE QUALITY OF WILD AND FARMED MUSSEL POPULATIONS: A STUDY CARRIED-OUT IN THE CENTRAL-WESTERN ADRIATIC SEA

Mussels (*Mytilus galloprovincialis*) are the most important species for Italian shellfish production, which primarily comes from sea farms and wild populations in the western Adriatic Sea. Various environmental and biological factors can influence the market value and quality of mussels which, recently, has declined in terms of meat loss and increased shell fragility. Given their filter-feeding habits, phytoplankton composition and abundance may play a key role in mussel health. This study, conducted under the PRIN-PNRR Project ENDRIMUS, assesses how chlorophyll-*a* (Chl-*a*) levels and phytoplankton assemblages influence the growth and health of farmed and wild *M. galloprovincialis* populations. Seasonal sampling was conducted at Rimini, Senigallia, and Giulianova (artificial reefs and longline farms). Seawater samples were analyzed for organic and inorganic particulate matter (POM, PIM), Chl-*a*, and phytoplankton community composition. Mussel samples were collected to assess the taxon-specific abundance of ingested phytoplankton (*e.g.*, diatoms *Chaetoceros* spp., *Skeletonema* spp., *Pseudo-nitzschia pungens*; dinoflagellates *Alexandrium minutum*, *Dinophysis* spp., *Scripsiella trochoidea* and Dinophyceae class) using molecular qPCR analysis. Chl-*a* and total phytoplankton abundance showed a latitudinal decrease (north to south) only in winter ($p \leq 0.05$), the most eutrophic period. A positive correlation was found for diatoms *Chaetoceros* spp. and *Skeletonema* spp. in seawater and mussel tissues ($p < 0.05$). No correlation was found for individual dinoflagellate species, but a positive correlation was observed when total dinoflagellate abundance was considered. The qPCR detected *A. minutum* (up to 222 cells g^{-1}) and *Dinophysis* spp. (up to 11,833 cells g^{-1}) in mussel tissues, with microscopy revealing up to 1,800 cells L^{-1} and up to 700 cells L^{-1}, for the two taxa, respectively. Pallial water analyzed by qPCR, showed higher phytoplankton abundance in winter, but no correlation was found with seawater. These results from the central-western Adriatic Sea may help in assessing factors affecting mussel health and growth.

A. RAGGIO[1,2], L. ROSELLI[2], I. PERCOPO[2], E. SCALCO[2], S. CIANCIMINO[2], P. FASCIGLIONE[2], I. DI CAPUA[1,2]

[1]National Biodiversity Future Center (NBFC), Palermo, Italy.
[2]Marine Organism Taxonomy Core Facility – MOTax, Department of Research Infrastructures for Marine Biological Resources, Stazione Zoologica Anton Dohrn, Naples, Italy.
iole.dicapua@szn.it

PLANKTON ATLAS: JOURNEY INTO THE (IN)VISIBLE BIODIVERSITY OF THE OCEAN

Plankton plays a fundamental role in marine ecosystems, yet its biodiversity remains largely unknown to both the scientific community and the general public, often overshadowed by more charismatic marine megafauna. The Plankton Atlas is a scientific outreach initiative designed to bridge this gap by showcasing the biodiversity of these planktonic taxa, from phytoplankton to macro-zooplankton, including copepods and meroplaktonic larvae, etc, highlighting their taxonomic features, biological traits, ecological roles, and intriguing curiosities. Unlike classical scientific plates, the Atlas features meticulously illustrated pages that blend scientific accuracy with artistic interpretation curated by the Italian School of Comix. These artistic drawings highlight the natural beauty of planktonic organisms, making each profile visually engaging and scientifically informative. High-resolution illustrations are paired with detailed scientific profiles, presenting complex biological information in a clear and accessible format suited for both specialists and non-specialists. Developed within the National Biodiversity Future Center (NBFC) Spoke 7.2 framework and in collaboration with experts in integrated plankton taxonomy, this multidisciplinary project combines rigorous scientific methodology with an engaging educational approach. A key component of the project is also its collaboration with secondary schools, fostering student engagement in marine biodiversity studies. By emphasizing the crucial role of plankton in oceanic functioning and global biogeochemical cycles, the Plankton Atlas aims to spark curiosity, promote ocean literacy, and strengthen connections between the scientific community and the wider public. This work underscores the urgent need to raise awareness and appreciation of the plankton diversity life forms that sustain marine ecosystems, emphasizing their vulnerability in the face of environmental changes.

G. RAVERA[1], M. CANGINI[2], F. RICCI[1], S. CAPELLACCI[1], F. GRILLI[3], C. FERRARIN[4], S. CASABIANCA[1], S. MILANDRI[2], G. PRIOLI[5], M. MARINI[5], A. PENNA[1]

[1]Department of Biomolecular Sciences, University of Urbino, Italy.
[2]Fondazione Centro Ricerche Marine, National Reference Laboratory for Marine Biotoxins, Cesenatico (FC), Italy.
[3]Institute for Biological Resources and Marine Biotechnologies (IRBIM), National Research Council (CNR), Ancona, Italy.
[4]Institute of Marine Sciences (ISMAR), National Research Council (CNR), Venice, Italy.
[5]M.A.R.E. S.c. a r.l., Cattolica (RN), Italy.
g.ravera@campus.uniurb.it

NEW INSIGHTS INTO THE DYNAMICS OF THE ECOLOGICAL TOXIC DINOFLAGELLATE *DINOPHYSIS* (EHRENBERG, 1839) AND DSP (DIARRHETIC SHELLFISH POISONING) EVENTS IN THE ADRIATIC SEA: IMPLICATIONS FOR SAFE MARINE AQUACULTURE PRODUCTION MANAGEMENT

Dinophysis spp. is a harmful marine dinoflagellate responsible for the production of lipophilic toxins, which accumulate in shellfish tissues. Therefore, monitoring is required to ensure safe human consumption. Mussel farming is a strategic economic activity for the northern Adriatic coast, where seawater and bivalves are regularly monitored. Specifically, this study was carried out along the Emilia-Romagna and Marche coasts and analysed the ecological dynamics of *Dinophysis* species assemblages in relation to the toxicity events recorded in mussel farms, as well as oceanographic and environmental variables over the multi-year (1998–2023) of continuous observations. A clear seasonality of *Dinophysis* species emerged, with a succession of *D. acuminata* and *D. sacculus* in spring-summer, followed by *D. caudata* and finally *D. fortii* and *D. tripos* in autumn. Moreover, DSP (diarrhetic shellfish poisoning) toxicity events were mainly recorded in autumn and winter and were linked to *D. caudata, D. fortii* and *D. tripos* (rs=0.84, rs=0.83, and rs=0.66, respectively, p<0.05). Additionally, some *Dinophysis* species showed an optimum temperature niche for their growth. Furthermore, toxicity in bivalve mussels decreased in the analysis of interannual trends, alongside a declining trend in DIN, phosphate, total phosphorus, and chlorophyll *a*. Lastly, 2015 and 2022 were characterized by prolonged toxicity events, which coincided with colder and slightly saltier surface waters than the mean climatological conditions for the entire study period. Data analysis highlighted the importance of long-term observations in understanding the variability of *Dinophysis* dynamics and DSP events in relation to environmental conditions, thereby improving the management of aquaculture activities.

S. SAVIANO[1], I. D'AMBRA[2], M.A. AMBROSIO[1], V. BOTTE[2], D. IUDICONE[2], M.G. MAZZOCCHI[2], L. MERQUIOL[2], D. CIANELLI[1]

[1]Department of Research Infrastructures for Marine Research, Stazione Zoologica Anton Dohrn, Naples, Italy.
[2]Integrative Marine Ecology Department, Stazione Zoologica Anton Dohrn, Naples, Italy.
daniela.cianelli@szn.it

STABLE ISOTOPES AND MODELING ALLOW TO TRACK *PELAGIA NOCTILUCA* JELLYFISH WITHIN THE GULF OF NAPLES

Jellyfish (Cnidaria, Scyphozoa) often appear in unexpected large aggregations along the coasts, where they interfere with human activities (tourism, fisheries, power plants). Therefore, tracking their movements and predicting their outbreaks is crucial for several economic activities but is challenged by their fragile bodies and ephemeral appearance. We here combined modeling and stable isotope (SI) approaches to define the patterns of outbreaks of the scyphomedusa *Pelagia noctiluca* in the Gulf of Naples (GoN). Carbon and nitrogen SIs of medusae collected during outbreaks on 6 March, 3-5 June, 24 July and 20 November 2019 did not reflect the SIs of their potential prey collected within the GoN, but rather those found in pelagic zones. This mismatch was corroborated by particle tracking simulations performed using a regional ocean modeling system (ROMS), which allowed to reconstruct the trajectories of individuals up to 20 days before collection. Numerical results suggested that medusae were driven from offshore towards the coastal areas of the GoN by the surface dynamics of the southern Tyrrhenian Sea and wind regimes promoting the entry of water – and medusae - into the GoN. In addition, local dynamics characterized by slow advection favoured the permanence of *P. nocticula* within the GoN. Our results suggest that the correct interpretation of SI ratios of scyphomedusae within coastal areas is intimately dependent on their movements across diverse isoscapes.

E. TRAMONTIN, U. DE CLEMENTE, A.C. TRANO, F. MARGIOTTA, R. CASOTTI

Department of Integrative Marine Ecology, Stazione Zoologica Anton Dohrn, Napoli, Italy.
raffaella.casotti@szn.it

ANNUAL PICOPLANKTON DISTRIBUTION AT THE LTER STATION MARECHIARA IN THE GULF OF NAPLES (ITALY)

Picoplankton, including heterotrophic and photosynthetic microbes smaller than 5 micron in Equivalent Sphaerical Diameter (ESD), are a fundamental component of the plankton. They are considered as independent from larger phytoplankton, representing a constant background, strictly controlled by grazers. Annual picoplankton dynamics was investigated monthly at a fixed station in the Gulf of Naples by means of flow cytometry at 10 depths in 2023. Synechococcus and Prochlorococcus cyanobacteria as well as picoeukaryotes were discriminated based on their scatter and fluorescence from chlorophyll and/or phycoerythrin, while heterotrophic prokaryotes were counted after staining with SYBRGreen stain and discriminated based on their relative DNA content. The annual cycle of concentrations shows peaks of Synechococcus in summer, probably related to predators inhibition by high temperatures. Picoeykaryotes, instead, follow the general dynamics of larger phytoplankton. The heterotrophic prokaryotes show ephemeral peaks probably due to local terrestrial inputs mediated by meteorological conditions (*e.g.* rain). Using coversion factors, C biomass was estimated for the picoplankton and compared to chl-derived biomass. While a minor component during the spring phytoplankton bloom, picoplankton contributes to a significant eprcentage of total biomass in the summer and oligotrophic periods. Considering the current oligotrophication of the Mediterranean Sea, picoplankton is proposed as sentinel component of marine plankton and flow cytometry as main method of investigation for its assessment.

POSTER DELLA SESSIONE VARI

G. CARUSO[1], R. CALOGERO[2], A. LO GIUDICE[1], C. RIZZO[1,3]

[1]Istituto di Scienze Polari (ISP), Consiglio Nazionale delle Ricerche (CNR), Messina, Italia.
[2]Dipartimento di Ecologia Marina Integrata, Stazione Zoologica Anton Dohrn, Sicily Marine Centre, Messina, Italia.
[3]Dipartimento di Biotecnologie Marine Ecosostenibili, Stazione Zoologica Anton Dohrn, Sicily Marine Centre, Messina, Italia.
gabriella.caruso@cnr.it

CARATTERIZZAZIONE DEI TASSI ENZIMATICI MICROBICI IN SITI COSTIERI CALABRESI

La stima dell'attività di decomposizione microbica dei polimeri organici può fornire una alternativa rapida per determinare la qualità ambientale di siti marini. In quest'ottica, lungo la fascia costiera calabrese sono stati determinati i tassi enzimatici microbici al fine di valutare quanto il metabolismo microbico possa costituire un parametro rappresentativo dello stato trofico dell'ambiente marino costiero. In inverno ed estate 2022-2023 sono stati eseguiti dei campionamenti in 3 siti costieri calabresi prospicienti le aree di Reggio Calabria (RC), Gioia Tauro (GT) e Vibo Valentia (VV). Per ciascun sito sono stati prelevati campioni di acqua di mare, sedimento e sabbia in corrispondenza di 3 stazioni dislocate lungo un transetto parallelo alla linea di costa. I tassi enzimatici microbici sono stati misurati mediante incubazione dei campioni con composti fluorogenici riconosciuti come substrati dagli enzimi leucin-aminopeptidasi (LAP), beta-glucosidasi (GLU) e fosfatasi alcalina (AP), correlati rispettivamente alla degradazione di proteine, polisaccaridi e fosfati organici. Sono stati inoltre misurati i principali parametri chimico-fisici delle acque (temperatura, salinità ed ossigeno disciolto). I tassi enzimatici misurati hanno mostrato valori differenti in base alla matrice analizzata, con incrementi generalmente osservati nella stagione estiva per tutti gli enzimi esaminati. Nelle acque, gli enzimi LAP e AP hanno presentato una attività predominante, raggiungendo valori massimi di 7,31 e 9.36 nmol/l/h, rispettivamente. Valori enzimatici di circa 1-2 ordini di grandezza superiori rispetto alle acque sono stati misurati nel sedimento (LAP: 16.55-231.44 nmol/g/h; AP: 16.08-106.31 nmol/g/h), con picchi generalmente estivi, ad eccezione della stazione GT. Nella matrice sabbia sono stati riscontrati valori significativamente ($p<0.01$) più elevati rispetto all'acqua ed al sedimento, in particolare nel sito RC in estate. I parametri collegati al metabolismo microbico forniscono un indicatore dello stato ambientale, permettendo di valutare i flussi di fosforo inorganico e di carbonio potenzialmente mobilizzati tramite attività di idrolisi enzimatica.

M. CIANFLONE[1,2,3], L. CICALA[3], G. UCCIERO[1,2,4]

[1]Department of Biology, University of Naples Federico II, Napoli, Italy.
[2]National Biodiversity Future Center (NBFC), Palermo, Italy.
[3]Italian Aerospace Research Centre (CIRA), Capua (CE), Italy.
[4]Department of Earth and Marine Sciences, University of Palermo, Palermo, Italy.
marzia.cianflone@unina.it

THE USE OF SATELLITE IMAGES FOR MARINE BIODIVERSITY MONITORING: LOSS OF *POSIDONIA OCEANICA*

Climate change and local human impacts are causing detrimental effects across marine ecosystems. However, it remains difficult to make projections on their future trends due to a substantial lack of data on the present and past spatial distribution and extent of both habitats and human activities. Satellite remote sensing allows for global and local-scale environmental monitoring at low cost and with high revisit frequency. The availability of agency satellites, such as Sentinel-2, and commercial satellites, like the Planetscope constellation, enables continuous and long-term monitoring of underwater vegetation. However, the interposition of the water column limits the monitoring range to shallow coastal areas due to water transparency. The use of free agency data (with lower spatial resolution) and commercial data (with higher resolution) is combined to reduce the costs of data acquisition. Furthermore, data obtained from the Copernicus Marine Service, in combination with bathymetric data, are used to estimate the effects of the water column on the reflectance of underwater vegetation. In this study, a long-term analysis is proposed to identify potential changes in vegetation cover over time, which can lead to *in situ* acquisition campaigns to directly verify the detected changes. This strategy was applied to investigate the habitat loss of the *Posidonia oceanica* meadow in Vilanova i la Geltrú (Spain), as the potential consequence of the severe storm "Gloria," which affected the north-western Mediterranean in January 2020. Preliminary results of this study show that a loss of ~160’000 m^2 of *Posidonia oceanica* indeed occurred immediately after the storm. Further studies will assess whether the changes can be attributed to the storm, examining also other impacted/not impacted locations. Therefore, it can be concluded that the use of satellite images is an important tool for monitoring large-scale coastal habitats, even retrospectively, thus supporting future mapping efforts under specific conditions.

G. DONATO[1], A. LUNETTA[2,3], I.A. GATÍ[4], A. SPINELLI[5], S. GIACOBBE[4]

[1]Department of Biological, Geological and Environmental Sciences, University of Catania, Italy.
[2]Department of Biological, Geological and Environmental Sciences (BIGEA), University of Bologna, Italy.
[3]Institute for Biological Resources and Marine Biotechnologies (IRBIM), National Research Council (CNR), Section of Messina, Italy.
[4]Department of Chemical, Biological, Pharmaceutical and Environmental Sciences, University of Messina, Italy.
[5]Research Department, Fundación Oceanográfic de la Comunitat Valenciana, Oceanográfic, Valencia, Spain.
gemma.donato@phd.unict.it

THE DECLINE OF *PINNA NOBILIS* IN LAKE FARO: CONSERVATION CHALLENGES

The noble fan shell, *Pinna nobilis*, an endemic Mediterranean species and a key habitat-forming organism, is critically endangered following a global-scale mass mortality event (MME). Today, only scattered residual populations persist, mostly in brackish environments. As a consequence of the MME, a millennia-old population in the Lake Faro natural reserve (Northeastern Sicily) dramatically declined from 452 to 19 individuals. Most survivors belonged to a group of 22 specimens relocated, under the Reserve Management's instructions, from a lakebed subject to periodic dredging to a safe area, clearly delimited and regularly monitored. Currently, only 9 specimens remain in the lake, 6 of which are maintained in the safe area. This further population decline can be attributed to the shorter lifespan of *P. nobilis* in transitional waters compared to the longer-lived marine populations. The wide variability of the hydrological parameters – ranging from seasonal to less-than-daily fluctuations – is the main responsible for the reduced longevity of *P. nobilis*, together with the overgrowth of their epibionts. To mitigate the effects of the latter stressor, epibionts were gently removed in July 2023, revealing the co-occurrence of 7 Phyla (12 classes). At the species level, the occurrence of the alien oyster *Isognomon bicolor* is noteworthy. This invasive, bed-forming species, rapidly spreading throughout the eastern-central Mediterranean, may represent a new threat to residual *P. nobilis* populations due to possible competition. Unfortunately, despite some observed spawning events, no further recruitment occurred after the initial settlement of four juveniles. Larval collectors, moreover, failed. Lastly, despite the reserve's protected status and the clear delimitation of the safe area, the disappearance of some specimens must be reported as evidence of undue human interference. In conclusion, the present data highlighted the vulnerability of the residual *P. nobilis* population in Lake Faro, emphasizing the urgent need for more stringent and effective protection measures.

R. ESPOSITO[1], A. POLLIO[2], A. RICCIARDELLI[1,2], M. MUTALIPASSI[3], M. COSTANTINI[1], V. ZUPO[4]

[1]Department of Ecosustainable Marine Biotechnology, Stazione Zoologica Anton Dohrn, Naples, Italy.
[2]Department of Biology, University of Naples Federico II, Italy.
[3]Department of Integrated Marine Ecology, Stazione Zoologica Anton Dohrn, Naples, Italy.
[4]Department of Ecosustainable Marine Biotechnology, Stazione Zoologica Anton Dohrn, Ischia Marine Center, Ischia (NA), Italy.
roberta.esposito@szn.it

ECOTOXICOLOGICAL EFFECTS OF CYANOBACTERIA TESTED ON LARVAE OF THE SEA URCHIN *PARACENTROTUS LIVIDUS* (LMK)

Cyanobacteria are prokaryotic oxygenic phototrophs playing crucial ecological roles. They may control the presence of other organisms in benthic and planktonic environments by diffusing allochemicals. They may also influence the quality of freshwater destined to human consumption. Consequently, cyanobacteria attracted interest being a rich source of bioactive compounds which may be released in the spent medium of cultures. In this view, cyanotoxins have harmful or fatal impacts, due to acute toxicity on marine organisms present in their environment. However, the production of constitutive allochemicals is affected by such factors as salinity, temperature, light irradiance and culture media. Here, we aimed at assessing the toxic effects of the spent medium used to cultivate seven cyanobacterial strains belonging to the orders Synechoccales and Nostocales. These strains were isolated and cultivated in three different conditions: i. fourty days with final collection of the medium; ii. fourty days with changes of medium every 10 days and final collection; iii. five months of culture, prior to collect the medium. The bioactivity of their spent medium was measured by means of standard toxicity tests performed on embryos of the sea urchin *Paracentrotus lividus*. Most spent media had effect on the first mitotic division. All cyanobacteria produced a developmental delay of sea urchin embryos, blocking them at the stage of early pluteus, gastrula or blastula. These findings contribute to the understanding of critical factors influencing the toxigenic power of cyanobacteria towards target invertebrates. Future isolation, identification and production of bioactive compounds will permit their exploitation for biotechnologies in the field of ecological conservation and medical applications.

E. FABBRIZZI[1,2], S. GIAKOUMI[2,3], D. PETZA[4], J.G. ÁLVAREZ-ROMERO[5,6], J. BEHER[7,8], S. KATSANEVAKIS[4], E.B. LAMINE[9], F. COLLOCA[2,10], E. DOMÍNGUEZ CRISÓSTOMO[11], M. ELLIOTT[12,13], W. FLANNERY[14], I. GALPARSORO[15], M. KRUSE[16], B. MCATEER[13], E.J. MCINTOSH[17], V. RESAIKOS[1], V. STELZENMÜLLER[16], S. FRASCHETTI[1,2,18]

[1]Department of Biology, University of Naples Federico II, Italy.
[2]National Biodiversity Future Centre (NBFC), Palermo, Italy.
[3]Sicily Marine Centre, Stazione Zoologica Anton Dohrn, Palermo, Italy.
[4]Department of Marine Sciences, University of the Aegean, Mytilene, Greece.
[5]Global Science, The Nature Conservancy, Hobart, Australia.
[6]Marine & Aquaculture Sciences, James Cook University, Townsville, Queensland, Australia.
[7]School of Biosciences, University of Melbourne, Australia.
[8]International Institute of Applied Systems Analysis (IIASA), Laxenburg, Austria.
[9]Université Côte d'Azur, CNRS, ECOSEAS, Nice, Provence-Alpes-Côte d'Azur, France.
[10]Department of Integrative Marine Ecology, Stazione Zoologica Anton Dohrn, Rome, Italy.
[11]Department of Biology, University of Algarve, Faro, Portugal.
[12]International Estuarine and Coastal Specialists (IECS) Ltd, Leven, UK.
[13]School of Environmental Sciences, University of Hull, UK.
[14]Queen's University Belfast, Northern Ireland, UK.
[15]AZTI, Marine Research, Basque Research and Technology Alliance (BRTA), Pasaia, Spain.
[16]Thünen Institute of Sea Fisheries, Bremerhaven, Germany.
[17]Blue Glaucus Ltd., London, UK.
[18]CoNISMa, Rome, Italy.
erika.fabbrizzi@unina.it

TWENTY YEARS OF MARINE SYSTEMATIC CONSERVATION PLANNING AND LINKS TO MARINE SPATIAL PLANNING: A GLOBAL SCOPING REVIEW FOR GOOD PRACTICES

The ocean is increasingly dominated by human activities, jeopardizing marine biodiversity and the many benefits to people. Allocating adequate space to ensure sustainable and equitable use of the ocean resources, and cost-effective marine ecosystem conservation and restoration is challenging, considering the recent ambitious global, regional, and national targets, such as those set by the Global Biodiversity Framework and the European Nature Restoration Law. Systematic Conservation Planning (SCP) provides a comprehensive framework to prioritize conservation interventions for biodiversity protection while minimizing the associated costs, facilitating dialogue among maritime sectors. The scoping review here assesses the contribution of SCP to Marine Spatial Planning processes in guiding decision-making for the achievement of conservation objectives in harmony with human uses of marine space. The 149 studies analysed, spanning from 2002 to early 2023, are distributed across all continents and encompass nine biogeographic realms. Our analysis reveals that few SCP-based spatial plans have been implemented and only one study explicitly confirmed the achievement of conservation targets set within the SCP process. Weak criteria for evaluating plan effectiveness affected by uncertainties linked to future climate conditions and limited data availability were identified as important obstacles to effectively implement SCP outcomes. The review has compiled context-specific recommendations, highlighting that good practices vary across countries depending on their geopolitics and economy from small island developing states to middle- and high-income countries. One of the key output of our study is an open-access systematic map of evidence, offering georeferenced information on SCP studies to support planners and decision-makers in future marine conservation management.

S. IGNOTO[1], V. PERRICONE[2], R. BACCHETTA[1], R. MARCHESI[3], F. BONASORO[1], D. CANDIA CARNEVALI[1], M. SUGNI[1]

[1]Department of Environmental Science and Policy, University of Milan, Italy.
[2]Department of Research Infrastructures for Marine Biological Resources, Stazione Zoologica Anthon Dhorn, Naples, Italy.
[3]Department of Earth Sciences "Ardito Desio", University of Milan, Italy.
sara.ignoto@unimi.it

STRUCTURAL DESIGN OF ECHINOID STEREOM AS A BASIS FOR THE DEVELOPMENT OF INNOVATIVE MATERIALS

The echinoid dermaskeleton forms a globose test composed of interconnected plates characterized by a lightweight and resilient 3D lattice-like calcitic meshwork: the stereom. This architecture demonstrates significant potential in meeting various structural and mechanical needs, with a clear structure-function relationship designed to withstand biotic and abiotic stress. This study aimed to describe the morphological characteristics and functional variability of the stereom in *Paracentrotus lividus* (Lamarck, 1816), comparing three interambulacral plate types (aboral, ambital, oral) within individual and across different test sizes (ages). Sea urchins from three diameter classes (I: 1-2 cm; II: 3-4 cm; III: 5-6 cm) were collected in Sicily and frozen. After thawing, samples were treated with 0.2M NaOH to remove the organic components. Single plates were isolated from the interambulacral regions, longitudinally abraded to expose the median section of the primary tubercle and photographed by Scanning Electron Microscope (SEM). Images were analyzed using ImageJ software to calculate the porosity, trabecular orientation and stereom thickness in different areas. The results showed differences between the types of plates in the same individual, but no apparent variation between the same type across the diameter classes. Notable differences included a lower height of the tubercle in the oral plates, but a major thickness in the underlying layers, as well as the presence of additional layers in the ambital plates. These findings suggest that *P. lividus* urchin optimizes the morphology and microstructure of the stereom according to the position of the plates on the test and probably the mechanical stress they withstand. Ongoing mechanical analysis will further elucidate the morpho-functional characteristics of the stereom in the specific plates. In the future, this study, using an interdisciplinary approach, will provide insights into the morpho-function and mechanical resistance of *P. lividus* stereom laying the groundwork for developing innovative bioinspired structural materials.

L. MANFRA[1,2], S. NOVENTA[1], E. PRATO[3], L. ALBARANO[4], A. AMATO[2,4], M. COSTANTINI[2], A. ROTINI[1], F. BIANDOLINO[3], G. LIBRALATO[2,4]

[1]Institute for Environmental Protection and Research (ISPRA), Rome, Italy.
[2]Department of Ecosustainable Marine Biotechnology, Stazione Zoologica Anton Dohrn, Napoli, Italy.
[3]Water Research Institute (IRSA), National Research Council (CNR), Taranto, Italy.
[4]Department of Biology, University of Naples Federico II, Italy.
loredana.manfra@isprambiente.it

ENVIRONMENTAL RISK ASSESSMENT (ERA) APPROACH FOR MICROPLASTICS IN THE MARINE ECOSYSTEM

Microplastics (MPs) in marine environments are raising growing concerns due to their persistence and consequent effects induced on organisms and transfer within the food webs, up to humans. By 2100, MP levels in most coastal and some deep-sea sediments have been predicted to reach or exceed ecotoxicological thresholds. Current Environmental Risk Assessment (ERA) consists of comparing the Environmental Concentrations (Predicted, PECs or Measured, MECs) with the Concentrations of No Effect (Observed, NOECs or Predicted, PNECs). The NOECs and PNECs are limits below which unacceptable effects on organisms will most likely not occur. They are usually based on bioassays and take into account assessment factors considering uncertainty. A PEC/PNEC ratio <1 indicates an negligible risk. The purpose of the present work is to critically exploit acute and long-term ecotoxicological data, collected experimentally on MPs (38±212 µm) of PolyLactic Acid (PLA) and PolyPropylene (PP) derived from disposable glasses, in an ERA procedure. The acceptable risk thresholds for marine compartments have been derived by considering biological responses of species representatives of a range of taxonomic and trophic levels (decomposers, producers and consumers). Although useful, the ERA approach shows some limitations, as MPs are complex entities, often mixed with additives and that can act as vectors for other chemical and biological contaminants. Thus, a comprehensive regulatory framework is urgently needed for the assessment of MPs environmental risks. Research conducted in the framework of the Project – Biomonitoraggio di micro e nanoplastiche biodegradabili: dall'ambiente all'uomo in una prospettiva one health (BioPlast4Safe) - with the technical and economic support of the Italian Ministry of Health – PNC.

F. MINGOIA[1], S. IGNOTO[1], R. BACCHETTA[1], F. BONASORO[1], C. LANGELLA[2], M. SUGNI[1]

[1]Department of Environmental Science and Policy, University of Milan, Italy.
[2]Department of Architecture, University of Naples Federico II, Italy.
francesca.mingoia@studenti.unimi.it

MORPHO-FUNCTIONAL CHARACTERIZATION OF *PARACENTROTUS LIVIDUS* (LAMARCK, 1816) PEDICELLARIAE AND THEIR USE AS MODELS IN BIOMIMETICS

Sea urchins represent valuable models for biomimetic studies due to their distinctive morphological characteristics. Among the test's skeletal structures, pedicellariae are small stalked appendages, (150 µm to 3 mm). These structures can be classified into four distinct groups: ophiocephalous, globiferous, tridentate, and triphyllous. Each type exhibits unique morphological and functional properties, offering significant insights for a morpho-functional analysis. Adult individuals (4–5 cm diameter) of *Paracentrotus lividus* were collected in Liguria and transported to the University of Milan. Selected pedicellariae were treated with sodium hydroxide (NaOH 0.2M) to isolate and analyze the ultrastructure of the skeletal component, while others were directly processed and examined using scanning electron microscopy (SEM). The individual and collective motility of the different pedicellariae was assessed through image and video acquisition by stereomicroscopy. This approach enabled the evaluation of their responsiveness to various stimuli, movement frequency and consistency, flexibility, and reciprocal interactions. Each pedicellaria type exhibits distinct structural characteristics, particularly in valve morphology (needle-like, globular) and rotation. The peduncle comprises a skeletal rod that extends throughout the structure in globiferous pedicellariae, whereas in other types, it is followed by a flexible hydrostatic portion (neck), which can also be extendable in tridentate and ophiocephalous pedicellariae. Motility analysis revealed that movement is restricted and rigid in globiferous pedicellariae, while in triphyllous pedicellariae it is continuous, rapid, multi-directional, and apparently independent of specific stimuli. Ophiocephalous pedicellariae respond to external stimuli with an immediate opening of the valves, whereas tridentate pedicellariae exhibit reduced responsiveness to direct stimuli and are characterized by slower movements. The observed motility patterns are closely correlated with morphological features and with functional specialization such as defence and self-cleaning. The biological data obtained in this study were applied to the design and development of bioinspired objects (*e.g.*, lamps), integrating various morpho-functional principles into innovative design solutions.

N. NURRA[1], M. COCCO[2], R. ORSELLI[2], L. SPINELLI[2], G. GIACCARI[3], G. CUOMO[3], G. ZANNONI[4], A. MASSARO[5]

[1]Pelagosphera Soc. Coop., Torino, Italia.
[2]EdgeLab Spa, La Spezia, Italia.
[3]20tab Srl, Roma, Italia.
[4]Superfici Soc. Coop., La Spezia, Italia.
[5]Aplysia Soc. Coop., Livorno, Italia.
nicola.nurra@unito.it

PROGETTO AUTOMA. TECNOLOGIA E RICERCA PER LA BIODIVERSITÀ MARINA

AUTOMA (*AUTOmatic Marine Alien identification*) fa parte dei progetti del PNRR finanziati nell'ambito del National Biodiversity Future Center (NBFC). Il progetto, messo a punto da un consorzio di PMI ha preso avvio a novembre 2024 e avrà durata di un anno. AUTOMA coniuga sviluppo industriale, innovazione tecnologica e ricerca scientifica applicata all'ambiente marino finalizzata alla conservazione della biodiversità e al monitoraggio e la diffusione di specie aliene NIS e AIS (Non *Indigenous Species* e *Invasive Alien Species*) e di specie autoctone di particolare interesse ecologico nel Mar Mediterraneo. Il progetto si avvale di veicoli autonomi subacquei (AUV tracker - *Autonomous Underwater Vehicles*) equipaggiati di sensoristica avanzata per il rilievo di dati fisici, biologici e ambientali. Una piattaforma digitale basata su processi di machine learning e AI, consente di ottenere dati quali-quantitativi sulla diffusione e dispersione di specie target aliene e autoctone, e fornirà elementi di *early warning* su presenza di NIS in aree sottoposte a tutela. Le prime fasi operative si concentrano in zone di protezione, AMP Secche della Meloria e le acque del PNAT (Parco Nazionale Arcipelago Toscano), con estensione del monitoraggio ad altre località destinate ad attività ricreative subacquee. Elemento chiave del progetto è il coinvolgimento della comunità subacquea in un'ottica di partecipazione e *Citizen Science*, che potrà contribuire attivamente all'arricchimento del database digitale, rendendolo accessibile e implementabile anche dopo il termine del progetto. In un Mediterraneo segnato dalla crisi climatica, AUTOMA si propone come osservatorio privilegiato a mesoscala per il monitoraggio delle specie marine aliene e autoctone, in grado di fornire dati cruciali per la gestione sostenibile della biodiversità e contribuendo alla mitigazione delle problematiche ecologiche, economiche e sanitarie legate all'invasione biologica.

F. SCARPA[1], I. DEPLANO[1], M. PERRA[1,2], C. LOCCI[1,2], D. SANNA[1], M. CASU[2]

[1]Department of Biological Sciences, University of Sassari, Italy.
[2]Department of Veterinary Medicine, University of Sassari, Italy.
fscarpa@uniss.it

GENETIC ANALYSIS OF WASTEWATER: SARS-COV-2 AS A SENTINEL FOR PUBLIC AND ENVIRONMENTAL HEALTH

Wastewater, often called the "silent carrier" of pathogens, reflects the overall health of communities due to its rich biological and chemical composition. It has become a valuable resource for tracking infectious diseases. For example, since SARS-CoV-2 is excreted in human feces, wastewater analysis provides critical insights into disease spread and supports public health measures. In this study, we analyze the genetic variability of SARS-CoV-2 found in wastewater samples from environmental sources and compare it with strains isolated from human hosts. Our findings indicate large-scale temporal and geographic patterns, though no significant structuring was observed at finer spatial or temporal levels. Notably, a similar trend was found in virus lineages from human samples, reinforcing the role of wastewater monitoring in the early detection of infections by identifying viral traces in feces. Molecular dating suggested that outbreak timelines were comparable. This early surveillance method can help pinpoint potential infection hotspots even before individuals develop symptoms. Furthermore, the genetic variability and evolutionary rates of the main SARS-CoV-2 variants closely resembled those found in human-derived samples, mirroring trends observed throughout the pandemic. These findings highlight the necessity of continuous genomic monitoring of wastewater, especially given its direct impact on aquatic ecosystems. Pathogens present in wastewater can affect aquatic organisms, including fish, invertebrates, and plants, leading to diseases, mortality, and shifts in biodiversity within biological communities. Moreover, it is important to emphasize that the data collected and stored in wastewater databases further reinforce the idea that humans act as an umbrella species for the environment and all the organisms within it. By monitoring human health through wastewater, we can also gain crucial insights into broader environmental health, reinforcing the interconnectedness of human, animal, and ecosystem well-being. This perspective aligns with the One Health and Circular Health approaches, which emphasize the need for an integrated, holistic vision of health that considers the mutual influences between humans, animals, and the environment.

G. UCCIERO[1,2,3], M. CIANFLONE[2,3,4], A. CAPUOZZO[3,5], A. TIRANTI[6], F. WANDERLINGH[6], F. ACAMPA[1,2,3,7], G. INDIVERI[3,6], V. LIPPIELLO[3,5], S. FRASCHETTI[2,3]

[1]Department of Earth and Marine Sciences, University of Palermo, Italy.
[2]Department of Biology, University of Naples Federico II, Italy.
[3]National Biodiversity Future Center (NBFC), Palermo, Italy.
[4]Italian Aerospace Research Centre (CIRA), Capua (CE), Italy.
[5]PRISMA Lab., Department of Electrical Engineering and Information Technology, University of Naples Federico II, Italy.
[6]Department of Computer Science, Bioengineering, robotics and Systems engineering, University of Genoa, Italy.
[7]WSense s.r.l., Rome, Italy.
gennaro.ucciero@unipa.it

TECHNOLOGIES FOR MARINE BIODIVERSITY MONITORING AND MAPPING: A SYSTEMATIC REVIEW

Recent technological advancements in cutting-edge research fields such as robotics, artificial intelligence, remote sensing, and smart sensor platforms are revolutionizing scientific research and exploration. This is especially true in marine biology and ecology, where these technologies have opened the possibility of exploring and characterizing environments that had never been studied before. As technological progress continues, primarily driven by private companies, it is crucial to understand the full potential of existing tools for marine ecological research. More importantly, it is essential to assess which technologies offer the best balance between scientific objectives, cost-effectiveness and sustainability, while also considering the rapid obsolescence and the ongoing contributions of the scientific community in this field. In this study, we carried out a systematic review to describe the technological tools available for monitoring and mapping marine biodiversity. The structure of the review follows the PRISMA Protocol and is designed to systematically analyze techonologies developed by both private companies and public institutions. Out of 1028 papers retrieved from Scopus, Web of Science and Google Scholar, 167 articles were selected to assess the current state of market-available technologies. The review shows promising advancements in adaptable instruments, such as underwater cameras and AUVs (autonomous underwater vehicles), which can operate across various environmental conditions. Additionally, it identifies specialized tools suited for specific habitats or target organisms, such as ROVs (remotely operated vehicles) and hydrophones for monitoring marine fishes and mammals. However, there is still a long way to go to enable a large-scale adoption of more advanced technologies, especially due to limited research funding, that requires more cost-effective solutions. Overcoming these barriers will be key to enhancing marine biodiversity monitoring in the future.

V. VELLANI[1,2], K. SCHLAPPA[2], A. GLAVINA[1], G. IVAN[1], G. BEVILACQUA[1], A. PERION[1], G. GESSI[1], D. LESA[1], M. RENZI[1,2]

[1]Dipartimento di Scienze della Vita, Università di Trieste, Italia.
[2]Consorzio Nazionale Interuniversitario per le Scienze del Mare (CoNISMa), Roma, Italia.
karin.schlappa@gmail.com

CREME SOLARI E STRESS TERMICO: RISPOSTA BIOLOGICA DI *ARTEMIA FRANCISCANA* (GRANDI LAGHI SALATI, USA)

In questo studio è stata valutata la risposta biologica a tre creme solari in combinazione con lo stress termico su *Artemia franciscana* (Grandi Laghi Salati, USA), un organismo modello utilizzato per studi ecotossicologici in ambienti di acqua salata. Le creme analizzate sono caratterizzate da filtri chimici e/o fisici, questi ultimi presenti anche sotto forma di nanoparticelle. Gli organismi sono stati esposti a 50 mg/L di ciascuna crema (solubilizzata in DMSO 0.5%) a 25±0.5 °C e 30± 1°C. La risposta biologica (espressa in termini di mortalità media±deviazione standard) è stata registrata a 24, 48 e 168 ore per ciascuna temperatura di esposizione; al termine dell'esperimento è stato stimato l'ET_{50} (tempo necessario per osservare un effetto sul 50% degli organismi). I crostacei sono stati testati in condizione di alimentazione dalle 48 alle 168 ore. I risultati suggeriscono che la temperatura, in associazione allo stress generato dall'esposizione alle creme, è in grado di produrre un effetto additivo sulla risposta biologica di *A. franciscana,* a prescindere dalla composizione della crema solare, sebbene la condizione alimentare rappresenti un ulteriore aspetto determinante. Questi risultati dovrebbero essere considerati alla luce delle proiezioni future, in cui l'aumento della temperatura e degli stressori multipli potrebbero ulteriormente influenzare lo stato di salute degli organismi marini.

11° Workshop del Gruppo Cetacei

COMUNICAZIONI

M. AZZOLIN[1,2,3], A. ARCANGELI[4], M. COSTANTINO[2], M. GAMBA[1,3], C. GIACOMA[1,3], A. GIOVANNINI[2], L. FAVARO[1,3], S. SILVESTRI[5], M.A. IORFINO[5]

[1]Department of Life Sciences and Systems Biology, University of Turin, Italy.
[2]Gaia Research Institute, Torino, Italy.
[3]Interuniversity Center for Cetacean Research (CIRCE), University of Siena, Italy.
[4]ISPRA, Rome, Italy.
[5]Department of Biological, Geological, and Environmental Sciences, University of Bologna, Italy.
marta.azzolin@gmail.com

SEASONAL VARIATION IN THE DISTRIBUTION OF SUITABLE HABITATS OF BOTTLENOSE DOLPHINS, *TURSIOPS TRUNCATUS* (MONTAGU, 1821), IN THE ADRIATIC SEA

The common bottlenose dolphin, *Tursiops truncatus* (Montagu, 1821), is a commonly studied marine species due to its widespread presence and ecological importance. It is listed in Annexes II and IV of the Habitats Directive (Council Directive 92/43/EEC) and is protected under international conventions and regional agreements. Since December 2014, a systematic survey of cetaceans has been conducted in the ADRION (Adriatic and Ionian Sea) Region using ferries as observation platforms. This research, coordinated by the University of Torino, with the cooperation of the Gaia Research Institute, under the supervision of ISPRA's FLT-Med Network, aims to monitor the presence and distribution of cetaceans in the ADRION Region. Presence data were analysed using the Maximum Entropy Algorithm with the MaxEnt software to study the distribution of suitable habitats for bottlenose dolphins in the Adriatic Sea, the area of the ADRION region where they were most frequently detected, and how this distribution varies across seasons. The results indicate that during winter and summer, suitable habitats are primarily concentrated in the central portion of the basin. In contrast, during spring and autumn, these habitats also extend into the southern part of the Adriatic Sea. Understanding the seasonal habitat suitability of bottlenose dolphins will help inform targeted conservation measures aimed at a dynamic protection of this highly mobile species.

F. CARUSO[1], V. SCIACCA[2], G. CAPASSO[1], A. EVRARD[1], S. FERRI[1], S. VIOLA[3], S. PULVIRENTI[3], G. RICCOBENE[3], A. BOCCONCELLI[1,4], A. BORRONI[5], A. SECHI[5], M. ROSSO[5]

[1]Stazione Zoologica Anton Dohrn, Naples, Italy.
[2]Institute of Polar Sciences (CNR-ISP), Messina, Italy.
[3]National Institute for Nuclear Physics (INFN-LNS), Catania, Italy.
[4]Woods Hole Oceanographic Institution, Woods Hole, USA.
[5]CIMA Research Foundation, Savona, Italy.
francesco.caruso@szn.it

THE DIVES PROJECT: DEEP-SEA INVESTIGATION WITH A VIEW TO PROTECT ELUSIVE CETACEAN SPECIES

The PRIN DIVES project investigates the distribution, foraging strategies, and underwater behavior of sperm whales (*Physeter macrocephalus*) and Cuvier's beaked whales (*Ziphius cavirostris*) in the central Mediterranean Sea. By integrating passive acoustic monitoring (PAM), vessel-based surveys, and bio-logging, the project provides high-resolution data on these deep-diving cetaceans. PAM activities include autonomous recording units and the IPANEMA-CT cabled observatory, equipped with a phased array of four broadband hydrophones, enabling continuous and near real-time acoustic monitoring off eastern Sicily (Italy). Additionally, non-invasive bio-logging tags have been deployed to record diving behavior and vocal activity. Preliminary results on sperm whales revealed foraging dives reaching depths of about 1300 meters, the presence of the Mediterranean-specific 3+1 coda pattern, and echolocation clicks emitted during descent and bottom phases. Moreover, buzzes (creaks) and kinematic changes were also detected, indicating active prey capture. Efficient foraging is essential for the survival and reproductive success of apex predators like these whales, whose habitats are increasingly impacted by human activities, reducing prey availability and increasing energy expenditure. These first findings provide crucial ecological and behavioral information on an endangered Mediterranean whale population, supporting conservation strategies and advancing non-invasive monitoring techniques.

S.C. CLEMENTE[1], V.M. MARTEL[2], F. RAMAZZOTTI[3],
F. FUSAR POLI[2], E. VALSECCHI[1]

[1]Department of Earth and Environmental Sciences (DISAT), University of Milano-Bicocca, Italy.
[2]Society for the Study of the Cetaceans of the Canary Islands (SECAC), Arrecife, Lanzarote, Spain.
[3]Department of Biotechnologies and Biosciences (BtBs), University of Milano-Bicocca, Italy.
elena.valsecchi@unimib.it

MORPHOLOGICAL AND MOLECULAR ANALYSIS OF CEPHALOPODS PREY RETRIEVED FROM THE DIGESTIVE TRACT OF AN EXCEPTIONALLY FRESH CUVIER'S BEAKED WHALE (*ZIPHIUS CAVIROSTRIS*) STRANDED IN GRAN CANARIA (CANARY ISLANDS)

Cuvier's beaked whale (*Ziphius cavirostris* G. Cuvier, 1823) remains one of the least understood cetacean species, with limited information available regarding its behavior, diet, and ecological role. Understanding its trophic ecology is essential not only to expand current knowledge of deep-diving marine mammals but also to enhance conservation strategies. This study provides a detailed analysis of the cephalopod species consumed by a stranded Cuvier's beaked whale in the Canary Islands, utilizing a combined morphological and molecular approach to identify prey items based on beaks and tissue samples. The individual examined was found in an exceptionally good state of preservation, with only minor external injuries attributed to shark bites. The necropsy was performed on the same day of the stranding, ensuring minimal post-mortem alterations. The presence of semi-digested cephalopods suggests that the whale had been actively foraging shortly before its death. Cephalopod beaks retrieved from the digestive tract were analyzed morphologically and cross-referenced with molecular data to obtain a robust taxonomic identification of prey species. This integrative approach enhances the reliability of species identification and offers novel insights into the dietary preferences of *Ziphius cavirostris*. The findings confirmed the literature's observations, posing *Cranchidae* and *Octopoteuthidae* as the main basis of the diet of this deep-diving species, although some unusual preys were discovered, along with a couple of specimens belonging to yet undescribed species or species for which the taxonomically diagnostic sequence has not already been deposited in international genome databases. Given the rarity of such well-preserved specimens and the challenges associated with studying deep-diving cetaceans, this case study represents a valuable contribution to the understanding of the feeding ecology of Cuvier's beaked whale, highlighting the whale's ecological role in deep-sea food webs. The results provide a foundation for future research and emphasize the importance of continued efforts to assess the species' trophic interactions and conservation needs.

M. COSTANTINO[1,2], G. NEGRI[2], G. ROSESTOLATO[2], M. AZZOLIN[1,2,3]

[1]Department of Life Sciences and Systems Biology, University of Turin, Italy.
[2]Gaia Research Institute, Torino, Italy.
[3]Interuniversity Center for Cetacean Research (CIRCE), University of Siena, Italy.
matteo.costantino91@gmail.com

VARIATION OF THE SWIMMING PARAMETERS OF *STENELLA COERULEOALBA* ACCORDING TO SOCIAL STRUCTURE AND BEHAVIOURAL CONTEXT

Cetaceans, as highly social animals, display a wide range of behaviours. Investigating behavioural patterns in different contexts can provide valuable insights into their ecology and contribute to conservation efforts. From 2019 to 2024, land-based monitoring was conducted during spring and summer from a fixed location on the east coast of the Gulf of Corinth to study the presence and behaviour of the striped dolphin, *Stenella coeruleoalba* (Meyen, 1833). A total of 138 surveys were carried out, amounting to 215.38 hours of observation and 70 sightings of striped dolphins. The Sighting per Unit of Effort (SPUE) varied across years, seasons, and time of the day, with the highest values recorded in 2019 (0.765), during spring (0.479), and in the 3-6 pm time slot (0.563). The observed behavioural contexts included traveling, feeding, resting, playing/socializing, and diving. Larger groups (over 20 individuals) tended to remain compact while moving and predominantly engaged in traveling, displaying a range of swimming speeds from slow to fast. Smaller groups exhibited all behavioural contexts more evenly. The presence or absence of calves influenced swimming speed, which increased in their absence, accompanied by greater behavioural diversity. Additionally, the presence of calves was associated with reduced diving time, as groups remained in constant motion.

V. DE MILATO[1], R. CARLUCCI[1,2], M. INGROSSO[1,3], F. LORUSSO[1], P. RICCI[1,2]

[1]Dipartimento Bioscienze, Biotecnologie e Ambiente, Università di Bari, Italia.
[2]Consorzio Nazionale Interuniversitario per le Scienze del Mare (CoNISMa), Roma, Italia.
[3]Lega Navale Italiana, Roma, Italia.
v.demilato@studenti.uniba.it

APPROCCIO INTEGRATO PER LO STUDIO DELLA PRESENZA DI CETACEI PRESSO L'ARCIPELAGO DELLE ISOLE TREMITI (BASSO ADRIATICO)

Lo sforzo di ricerca per il monitoraggio dei cetacei risulta distribuito in maniera non omogenea nel Mar Mediterraneo. In questo contesto l'Area Marina Protetta delle Isole Tremiti, pur essendo oggetto di numerosi studi sulla biodiversità, presenta informazioni limitate riguardo alla presenza della cetofauna tra le isole e la costa. In questo contributo si riportano i risultati derivanti dall'applicazione di due metodologie adottate per acquisire informazioni preliminari sulla loro presenza nel corso del 2024. Il primo è un approccio *web-based* e ha previsto l'analisi di video acquisiti da diversi *social network* (*Facebook, TikTok, Instagram, YouTube*) utilizzando diverse parole chiave (delfini Tremiti, delfini Gargano, cetacei Gargano, delfini Termoli, delfini Vieste), al fine di collezionare avvistamenti realizzati da turisti ed operatori marittimi. A seconda della qualità dei video acquisiti, si è proceduto a determinare: la specie, il numero di individui, il periodo dell'avvistamento e le condizioni meteo-marine. Il secondo approccio ha previsto 8 *survey* di avvistamento in mare basati sulla metodologia del *Fixed Line Transect* e realizzati utilizzando, come piattaforma di avvistamento, un catamarano veloce lungo la tratta Termoli-San Nicola, durante il periodo giugno-settembre 2024. Sul totale di 50 video analizzati nel periodo 2013-2024, 1 documenta la presenza di *Balaenoptera physalus*, 8 di *Stenella coeruleoalba* e 12 di *Tursiops truncatus*. Il numero d'individui osservati per ogni specie risultava di 4 individui per *B. physalus,* e compreso tra 3 e 8 per *S. coeruleoalba* e tra 1 e 10 per *T. truncatus*. Durante l'attività di rilevamento sono stati realizzati un totale di 5 avvistamenti. Tuttavia, è stato possibile determinare la specie osservata (*T. truncatus*) solo per un avvistamento effettuato nel mese di luglio. L'approccio integrato di metodologie *web-based* e *field-based* può supportare la raccolta di informazioni sulla presenza dei cetacei in aree poco investigate, indirizzando successive attività di monitoraggio sistematico.

S. FERRI[1,2], V. SCIACCA[3], A. EVRARD[1], S. CANESE[1,4],
L. FAVARO[2], F. CARUSO[1,4]

[1]Stazione Zoologica Anton Dohrn, Naples, Italy.
[2]Department of Life Sciences and Systems Biology (DBIOS), University of Turin, Italy.
[3]Institute of Polar Sciences (ISP), National Research Council (CNR), Messina, Italy.
[4]National Biodiversity Future Center (NBFC), Palermo, Italy.
sara.ferri@unito.it

INVESTIGATING FIN WHALE ACOUSTIC PRESENCE AND LOW-FREQUENCY NOISE IN THE CENTRAL MEDITERRANEAN SEA

Fin whales, *Balaenoptera physalus* (Linnaeus, 1758), are the only mysticetes regularly found in the Mediterranean Sea, but their distribution and behavior are still poorly understood. Here, we investigated the acoustic presence of fin whales in the Central Mediterranean Sea and assessed low-frequency noise levels, in accordance with the EU Marine Strategy Framework Directive (MSFD). Acoustic data (5-min recordings) were collected using autonomous acoustic devices deployed in offshore waters across different areas: Sicily Channel (site-1), from 18 Feb to 27 Apr 2022; North Tyrrhenian Sea (site-2), from 29 Jun–27 to Sep 2023; Ionian Sea (site 3), from 12 Dec 2023 to 19 Marc 2024. All audio files were down-sampled at 2000 Hz in order to ensure uniformity between datasets. A customized automatic detector (SAW) and algorithms developed in MATLAB were applied to all sites to: (*i*) detect fin whales "20 Hz calls", and (*ii*) estimate ambient noise levels as indicated by the MSFD. Preliminary results confirmed the widespread acoustic presence of fin whales in the region, and a significant influence of anthropogenic noise from marine traffic, fishing activities and military exercises. The persistent presence of anthropogenic noise in the local soundscape raises concerns about its potential to disrupt species communication. This study, as part of the PRIN KNOWhale project, provides baseline data on the acoustic presence of fin whales and the impact of underwater noise in the Central Mediterranean Sea. However, further long-term and large-scale surveys are essential to identify critical areas and to mitigate the current human impact on this vulnerable species.

C. FOSSATI[1,2], M. MANGHI[2], G. CALTAVUTURO[2], D. LELONG[1]

[1]Centro Interdisciplinare di Bioacustica e Ricerche Ambientali (CIBRA), DSTA, Università di Pavia, Italia.
[2]NAUTA Scientific, Milano. Italia.
claudio.fossati@unipv.it

RACCOLTA DATI E MISURA DEL RUMORE DIFFUSO NEI MARI ITALIANI

La misura e l'impatto del rumore antropico in ambiente subacqueo stanno diventando temi sempre più attuali. Dopo la pubblicazione della *Marine Strategy Framework Directive* nel 2008, gli stati membri della Comunità Europea si sono progressivamente dotati di documenti e linee guida per affrontare il problema. In Italia è di recente pubblicazione il Registro Nazionale dei Suoni Impulsivi, mentre ancora non è disponibile quello sui rumori continui. Dopo un periodo iniziale di attenzione quasi esclusiva sui rumori impulsivi (con la creazione del Report Parlamentare Annuale sugli Airgun), l'interesse ora si è allargato ai rumori continui e le agenzie governative statali e regionali richiedono sempre più estesamente il monitoraggio dei rumori subacquei emessi durante lavori industriali nella fascia costiera e in mare aperto. La definizione della regolamentazione riguardante i rumori continui e le conseguenti linee guida necessita, però, di dati reali sulla situazione presente nei mari intorno all'Italia. La conoscenza della situazione reale è infatti fondamentale per stabilire le soglie su cui calcolare i LOBE (*Level of Onset of adverse Biological Effects*). NAUTA e CIBRA hanno negli ultimi anni raccolto una grande mole di dati in tal senso, in parte già elaborati, producendo valori RMS totali, per percentili e per bande (inclusi 63 e 125 Hz) e di SEL (*Sound Exposure Level*). I risultati preliminari mostrano una situazione di rumore diffuso, soprattutto in prossimità delle coste, che supera spesso i 110dB RMS proposti come soglia di rumore in grado di causare alterazioni comportamentali nei cetacei nelle Linee Guida ISPRA del 2011. Questi dati, se confermati dai nuovi rilevamenti in corso, descrivono una situazione del rumore che necessita di attenzione in tempi brevi, sia per calibrare le soglie proposte che per affrontarne gli impatti sugli animali.

Y. LUCCHETTA[1], M. NEGRI[2], G. GNONE[3,4], S. NUTI[5], M. BELLINGERI[3]

[1]Dipartimento di Bioscienze, Università di Milano, Italia.
[2]R.S.T.A. scrl, Genova, Italia.
[3]Acquario di Genova, Genova, Italia.
[4]Fondazione Acquario di Genova Onlus, Genova, Italia.
[5]CE.TU.S Cetacean Research Centre, Viareggio (Lu), Italia.
ylenia.lucchetta@gmail.com

PARAMETRI RIPRODUTTIVI DI *TURSIOPS TRUNCATUS* NEL SANTUARIO PELAGOS (MAR MEDITERRANEO NORD-OCCIDENTALE)

Dal 2001 Fondazione Acquario di Genova e CE.TU.S. conducono un'attività di ricerca sul tursiope, *Tursiops truncatus* (Montagu, 1821), in Liguria e Toscana (Mar Mediterraneo nord-occidentale), all'interno del Santuario Pelagos. Uno degli obiettivi del progetto è monitorare il comportamento riproduttivo delle femmine, il loro tasso di fertilità e il tasso di mortalità dei cuccioli. I dati sono stati raccolti a bordo di gommoni (5,10 m di lunghezza) in Liguria e di un catamarano a vela (12 m di lunghezza) in Toscana. Per registrare le rotte di campionamento e i punti di avvistamento della specie target sono stati utilizzati dei dispositivi GPS. Durante gli avvistamenti, sono stati raccolti dati fotografici per l'identificazione degli esemplari attraverso marcaggi naturali della pinna dorsale. Le immagini fotografiche hanno permesso di determinare il sesso di alcuni individui identificati, tramite l'associazione regolare con un *newborn* (nel caso delle femmine) o tramite la documentazione dell'area ventrale (sia per le femmine che per i maschi), e di ricostruire le storie riproduttive delle femmine. Sono stati calcolati il tasso di fertilità annuo (YFR), il tasso di fertilità totale (TFR), l'intervallo tra i parti (CI) e il tasso di mortalità dei cuccioli entro il primo anno di vita (MR1). Dal 2006 al 2019, sono stati registrati 225 avvistamenti di tursiopi e sono stati identificati fotograficamente 331 individui. Di questi, 61 sono stati identificati come femmine e 18 come maschi. Sono stati confrontati i dati ottenuti con quelli di altri studi, sia all'interno che all'esterno del Mediterraneo. Il TFR, pari a 0,34, è risultato superiore, il MR1, 0,22, leggermente più elevato, mentre il CI, 3,27±0,2 (SE), è risultato coerente con i risultati ottenuti in precedenza. Lo studio permetterà di aggiornare i risultati preliminari e testare l'ipotesi, suggerita dall'analisi del YFR, per cui potrebbe esserci una certa sincronizzazione tra le nascite.

M. PASINO[1], M.V. IACOVELLI[1], P. IACUMIN[2], M. PODESTÀ[3], G. GNONE[4], J. GIMÉNEZ[5], MEDITERRANEAN MUSEUM NETWORK, F. TINTI[1]

[1]Department of Biological, Geological and Environmental Science, University of Bologna, Ravenna, Italy.
[2]Department of Chemistry, Life Sciences and Environmental Sustainability, University of Parma, Italy.
[3]Museum of Natural History of Milan, Italy.
[4]Acquario di Genova, Genova, Italy.
[5]Instituto Español de Oceanografía (IEO-CSIC), Centro Oceanográfico de Málaga, Spain.
martina.pasino2@unibo.it

TRACING TIME'S FOOTPRINTS: EXPLORING FEEDING ECOLOGY AND HISTORICAL CHANGES OF MEDITERRANEAN COMMON DOLPHIN (*DELPHINUS DELPHIS*) OVER TWO CENTURIES

The Mediterranean population of common dolphin (*Delphinus delphis*) presents an enigmatic natural history in the last centuries. Once widely prevalent in the 19th and early 20th, it faced a significant decline across most of the basin by the late 1960s. The causes and mechanisms behind this decline remain largely unknown and poorly understood. The IUCN has designated the Inner Mediterranean population of common dolphins as Endangered. Here, we analyzed stable isotopes of nitrogen and carbon ($\delta^{15}N$ and $\delta^{13}C$) on skeletal remains collected in 22 Mediterranean natural history museums to investigate spatio-temporal trophic shifts and niche partitioning of the Mediterranean common dolphin over the past 200 years. We compared the isotope composition of historical common dolphins with those of the contemporary populations of *Stenella coeruleoalba* and *Tursiops truncatus* which co-occur in the Mediterranean, occupying different habitats and trophic niches. We found that common dolphin individuals inhabiting the Mediterranean before 1970 occupied a significantly higher trophic level than the contemporary ones. The comparative analysis between dolphin species revealed that historically common dolphins occupied a well-defined isotopic niche separate from other species, while the contemporary populations shifted to overlap those of the striped dolphin. We cannot exclude that this significant ecological shift could be driven by habitat and trophic competition with human activities as prolonged and intense fishery stock exploitation has occurred in the basin. However, it appears that a key factor in the common dolphin's decline was competition with the striped dolphin, a widespread species in the region, that has effectively "squeezed" the common dolphin's habitat. This is the first long-term evidence of an ecological and/or trophic shift in the common dolphin Mediterranean population, which could be the starting point for understanding the causes and impacts of the species' near-collapse in the Mediterranean.

V. SCIACCA[1], F. CARUSO[2], G. CARUSO[1], P. CASTAGNO[3], G. DE VINCENZI[1], S. FERRI[2,4], F. FILICIOTTO[1]

[1]Institute of Polar Sciences (CNR-ISP), Messina, Italy.
[2]Stazione Zoologica Anton Dohrn, Napoli, Italy.
[3]Department of Mathematics, Computer Science, Physics and Earth Science, University of Messina, Italy.
[4]Department of Life Sciences and Systems Biology (DBIOS), University of Turin, Italy.
virginia.sciacca@cnr.it

THE PROJECT "KNOWHALE": KNOWLEDGE IMPROVEMENT FOR THE CONSERVATION OF ENDANGERED MEDITERRANEAN FIN WHALE (*BALAENOPTERA PHYSALUS*) IN SOUTHERN ITALY

The population of fin whales, *Balaenoptera physalus* (Linnaeus, 1758), that inhabits the Mediterranean Sea is protected by several international agreements, and it has been recently classified as "endangered" by the Red List of the International Union for Conservation of Nature. Many surveys confirmed the seasonal presence of the species in highly productive regions of the Mediterranean Sea, where the animals aggregate for feeding and social purposes. However, very little is known about the population's acoustic behavior, and no information is available concerning the main reproductive areas and routes that the individuals seasonally follow in the basin. Moreover, the poor quantity of data available in the Central Mediterranean Sea limits the definition of the movements, ecology, and behavior of the species. This work is part of a collaborative effort within the research project "KNOWhale" (PRIN PNRR 2022) and aims to expand knowledge about the species' acoustic behavior and seasonal distribution. In particular, we aim at improving knowledge on the species acoustic behavior and seasonal movements in the south-central Mediterranean Sea. Acoustics represents an essential not-invasive tool to study whale movements, and it could shed light on the species ecology and threats. Additionally, understanding the structure and use of fin whale songs within the same population represents the next necessary step to know their acoustic behavior. Here, acoustic data from different sites were collected from 2017 to 2025, and novel approaches were applied to detect the "20 Hz" calls of fin whales. Occurrence of the species was ascertained at different locations and preliminary results on their songs reveal new insights into this population. The KNOWhale project will be crucial to monitor the distribution and conservation status of the Mediterranean fin whale.

A. ZANOLI[1], S. FERRI[1,2], R. ALI AHMED[1,3], G. OLIVIERI[2,4], A. EVRARD[2], F. ABDOU RABI[5], Y.B. ALI ABDALLAH[3], C. GIACOMA[1,6], F. CARUSO[2], L. FAVARO[1,2,6]

[1]Department of Life Sciences and Systems Biology (DBIOS), University of Turin, Italy.
[2]Stazione Zoologica Anton Dohrn, Naples, Italy.
[3]Centre National de Contrôle et de Surveillance des Pêches, Parc National Shisiwani, Union des Comores.
[4]Department of Biology, University of Naples Federico II, Italy.
[5]Agence des Aires Protégées des Comores, Moroni, Union des Comores.
[6]Interuniversity Center for Cetacean Research (CIRCE), University of Siena, Italy.
anna.zanoli@unito.it

ACOUSTIC MONITORING OF CETACEANS AND UNDERWATER NOISE IN SHISIWANI MARINE NATIONAL PARK (COMOROS)

The Comoros Archipelago, with its volcanic islands and deep coastal waters, provides a crucial habitat for cetaceans. Despite being a marine mammal biodiversity hotspot, little is known about cetacean presence and vocal activity in the region. This study provides new insights into the acoustic ecology of cetaceans in Shisiwani National Park (Anjouan, Comoros), using passive acoustic monitoring to examine their vocal activity and evaluate the extent of underwater anthropogenic pollution in the area. An Autonomous Recording Unit (ARU) was deployed in coastal waters at approximately 30 meters depth from April to September 2024. A total of 7,532 audio files (~540 GB) were acquired at a 128 kHz sampling rate with a 16% duty cycle. A subsample (5 minutes every hour, 3,766 files) was analyzed through spectrogram visualization to detect cetacean vocalizations and anthropogenic noise sources. Identified species included delphinids of the genus *Stenella* and the humpback whale (*Megaptera novaeangliae*), confirming the presence of both coastal and oceanic cetaceans in the region. Ecoacoustics indices, such as ACI, BI, and entropy, were calculated to quantitatively assess soundscape patterns and capture variations in acoustic complexity and diversity. Generalized Linear Mixed Models (GLMMs) were used to investigate the effect of biological and anthropogenic factors on the acoustic environment. The results revealed a significant impact of ship noise on cetacean vocal activity, with a reduction in entropy, suggesting a homogenization of the soundscape and a potential masking effect on communication signals. This effect was pronounced during nighttime hours, when acoustic diversity naturally increases, further emphasizing the vulnerability of cetacean acoustic behaviour to anthropogenic noise. Even in this remote area, evidence of anthropogenic activity underscores the relevance of soundscape analysis for understanding human impacts on marine ecosystems. This research provides valuable insights for future conservation efforts within this key region of the Indian Ocean Sanctuary.

POSTER

M. BONATO[1,2], L. CEOLOTTO[1], G. PIETROLUONGO[1,2], K. VISHNYAKOVA[1], C. CENTELLEGHE[1,3], S. MAZZARIOL[1,3]

[1]Department of Comparative Biomedicine and Food Science, University of Padua, Legnaro (PD), Italy.
[2]National Interuniversity Consortium for Marine Sciences (CoNISMa), Roma, Italy.
[3]Interuniversity Center for Cetacean Research (CIRCE), Genova, Italy.
marco.bonato@unipd.it

DOLPHIN MONITORING AND FIRST ACOUSTIC CHARACTERIZATION IN THE VENETO REGION: A MULTI-METHOD APPROACH FROM THE POSEIDONE PROJECT

The northern Adriatic Sea with the Dalmatian Archipelago is defined as an Importamt Marine Mammal Area (IMMA) for the common bottlenose dolphin, *Tursiops truncatus* (Montagu, 1821). Diverse habitat features make this area suitable for aggregations and breeding grounds of this species. Within the Interreg project Poseidone (ITA-SI0400091), in 2023 and 2024, the integration of at-sea survey campaign and citizen science aimed to collect presence and bioacoustic data of bottlenose dolphins in Veneto waters. Boat-based surveys covered 500 nautical miles over 30 monitoring days, collecting demographic, behaviour, photo-identification, and bioacoustic data. In parallel, the project education and awareness campaign allowed the integration of scientific data with citizen science data through direct reports to the project partners or the use of mobile applications. Traditional surveys recorded 15 dolphins in 2 sightings with 6 individuals photo-identified, while citizen science reports documented 85 sightings. This significant increase highlights the complementary value of citizen science, which provided data over a broader spatial and temporal scale than traditional methods alone. Additionally, boat-based surveys allowed, in parallel with other data, acoustic recordings of dolphin vocalizations in this area for the first time. Preliminary analysis identified 45 whistles analyzed for acoustic parameters: total duration (726,2 ms), minimum frequency (6123,7 Hz), maximum frequency (13.876,2 Hz), beginning frequency (6238,8 Hz), and end frequency (12.889,3 Hz). Comparisons with *Tursiops truncatus* (Montagu, 1821) from the Croatian coast suggest significant differences in whistle duration and beginning frequency, indicating the possible presence of a stable population along the Veneto coastline. These findings underscore the crucial role of citizen science in complementing traditional monitoring, enhancing conservation strategies, and improving research efficiency, particularly in regions with limited resources for systematic surveys.

F. BONUCCI[1], D. BEDOCCHI[1], B. LOFFREDO[1], J. TESTI[1], L. TROPI[2], V. ELIA[1], C. MARESCALCHI[1], N. DELLA GIOVAMPAOLA[1], G. CONSALES[1], F. CAPANNI[1], I. CECIARINI[1], L. MINOIA[1], V. MENONNA[3], G. GUBERTI[3], E. FRANCHI[1], L. MARSILI[1,4]

[1]Dipartimento di Scienze Fisiche, della Terra e dell'Ambiente, Università di Siena, Italia.
[2]Dipartimento di Scienze della Vita e dell'Ambiente, Università Politecnica delle Marche, Ancona, Italia.
[3]Regione Toscana, Protezione della Natura e del Mare, Firenze Italia.
[4]Centro Interuniversitario per la Ricerca sui Cetacei (CIRCE), Siena, Italia.
francesco.bonucci@student.unisi.it

RISULTATI PRELIMINARI SULLA DISTRIBUZIONE ED ABBONDANZA DEL TURSIOPE, *TURSIOPS TRUNCATUS* (MONTAGU, 1821), NELL'ARCIPELAGO TOSCANO SFRUTTANDO PIATTAFORME DI OPPORTUNITÁ

Il Santuario Pelagos (391/2001) è la più grande area marina protetta del Mar Mediterraneo, istituita per la conservazione dei mammiferi marini per la loro elevata presenza e frequentazione dell'area. Tuttavia, nonostante l'importanza ecologica della zona, lo sforzo di monitoraggio all'interno del Santuario Pelagos non è uniforme. Alcune aree, come quella meridionale, risultano meno indagate rispetto ad altre. Questa disparità nella raccolta di dati può limitare la conoscenza su indicatori fondamentali richiesti dalla Direttiva Habitat, come la distribuzione e l'abbondanza delle specie, compromettendo così l'efficacia delle misure di conservazione. Per colmare queste lacune, da luglio 2024 è stato avviato un monitoraggio sistematico del tursiope, *Tursiops truncatus* (Montagu, 1821), nell'area meridionale del Santuario, dove le informazioni sulla distribuzione e l'abbondanza di questa specie risultano ancora limitate. Il monitoraggio, condotto nell'area del Parco Nazionale dell'Arcipelago Toscano, utilizza la metodologia del *Fixed Line Transect*, servendosi dei traghetti delle compagnie Moby Lines e Toremar, operanti lungo le rotte Piombino (LI) – Portoferraio (LI) e Porto Santo Stefano (GR) – Isola del Giglio (GR), come piattaforme di osservazione. I dati raccolti fino ad ora indicano la presenza costante, durante tutti i mesi del monitoraggio, dei tursiopi in entrambe le aree di studio, con un'abbondanza maggiore osservata lungo la rotta Piombino – Portoferraio. I risultati preliminari ottenuti durante questi mesi di monitoraggio permettono non solo di ampliare le conoscenze su un'area del Santuario Pelagos ancora poco indagata ma evidenziano l'importanza di condurre un monitoraggio continuo durante tutto l'arco dell'anno per comprendere al meglio le dinamiche ecologiche della popolazione locale di tursiopi e per sviluppare strategie di conservazione mirate.

N. MAIO[1], T. FIORAVANTI[2], L. LATINI[2], A. SPLENDIANI[2], F. POLLARO[3], G. INSACCO[4], C. COCUMELLI[5], V. CAPUTO BARUCCHI[2]

[1]Department of Biology, University of Naples Federico II, Italy.
[2]Department of Life and Environmental Sciences, Università Politecnica delle Marche, Ancona, Italy.
[3]Centro Studi Ecosistemi Mediterranei, Perdifumo (SA), Italy.
[4]Municipal Museum of Natural History, Comiso (RG), Italy.
[5]Istituto Zooprofilattico Sperimentale del Lazio e della Toscana "M. Aleandri", Roma, Italy.
nicomaio@unina.it

THE COMMON MINKE WHALE (*BALAENOPTERA ACUTOROSTRATA* LACÉPÈDE, 1804) IN THE MEDITERRANEAN SEA. GENETIC RESULTS WITH AN UPDATED OVERVIEW ON DISTRIBUTION (CETARTIODACTYLA: BALAENOPTERIDAE)

The Common Minke Whale (*Balaenoptera acutorostrata* Lacépède, 1804) is a cosmopolitan species found in all oceans at latitudes from 65°S to 80°N. Its migration patterns are poorly known, however, seasonal migrations between high latitude summer feeding and low latitude winter breeding grounds were described in North Atlantic. Newborns are 2.6-2.8 m long and stay with their mother for about six months, during which time they migrate to cold waters at high latitudes. In Mediterranean Sea, records of the species are rare and it is considered as "Non Regular Species". Genetic analysis were performed on three individuals stranded along Italian coasts to highlight their geographical origin. A portion of the mitochondrial DNA control region was amplified and, sequences obtained were compared with those globally described. The alignment showed a 100% correspondence with North Atlantic haplotypes, confirming results reported in our previous studies. Most of the specimens stranded along the Italian coasts are represented by young calves, with a length less than four meters and most of the individuals were recorded in spring, a period immediately following the calving season. The last finding from Italian seas are very young calves with a total length between 2.50 m and 3.30 m (four individuals from 2010). Considering the migratory pattern of the species, our results suggests that the Mediterranean can be used as a potential calving or nursery ground by North Atlantic population. It is also possible that the Mediterranean basin is a resting area for mother-calf pairs on their way back north. In conclusion, this species may be considered more than a simple "visitor" in Mediterranean Sea, as some authors suggest too.

V. MASELLI[1], B. MUSSI[2], F. DI NOCERA[3], M. NORCIA[1], A. ILLIANO[1], E. ESPOSITO[3], A. DI COSMO[1]

[1]Department of Biology, University of Naples Federico II, Italy.
[2]Oceanomare Delphis APS, Rimini (RN), Italy.
[3]Istituto Zooprofilattico Sperimentale del Mezzogiorno, Dipartimento di Sanità Animale, U.O.S. Ittiopatologia, Portici (NA), Italy.
valeria.maselli@unina.it

HIGH-RESOLUTION MELTING OF THE MITOCHONDRIAL GENES: A POWERFUL APPROACH FOR FOUR CETACEAN SPECIES IDENTIFICATION IN THE MEDITERRANEAN SEA

Easy, economic, and accurate species authentication is currently necessary in various research areas and molecular diagnostic in biology, particularly for conservation studies involving endangered species. In this study, we present a novel method for the identification of four cetacean species in the Mediterranean Sea: the bottlenose dolphin (*Tursiops truncatus*), the striped dolphin (*Stenella coeruleoalba*), the sperm whale (*Physeter macrocephalus*), and the fin whale (*Balaenoptera physalus*). We propose an assay based on High-Resolution Melt (HRM) analysis of the mitochondrial genes, allowing an efficient and accessible species determination. We collected reference samples from tissue specimens and then validated the assay's applicability to non-invasive sources, such as fecal matter and seawater. We demonstrated that the assay has the potential to become a valuable tool for standardized genetic monitoring of the cetacean species in the wild in the Mediterranean area.

A. MENGARELLI[1,2], A. ZANOLI[1], B. BONELLI[1,3], M. BELLINGERI[3], G. GNONE[2,3], L. FAVARO[1]

[1]Department of Life Sciences and Systems Biology (DBIOS), University of Turin, Italy.
[2]Fondazione Acquario di Genova ONLUS, Genova, Italy.
[3]Acquario di Genova, Genova, Italy.
alice.mengarelli@unito.it

THE WHISTLES OF THE LIGURIAN COMMON BOTTLENOSE DOLPHINS: ACOUSTIC CHARACTERISATION AND SIGNATURE WHISTLE CATALOGUE ATTEMPT

The Pelagos Sanctuary is a Special Protected Area of Mediterranean Importance (SPAMI) dedicated to conserving Mediterranean marine mammals and their habitats. The Sanctuary is home to the common bottlenose dolphin, *Tursiops truncatus* (Montagu, 1821), a species of Community interest listed in the annexes II and IV of the Habitats Directive and a target of the Marine Strategy Framework Directive (MSFD). Due to significant human activity in the area, monitoring this dolphin population is crucial for its long-term sustainability. Acoustic monitoring is a promising tool for studying cetaceans in the wild and the bottlenose dolphin shows a complex acoustic repertoire, including whistles, frequency-modulated and narrowband sounds used in intraspecific communication. Among the whistles repertoire, bottlenose dolphins emit the signature whistle (SW), a signal with an individually unique frequency pattern that broadcasts the emitter's identity. The aim of this study was to describe the whistles acoustic variability of the Ligurian geographical unit of common bottlenose dolphins. Acoustic data were collected in 2023 during several field trips, on board inflatable boats provided by Acquario di Genova, carried out between Genoa and La Spezia. Acoustic recordings were made during encounters with dolphins and the relevant metadata (e.g., weather, sea conditions, number of individuals present during the sighting, association with human activities) were collected using sighting cards, and subsequently uploaded to the Intercet platform. Spectrographic annotations of the acoustic recordings were made with Praat software. In addition, we extracted several spectro-temporal parameters for each whistle identified and established a SW catalogue using the SIG-ID method. Our results provide an acoustic characterisation of whistle types identified within this geographical unit. This is intended to constitute a basis for developing a capture-recapture method using SWs as proxies for individual presence, to be used alongside the traditional photo-identification technique.

E. PIGNATA[1], G. CALOGERO[1,2], C. GUIDI[1], E. BIASISSI[1], M. MANGHI[3], D. VIRZI[2], B. VIOLI[1,4]

[1]Menkab: il respiro del mare APS, Savona, Italia.
[2]Area Marina Protetta "Isola di Bergeggi", Bergeggi (SV), Italia.
[3]NAUTA scientific s.r.l., Milano, Italia.
[4]Istituto Nazionale di Fisica Nucleare (INFN), Sezione di Genova, Italia.
eleonora.pignata.95@gmail.com

IL MONITORAGGIO ACUSTICO DEI CETACEI NELLE AREE MARINE PROTETTE: BERGEGGI E IL PROGETTO ABIS

Le aree marine protette sono note per essere hotspot di biodiversità e come tali giocano un ruolo fondamentale per il monitoraggio e l'osservazione di alcune specie di cetacei che in esse trovano ottime condizioni per riprodursi ed alimentarsi. In questo contesto, il progetto ABIS (Acoustic of Bergeggi ISland) ha l'obiettivo di raccogliere e analizzare i dati acustici nell'Area Marina Protetta Isola di Bergeggi, situata nella zona più settentrionale del Santuario Pelagos, al fine di ottenere importanti dati di presenza e assenza dei cetacei. A febbraio 2024 è stato posizionato un idrofono in prossimità della zona C dell'AMP, in modo da poter registrare suoni ad intervalli regolari, in orario diurno e notturno. Ad oggi sono stati raccolti dati per 211/330 giorni (64%), per un totale di 1256 ore registrate. Le analisi preliminari rivelano una presenza consistente di clicks (78%) e fischi (22%) di *Tursiops truncatus*, specie costiera regolare del Santuario Pelagos inserita all'interno della Direttiva Habitat. Il sito di registrazione è stato scelto considerando anche la particolare posizione dell'AMP Isola di Bergeggi, la quale si trova tra due canyon (Vado Ligure e Bergeggi-Noli) che favoriscono il passaggio e la presenza di grandi cetacei come *Physeter macrocephalus*. ABIS rappresenta quindi un esempio di progetto di monitoraggio non invasivo, che permette anche l'eventuale verifica del passaggio di specie non tipicamente costiere o non regolari nel Pelagos. L'applicazione di questa metodologia in tutte le AMP del Santuario Pelagos, oltre a fornire una tecnica comune di raccolta dati, creerebbe anche una compatta rete di collaborazione ed un supporto importante per il monitoraggio di zone di alto interesse come le Aree Marine Protette. Dall'estate 2024, il progetto CLAPS – Climatic Adaptation Pelagos Sanctuary ha dato concretamente forma a questa idea coinvolgendo il network delle AMP e parchi del Pelagos della parte italiana.