ABSTRACT BOOK

XVII INCONTRO DEI DOTTORANDI E DEI GIOVANI RICERCATORI IN ECOLOGIA E SCIENZE DEI SISTEMI ACQUATICI

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Stazione Zoologica Anton Dohrn

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SUMMARY

SYMPOSIUMS

- ***How to write a scientific paper***, a cura del Prof. **Roberto Danovaro**, Presidente della Stazione Zoologica Anton Dohrn e Professore Ordinario presso l'Università Politecnica delle Marche.

- ***Successful grant proposal writing***, a cura del Dott. **Wiebe H.C.F. Kooistra**, Dirigente di ricerca della Stazione Zoologica Anton Dohrn - Napoli.

- ***Communicating science as a scientist***, a cura della Dott.sa **Emanuela Dattolo**, Ricercatrice della Stazione Zoologica Anton Dohrn - Napoli.

SEMINARS

-***Le donne nella scienza***, a cura della Prof.ssa **Adriana Albini**, Direttrice del Laboratorio di Biologia Vascolare ed Angiogenesi-IRCCS Multimedica (Milano) e Docente presso l'Università di Milano Bicocca.

ORAL PRESENTATIONS

Session I

Biodiversity and Ecosystem Functioning

Full Talk

ASSESSING MARINE BENTHIC BIODIVERSITY IN THE CENTRAL MEDITERRANEAN SEA: AN INTEGRATIVE TAXONOMY APPROACH

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Comprehensive knowledge of marine biodiversity is fundamental to take necessary steps towards the conservation of marine ecosystems. Thorough biodiversity surveys necessitate both taxonomic and molecular analysis methods (e.g. metabarcoding) to characterize species and quantify the diversity of marine communities (integrative taxonomy). Moreover, establishing standardized methods for field surveys and sample processing procedures provides opportunities for broad-scale biodiversity comparisons. In this study, we employed a standardized integrative taxonomy approach by coupling DNA metabarcoding and morphological identification to characterize the invertebrate diversity of benthic communities at three locations across the Central Mediterranean Sea (Livorno and Palinuro, Italy; Rovinj, Croatia). Artificial Substrate Units (ASUs) scouring pads as species collectors were deployed at 15-25 m of depth during summer 2018 and retrieved after one year. All the invertebrates were manually sorted and identified to the lowest taxonomic level. Then, we targeted a hypervariable region of the mitochondrial gene coding for the Cytochrome Oxidase Subunit I (COI) to carry out DNA metabarcoding analyses. Preliminary results from both morphological and molecular approaches showed significant differences in community assemblages across the sampled locations, indicating that geographic distance is here a strong driver of variation. Subsequent analyses will focus on identifying the taxa that are the major contributors to the observed dissimilarity patterns. Finally, we aim to compare the results of both techniques to gain further insight into the benefits and limitations of each methodology, thus promoting the use of integrative taxonomy approaches in future marine biodiversity monitoring initiatives aiming to preserve life in our oceans.

MICROALGAL ASSOCIATIONS ON SEAGRASS MEADOWS: EFFECTS OF GLOBAL CHANGES ON THE FIRST COLONIZATION AND PLANT-ANIMAL CHEMICAL RELATIONSHIPS

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Researches in the frame of this Ph.D. project aim at defining the effect of various stressors, known to characterize the future of the world's oceans, on the biodiversity of key ecosystems. This investigation will contribute information on the trends of ecological successions in marine ecosystems, by analyzing two key stressors (temperature and pH) about possible views of ecological successions to clarify the multidimensional nature of forces structuring species assemblages. The research will provide insights on the trends of biodiversity "biased" by altered ecological succession. We aim at detecting indirect effects of Global Warming and Ocean Acidification on natural communities stably characterizing seagrass meadows. The project will take advantage of an intensive program of field operations, with the set-up and the deployment of panels with a low-adhesion surface, designed to collect the first stages of colonization of benthic algae in seagrasses meadows. Two sides located in Italy, characterized by a range of temperatures and pH regimes (Gulf of Trieste and Island of Ischia) will be explored. Algae will be collected and taxonomically identified. Selected diatom will be isolated and cultivated to identify the metabolic variability of strains selected in different environmental conditions. Algae produced in laboratory conditions will be used to extract bioactive metabolites and their fractions will be tested to confirm the consistency of their bioactivity on model organisms. Results might influence our vision of niche resources and the validity of neutral models influencing biodiversity levels. In addition, we will test the hypothesis that stressors shaping the ecology of future oceans might also select specific strains of microalgae, characterized by uncommon physiologic properties, consequently producing indirect effects on such delicate ecosystems as seagrass meadows, by tuning chemical communications.

A NETWORK OF INVERTEBRATE-MICROBE ASSOCIATIONS FROM SEAGRASS BEDS

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Invertebrate-microbe associations can have profound effects on host ecology and evolution, and benthic biogeochemistry. These associations may be of particular relevance in seagrass ecosystems, because i) the association with specific microbes may confer their host the capacity to survive under anoxic and/or sulfidic sediment conditions, and ii) their augmented physiologies may underpin ecosystem functioning and seagrass productivity. Here, we built a bipartite network of invertebrate-microbe associations from seagrass beds based on a list of 275 seagrass-associated invertebrate genera. This list was compiled from recent catalogs for the Mediterranean Sea and used to download the data available in the NCBI nucleotide database. While only 28% of the genera were represented in the molecular database, indicating the wide scope for further research into this topic, we obtained a network with 112 nodes representing 53 host genera and 59 microbial groups. Segregating the hosts according to their environmental position (infauna vs epifauna) highlighted a widespread association of infauna with gammaproteobacteria, while eukaryotic microbes were predominantly associated with epifauna, reflecting the contrasting lifestyles of these host groups. At the same time, community analyses on the network allowed to preliminarily discriminate gradients from intimate (one host and few microbes) to loose (diverse) associations. Far from being complete, this network analysis allows to explore and interrogate the available data on invertebrate-microbe associations from seagrass beds and can provide the foundation for further research and discovery. The same approach can further be applied to other systems, widening the applicability of this study.

EFFECTS OF EPISODIC ANOMALOUSLY INTENSE RAINFALL EVENTS ON RIVER AND LAGOON SEDIMENTARY ORGANIC MATTER QUANTITY, COMPOSITION AND DEGRADATION RATES

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Due to climate change, extreme meteorological events have become progressively more frequent, with dramatic consequences affecting ecosystems and humans' wellbeing. To provide insights on the effects of intense rainfall events on aquatic ecosystems, using a before-after sampling design, we tested the null hypothesis by which quantity, biochemical composition, and degradation rates of organic matter (OM) in river and lagoon sediments do not vary after anomalously intense rainfall events. During a monthly survey conducted between October 2019 and October 2020, we identified two major rainfall events (November 2019 and January 2020). In river sites biopolymeric C sedimentary contents did not vary after the event in November and slightly decreased after that in January (about 15-20%), whereas in lagoon sites they increased after the event in November (50-210%) but decreased (by 86%) after the one in January only in the internal lagoon site. In both ecosystems OM biochemical composition varied after the events, whereas protease activities decreased significantly only after the event in January. Our results suggest that anomalous rainfall events can determine significant, though variable, changes in sedimentary OM quantity and biochemical composition and affect also rates of C degradation rates with possible negative impacts on the ecosystem functioning of these aquatic systems. This study has been carried out as a part of the project "*Effects of climate environmental shifts on species, communities and ecosystems*", funded by Fondazione di Sardegna (2018; F74I19000980007).

VERTICAL VARIATION OF CORALLIGENOUS CLIFF ASSEMBLAGES IN MARINE BIOGEOGRAPHIC AREAS

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Estimating spatial patterns of variability in coastal marine priority habitats may allow to plan monitoring programs and impact evaluation studies and to optimize sampling designs in environmental investigations. In this study, the spatial variability of the vertical distribution (18 m, 23 m, 28 m, 33 m, and 38 m of depth) of coralligenous cliff assemblages was estimated in three marine biogeographic areas of the Mediterranean Sea: the Sardinia Sea, the Tyrrhenian Sea, and the Bonifacio Strait. Sampling sites were selected in the West, North, and East coast of Sardinia all in pristine conditions (far from any anthropogenic source of influence and in highly oligotrophic). Important variations among areas in the vertical zonation of the coralligenous cliffs have emerged, especially at shallow depths, and the dominant taxa have been highlighted. Despite these inconsistencies, a common increase in the number of taxa/groups per sample was found with depth. Thermal environment and hydrodynamics can be discussed as the most likely important drivers of such variability. Overall, these data support the hypothesis that pristine coralligenous cliff assemblages may have relevant different structures and indicate that the lack of gorgonians and bryozoans (commonly used as ecological indicators) is not necessarily a sign of local human impact, but can be the result of biogeographic patterns.

ECOLOGICAL IMPLICATION AND POSSIBLE APPLICATION OF ALLELOPATHIC COMPOUNDS PRODUCED BY MARINE ORGANISMS

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Allelopathic interactions are likely to play an important role in species' successions. Field and laboratory studies have been shown that marine algae, particularly diatoms, produce allelopathic compounds with high structural variability, including the polyunsaturated aldehydes (PUAs). Negative effects on the reproduction of marine organisms exposed to PUAs have been observed (e.g. reduction in survival, egg production, and hatching success), including predators such as copepods. Additionally, changes in growth, cell membrane permeability, and cell morphology in some microalgal species exposed to PUAs have been reported. While research efforts until now have been focused mainly on the interactions between planktonic species, my study is focused on the benthic environment and the involvement of macroalgae in terms of allelochemicals production and of their role in the interaction with other benthic organisms, such as meiobenthos and microalgae. Specifically, two macroalgae, *Cystoseira compressa*, and *Dictyopteris polypodioides* were sampled and quali-quantitative analyzed for PUAs' profile and their microphyte- and meiobenthic communities. PUAs results showed differences between the two algae and between the associated microalgal and meiobenthic communities, leading to hypothesize that PUAs may trigger complex cascading effects in the food web within the benthic environment.

ARE METABARCODING DATA USEFUL TO RECONSTRUCT FOOD WEBS IN PELAGIC SYSTEMS?

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The use of metabarcoding on water samples for the study of biodiversity has led to a huge production of data that are still partially explored, especially for what concerns the structure of communities. Metabarcoding data are mainly used to derive statistical co-occurrence networks, which can show how a community is divided into sub-communities of organisms frequently found together. In this study, we explore the usefulness of this type of data with the aim of understanding if and to what extent such co-occurrences can be informative for trophic interactions and food web structure. We analyzed two co-occurrence networks present in published databases describing winter and autumn pelagic communities from Monterey Bay (California). In a first step, by revising the literature about the biological characteristics and diets of the taxa detected by the metabarcoding analyses, we i) assigned to each co-occurrence between taxa a 'trophic-plausibility-rank', and ii) used the most plausible links to assemble trophic networks (i.e., meta-food-webs). Overall, we found a total of ~39% and ~28% of potentially trophic interactions within the winter and autumn networks, respectively. Furthermore, 90% and 100% of the obtained winter and autumn trophic networks were composed of planktonic interactions with a relevant presence of mixotrophic organisms participating in several trophic cycles. We then analyzed the structural properties and the roles of the main trophic players of these networks and found that the structure of metabarcoding-derived food webs showed a trophic hierarchy that is generally found in planktonic food webs derived from different methods and approaches.

THE “MIXOPLANKTON” OF CAMPANIA COASTS: A SURVEY THROUGH THEIR BIODIVERSITY AND ROLE PLAYED IN THE ECOSYSTEM FUNCTIONING

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Protistan plankton (i.e., unicellular eukaryotes) are traditionally classified as either phytoplankton or micro-zooplankton. However, over the last decade, the understanding of the marine food web has been increasingly improved and the phytoplankton-zooplankton dichotomy appeared as an outdated simplification. Most protistan planktons are indeed mixotrophs, capable of both photosynthesis and phagocytosis, and they are more frequently referred to as members of the functional group defined as “mixoplankton”. Based on their innate or acquired ability to photosynthesize, mixoplankton are categorized as either constitutive (CMs) or non-constitutive (NCMs) mixotrophs, respectively. In virtue of their innate biological properties, these organisms are considered important players in the planktonic food webs, as they can induce a substantial switch in the pathway of the overall carbon fluxes. Given the growing interest in mixoplankton, in the frame of the project IISPA-FEAMP, we are assessing the status of the mixoplankton compartment along with the cost of the Campania region, by analyzing water samples collected in the Gulfs of Naples, Salerno e Gaeta, with the main categories resulting to be important members of both ciliate (e.g., Strombidium, Tontonia, Mesodinium) and dinoflagellate taxa. Herein, we assess the current awareness on mixotrophic dinoflagellates and ciliates, with special reference to their role in marine food webs, by comparing literature data on the structure and abundance in the observed systems, and envision the potential role of these organisms in the planktonic food-web and, consequently, in the ecosystem functioning.

MARINE CLADOCERANS AND THEIR BIOLOGICAL ROLE IN LINKING BENTHIC AND PELAGIC HABITATS: SPECIES SEASONALITY AND RESTING EGG PRODUCTION

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Cladocerans, which are an important zooplankton group in marine coastal regions, contribute to the benthic-pelagic coupling thanks to their life cycle that includes the production of resting eggs. The growth, demise and resurgence of cladoceran populations and their demographic structure were followed from February 2019 to February 2021 in the inner Gulf of Naples at site LTER-MC, in zooplankton and sediment samples. Main findings highlighted: 1) the seasonal patterns of five species occurring from spring through summer/autumn; 2) the dominance of *Penilia avirostris* representing 61% and 77% of the total cladoceran abundance in the two years, respectively, 3) the highest parthenogenic female fecundity detected for *Pseudevadne tergestina* and *P. avirostris,* 4) the highest concentration of resting eggs for *P. tergestina* in the water column and for *P. avirostris* in the sediments. This study hints to the different occurrence of sexual reproduction in the cladoceran species present in the Gulf and reveals, for the first time, the contribution of their eggs to the resting stages bank in the area.

BACTERIA AND PHYTOPLANKTON IN THE SEA: CO-OCCURRENCE AND POSSIBLE INTERACTIONS

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Marine microbes include bacteria as well as phytoplankton. Although both have been investigated in terms of taxonomy, physiology, metabolism and their role in biogeochemical cycles, the relationship with one another is still little known. This relationship is often governed by microscale interactions played out within the region surrounding phytoplankton cells, called phycosphere. Phytoplankton can interact with free bacteria but also maintain attached bacteria on their surface. Such communities may differ in composition from their free-living counterparts, largely because different phytoplankton species release a wide spectrum of compounds to the surrounding medium. We have analyzed phytoplankton net samples from a fixed station in the Gulf of Naples (Italy) sampled weekly by Scanning Electron Microscopy (SEM), in order to observe occurrence of bacteria attached to phytoplankton with the hypothesis that these would change in quantity and morphotype depending on the season and the phytoplankton concentration. We found little bacteria attached to diatoms and no correlation between them and abundance of any diatom species neither during nor after the spring algal bloom. Similarly, we have sampled phytoplankton in the Adriatic Sea during a late-winter algal bloom with the aim of characterizing by HTS and comparing bacterial communities living free versus those attached to particles, during a diatom bloom, when most of particles were diatoms. We observed a clear separation between the bacterial communities associated with phytoplankton and free-living bacteria, which suggests that particle-attached bacterial communities are structured differently than free-living one, probably based upon interactions within microbes possibly mediated by secondary metabolites.

PARASITES DYNAMICS IN ADRIATIC SCYPHOMEDUSAE: THE CASE OF *RHIZOSTOMA PULMO* (MACRI, 1778) FROM THE GULF OF TRIESTE

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Marine parasites are an important but often neglected component of ecosystems. This is particularly true for cnidarian parasites and their life cycles; few evidences of trophic transmission of trematodes from jellyfish to fish have been reported. This context inspired our idea of investigating one of the most complex and diffused jellyfish in the Mediterranean Sea, *Rhizostoma pulmo.*

This work is the first attempt to study Trematoda parasites in Adriatic scyphomedusae. The goals are to 1) determine prevalence and intensity of metacercariae in *Rhizostoma pulmo*, 2) identify the species involved through morphological and molecular analysis, 3) test whether infection parameters change in different body parts and in relation to jellyfish size. While waiting for molecular results, all parasites morphologically investigated potentially belonged to the genus *Opechona*. The total number of parasites varied between 18.7±6.7 parasite per individual in 0-2 cm diameter jellyfish up to 510.2±136.4 parasites in larger ones. The 100% of infected individuals suggests that *R. pulmo* is a true host of digenetic trematodes, at least for this *Opechona sp.*, and therefore important for their life cycle in the region. This also supports the theory that fish predate on *Rhizostoma p.*, since trophic interactions are necessary for this genus to complete their cycles. Parasitology may be another way to investigate fish-jellyfish predation, integrating methods like gut contents and stable isotopes analysis. Further aspects should be investigated such as the characterization of parasites life cycle, the differences between the scyphozoan species and the potential role of blooms as elevators for parasites towards the fish compartment.

ALL IS FISH THAT COMES TO THE NET: METABARCODING FOR RAPID FISHERIES CATCH ASSESSMENT

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Monitoring marine resource exploitation is a key activity in fisheries science and biodiversity conservation. Since research surveys are time consuming and costly, fishery-dependent data (i.e., derived directly from fishing vessels) are increasingly credited with a key role in expanding the reach of ocean monitoring. Fishing vessels may be seen as widely ranging data-collecting platforms, which could act as a fleet of sentinels for monitoring marine life, in particular exploited stocks. We investigated the possibility of assessing catch composition of single hauls carried out by trawlers by applying DNA metabarcoding to the dense water draining from fishing nets just after the end of hauling operations (called "slush" water). We assessed the performance of this approach in portraying β-diversity and examining the quantitative relationship between species abundances in the catch and DNA amount in the slush (read counts generated by amplicon sequencing). We demonstrated that the assemblages identified using DNA in the slush satisfactorily mirror those returned by visual inspection of net content (about 71% of species and 86% of families of fish) and detected a strong relationship between read counts and species abundances in the catch. We therefore argue that this approach could be upscaled to serve as a powerful source of information on the structure of demersal assemblages and the impact of fisheries.

ASSESSMENT OF ODONTOCETES-FISHERY COMPETITION IN THE GULF OF TARANTO (NORTHERN IONIAN SEA, CENTRAL MEDITERRANEAN)

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Assessing odontocetes-fishery competition for food resources is crucial mostly in areas where human activities affect the marine environment in complex ways. Such competition has been investigated in the Gulf of Taranto (Northern Ionian Sea, Central Mediterranean) by means of the niche overlapping between odontocetes and fishing métier (Fishery Overlap index) estimated from an Ecopath food-web model applied on 51 functional groups and catches (landings and discard) by fishing métier as obtained from the EU Data Collection Framework and literature. In the area, the stable occurrence of *Stenella coeruleoalba*, *Tursiops truncatus*, *Physeter macrocephalus* and *Grampus griseus* is reported together with a fishery exploitation characterized by trawling, passive nets, longlines, purse seine and mixed gears (small scale fishery).

The resources overlap estimated on the total catches was higher for *T. truncatus* and *S. coeruleoalba* than for *P. macrocephalus* and *G. griseus*. Considering the total landings, the assessment has shown low or absent conflict between fishing exploitation and odontocetes. In fact, only *T. truncatus* showed significant overlap with mixed gears and purse seine in the investigated area.

Further analysis is necessary and local information about feeding preferences in odontocetes, their spatial distribution as well as on fishing effort displacement could reinforce those outcomes.

MONITORING NON-INDIGENOUS SPECIES IN PORT HABITATS: THE APPLICATION OF THE SMITHSONIAN PROTOCOL IN ITALY

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Non-indigenous species (NIS) are a global threat to marine ecosystems and biodiversity. The maritime traffic is considered one of the most important mechanism of NIS introduction and consequently ports are defined as high-risk areas. In the Mediterranean Sea an agreed-upon standardized method for baseline NIS monitoring in ports has not been developed yet, thus preventing the collection of homogenous data. We applied, for the first time in the Mediterranean Sea, a protocol developed and employed by the Smithsonian Environmental Research Center (SERC) for over 20-years along the American coasts to assess fouling communities across time and space, with a focus on NIS presence and abundance. We monitored five ports in the Gulf of La Spezia from 2018 to 2020, deploying a total of 50 PVC plates per year, horizontally attached to a brick facing downwards and immersed for three months during the summer season. After the submersion period, the sessile fauna attached on the plates was identified and the percent cover assessed. A total of 79 taxa were identified, including 11 NIS, belonging to Bryozoa, Annelida, Porifera and Tunicata. Mean NIS percent cover was the highest in the site near the commercial harbour of La Spezia (85±50%) and the lowest one in the marina of Porto Venere (17±23%), the farthest site from the harbour. SERC protocol resulted suitable also in the Mediterranean context and its main advantages include cost effectiveness, ease of application and possibility to obtain quantitative results in a reasonably short time.

EFFECTS OF MICROPLASTICS ON THE FUNCTIONAL TRAITS OF AQUATIC ORGANISMS: A META-ANALYSIS

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Microplastics are widespread in the aquatic environment and thus available for many organisms at different trophic levels. Many scientific papers have focused their attention on the study of the effects of microplastics on different species at individual level. Here we performed two global meta-analysis focusing on the study of the effect of microplastics on functional traits of aquatic organisms. We built two separate dataset - including both benthic organisms and fish - and analysed the overall effect of microplastics on a selected set of functional traits. We performed subgroup analyses to investigate the influence of habitat, taxa or species and used a meta-regression approach to explore possible correlation between effect size and organisms' dimension. Results show that microplastics may have a negative effect on functional traits of both benthic organisms and fish. Even with some differences between the two datasets, microplastics might impact the capacity of the organisms to assimilate energy. This depletion may result in the reduction of the metabolic resources with direct impact on performance traits (i.e. growth, mortality and reproduction) and therefore on individual fitness. Nonetheless, depending on their life stage, organisms may be more sensitive to microplastics pollution undergoing changes in growth rates, development of early life stage and behavioural patterns. We discussed how direct impact on organismal performance may have indirect rebounds at higher levels in the ecological hierarchy having a negative effect on the structure and functions of aquatic ecosystem and representing a risk for its stability and functioning.

DEVELOPMENT OF AN INNOVATIVE MARINE LITTER MONITORING METHODOLOGY IN MEDITERRANEAN MARINE PROTECTED AREAS WITHIN THE PLASTIC BUSTERS MPAS PROJECT

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The Plastic Busters MPAs - Interreg Med Project aims to conserve biodiversity and preserve natural ecosystems in pelagic and coastal Mediterranean Protected Areas by monitoring and tackling plastic pollution through the development and implementation of harmonized approaches. Following these objectives, an innovative sampling methodology was developed and applied to evaluate the abundance of floating marine litter in the SPAMI Pelagos Sanctuary and the Tuscan Archipelago National Park. In collaboration with Cima Foundation and ISPRA, two sampling campaigns were carried out by the University of Siena. Considering the potential plastic sources (e.g. harbour activities and riverine inputs) and the hydrodynamic features that may insist on these areas, an innovative sampling plan provided for a simultaneous visual survey of macrolitter monitoring and microlitter collection using a manta net. The transects performed were guided by a provisional daily plastic distribution model. A total of 273 macrolitter monitoring transects and 141 neustonic samples were collected in the selected areas. Plastic represents the most surveyed category, with an average density of 7.9±9.1 items/transect. More than 40,000 microparticles (avg. density 0.26±0.59 items/m^2) were isolated and physically and chemically characterized. Fragments and polyolefin polymers resulted in the most abundant classes. A density distribution correlation (r = 0,63) between macro- and microlitter was highlighted by the statistical analysis confirming the validity of the proposed methodological approach. This study pointed out the presence and the occurrence of floating marine litter in two ecological valuable areas, providing a scientific basis for tackling plastic pollution in MPAs and facilitate management recommendations.

PLASTIC LITTER AND INCREASED ATMOSPHERIC NITROGEN DEPOSITION AFFECT THE VEGETATIVE RECRUITMENT OF COASTAL DUNE PLANTS

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Beach-dune systems act as a sink of non-biodegradable plastics, and they could accumulate even biodegradable plastics in the future. The effects of these plastics on recruitment of dune plants by vegetative propagules are unknown. Moreover, whether plastics interact with increased atmospheric nitrogen (N) deposition, a global driver of plant biodiversity loss, in influencing dune plant communities, and how plant-plant interactions mediate their effects need to be investigated. By using one-year field experiment, we assessed individual and combined effects of plastics (non-biodegradable, biodegradable), N deposition (ambient, elevated) and biotic condition (no interaction, interaction with a conspecific or a heterospecific) on colonization success and growth of vegetative propagules of two dune plants, *Thinopyrum junceum* and *Sporobolus pumilus*, which co-occur along Mediterranean dunes and differ in ecological role (dune- *vs.* non-dune-building) and photosynthetic pathway (C3 *vs.* C4). Non-biodegradable plastic reduced survival probability of both species up to 100%. Elevated N and biodegradable plastic decreased *T. junceum* shoot biomass when grown alone and with a conspecific, respectively, and in combination they mitigated their negative individual effects on roots. Biodegradable plastic increased *S. pumilus* shoot and root biomass and, when combined with elevated N, enhanced biomass investment in belowground than aboveground organs. These findings suggest that non-biodegradable plastic may represent a threat to dunes by reducing plant colonization. They also indicate that biodegradable plastic and increased N could favor the generalist *S. pumilus* and hinder the dune-building *T. junceum*. Overall, this study underlines the need of preventing plastic accumulation on beaches and reducing N input.

LEAF LITTER DECOMPOSITION PROCESS ALONG THE PO RIVER: A MULTILEVEL APPROACH TO INVESTIGATE THE EFFECTS OF GLOBAL CLIMATE CHANGE

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Leaf litter decomposition has been proposed as a useful approach to assess river ecosystems functionality. Since the occurrence of dry events is becoming increasingly frequent also in those streams that were previously considered perennial (Alpine streams for example) the aim of this study was to investigate to what extent leaf litter decomposition processes are affected by climate change. We adopted the leaf bags technique in four different sampling sites along the Po river and we assessed: mass loss during time, Ash-Free Dry Mass (AFDM), macroinvertebrates and microconsumers community diversity and composition. We expect that: i) leaf litter decomposition is more efficient in sampling sites where water was present during the whole experiment; ii) macroinvertebrate community is more diverse in the sites where dry events did not occur; iii) microconsumers are negatively affected by water loss because of desiccation. Microconsumers diversity is expected to be lower in sites that experienced dry phases and, consequently, coarse particulate organic matter degradation will be lower and less efficient; iv) there would be a sort of gradient from upstream to downstream: the site located above the tree line has a pristine stream condition, water would be present during the whole experiment and CPOM decomposition would be fast and efficient. Going downstream the situation would be clearly different, especially for the sampling sites located most downstream, where dry events are likely to occur, slowing down litter breakdown and leading to a poor macroinvertebrates and micronsumers community.

THERMAL REGIME OF ALPINE STREAMS: CONTROLS AND ECOLOGICAL EFFECTS ON THE BIOLOGICAL COMMUNITY IN NATURAL AND REGULATED STREAMS

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Water temperature is recognized as one of the most important drivers in stream ecosystems. However, its effects on biodiversity and ecosystem functioning have been rarely investigated and few quantitative information about the natural thermal regime are available. The effects of thermal alterations are rarely disentangled from those related to other kinds of pressures such as water diversion for hydroelectric power generation. In the present study, four streams belonging to the Alpine catchment of Serio River (BG, Italy) are being monitored. Selected streams are representative of different natural conditions (snow-melt/storm-water and groundwater-fed streams) and human alterations (none, reservoirs and run of river power plant). Previously collected data, with air temperature and topographic information, have been used to produce quantitative models able to predict the daily temperature of stream water. Now, a detailed monitoring of macroinvertebrate communities is being carried out. Therefore, macroinvertebrates samples were collected monthly in the different streams to evaluate the ecological effect of the thermal regime in the life cycle, the growth rates and the macroinvertebrate biodiversity distribution; preliminary results will be presented. Further, photosynthetic efficiency in selected sites of the concerned watercourses is being measured by PAM to assess the response of the phytobenthonic component.

TOOLS TO ASSESS FLOW-ECOLOGY RELATIONSHIP IN RIVERS: MULTIPLE STRESSORS IMPACTS ON FUNCTION AND DIVERSITY OF A RIVER NETWORK

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Anthropogenic impacts and hydromorphological alterations modify habitat integrity and connectivity, which support aquatic ecosystems and biodiversity. We assembled a dataset including macroinvertebrate field data collected between 2009 and 2019 from 161 sampling sites, distributed over 90 rivers/streams in Trentino. We characterized each site by environmental characteristics (e.g., season, elevation, distance from source/ Strahler number, stream typology) and, we classified it according to a a-priori known "status", based on the presence of: i) hydrological alterations: hydropeaking and/or minimum vital flow; ii) morphological alterations: channelization, artificial embankments, barriers, etc..); iii) chemical alterations; iv) the co-occurrence of two or more alteration types. To achieve this classification, we used the water quality LIMECO index and the morphological quality index (IQM), and verified our classification with the expert evaluation of APPA-TN. Pressures were categorized and assigned to each site as follows: (a) reference sites; (b) unpolluted BUT hydrologically altered, (c) polluted BUT not hydrologically altered, (d) polluted AND hydrologically altered; e) unpolluted BUT morphological altered, (f) unpolluted BUT hydromorphological altered, (g) polluted AND morphological altered, (h) polluted AND hydromorphological altered. Hydromorphological impacts resulted the most common pressure which significatively affect the Adige watershed. Third, we investigated patterns in benthic community under the different pressure categories to assess relationships between functional structure and the ecologically-relevant environmental components in altered conditions. Understand the responses of benthic communities to hydromorphological disturbances regardless of their sensitivity to water pollution can be a useful tool in the assessment of the ecological status and water management of Alpine running waters.

THE ECOLOGICAL ROLE OF THE SEA CUCUMBER *Holothuria tubulosa* ON THE NUTRIENT CYCLING

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To explore the potential use of *Holothuria tubulosa* (Gmelin, 1791), among the most common and commercially exploited sea cucumbers in the Mediterranean Sea, as a tool for remediating adverse sedimentary organic matter accumulation due to benthic eutrophication, I investigated contents and degradation rates of sedimentary proteins extracted from the esophagus and the end gut of sea cucumbers collected at the two sampling sites characterized by contrasting sediment grain size and sedimentary organic matter contents. In sea cucumbers collected from both sites, the protein contents and degradation rates in sediments extracted from the esophagus were higher than those in the end gut. Also, the potential protein turnover time decreased from the esophagus and the end gut. Altogether, these results suggest that this sea cucumber has the potential to assimilate an average of 35% (comprised between 10 and 75%) of the ingested sedimentary proteins. As observed for other holothurians from the deep sea, the results of this study stimulate further experimental research to evaluate *H. tubulosa* use for amending organically polluted sediments. Research conducted under the the frame of the project “Marine habitats restoration in a climate change-impaired Mediterranean Sea [MAHRES]” (PRIN 2017; 2017MHHWBN).

LOCAL PLASTICITY OF *NUPHAR LUTEA* IN A EUTROPHIC SHALLOW LAKE

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Macrophytes are getting increasing attention because of their multiple roles in aquatic ecosystems. However, eutrophication, invasive species and habitat degradation are threatening macrophytes and freshwaters globally. In this context, the use of functional traits can give more quantitatively translatable information than the traditionally adopted taxonomic approach about their ecosystem functions and community dynamics.
Here, we incorporate a local patterns approach (hundreds of meters) into trait-based macrophytes investigation, focusing on yellow water lily (*Nuphar lutea* (L.) Sm.). Our aim is to quantify the intra-specific plasticity of a wide set of functional traits (including leaf economic spectrum and pigments), integrated with genetic and spectral reflectance data, linking to ecological patterns. Data were collected from a hyper-eutrophic shallow lake, Chiusi Lake (Tuscany, Italy). We found support for meso-scale patterns along the main environmental gradients, expressed in terms of water depth, conductivity, and sediment features.
A preliminary RDA analysis confirmed what previous studies had shown, namely that the two main axes of traits variation are related to dimensional traits (leaf weight – LW – and area – LA) on one axis, and Leaf Dry Matter Content (LDMC) and Specific Leaf Area on the other. We found that LW and LA, including the contribution of petioles, are positively related to water depth, while leaf pigments content shows a strong relation to water conductivity and sediment phosphorus.
This evidence suggests a relevant environmental filtering force on intra-specific responses to abiotic factors and reinforces the key contribution of intraspecific trait variability to shed light on spatial patterns within ecosystems.

Session I

Biodiversity and Ecosystem Functioning

Flash Talk

SIZE STRUCTURE OF POPULATION OF *PINNA NOBILIS* IN THE MAR PICCOLO OF TARANTO

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This study aimed to characterize the size structure of the population of pen shell *Pinna nobilis* (Linnaeus, 1758) in the Mar Piccolo of Taranto, subjected to a translocation program planned in the framework of urgent intervention for remediation, environmental enhancement, and upgrading of Site of National Interest (SIN) Taranto by the Special Commissioner for Remediation. According to the protocol, authorized by the National Ministry for Environment, Land and Sea Protection (MATTM), each pen shell was carefully detached from the seabed avoiding injury or damage, mainly to the byssus, by a team of specialized SCUBA divers. Subsequently, each individual, placed in a plastic tank with seawater, was soon moved by the board and settled in the translocation area. Biometric data of total shell length (TL) and maximum shell width (SW) were collected for each specimen through a metric board before their set in the new site. A total of 5590 specimens of *P. nobilis* were translocated from June 2016 to June 2017. The total shell length values ranged between 9.5 and 71.0 cm with a mean value of 27.3±9.0 cm. The maximum shell width ranged between 3.8 and 25.0 cm with a mean value of 11.9±3.0 cm. The size-frequency distribution of TL showed about 47% of specimens ranging from 20 and 28 cm TL.

CORALLIGENOUS REEF ASSEMBLAGES BIODIVERSITY: IDENTIFICATION OF CRUSTOSE CORALLINE ALGAL SPECIES IN DIFFERENT SARDINIA BIOGEOGRAPHIC AREAS

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Crustose Coralline Algae (CCA) are the main bio-constructors of the coralligenous reefs, one of the main coastal habitats of the Mediterranean Sea. Thus, the taxonomic identification of coralligenous CCA species is to be considered crucial to understanding bioconstruction features and connectivity of this widely distributed habitat. The importance and vulnerability of coralligenous reefs have been recognized by the European Community and more attention has been drawn to their investigation and conservation. In this study, we present data about species identification of CCA collected at two different depth (35m and 25m ± 1) in four sites of Sardinia belonging to three different bio-geographical regions: Asinara Island in the Sardinia Sea, Costa Paradiso in Bonifacio Strait, Tavolara Island, and Capo Carbonara in the Tyrrhenian Sea. The taxonomic identification was confirmed through molecular analysis. The results of this explorative study highlighted the presence of the genus *Mesophyllum* at Asinara, Costa Paradiso, and Tavolara, the genus *Lithophyllum* at Costa Paradiso and Capo Carbonara, *Lithothamnion* at Tavolara at 35m of depth. Unidentified CCA belonging to the order *Hapalidiales* were found at a depth of 35m in Costa Paradiso. This first exploration allowed us to identify the more common CCA species of Sardinian coralligenous reefs, providing useful information to plan further correlative and experimental investigations.

SPECIES DISTRIBUTION MODEL AND RISK ASSESSMENT TO SUPPORT CETACEAN CONSERVATION MEASURES IN THE CENTRAL MEDITERRANEAN SEA

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Risk and vulnerability assessment is of recent application in the context of cetacean conservation plans. Species Distribution Models (SDM) are valuable tools to both identify species suitable habitats and to design risk maps to detect potential areas where conflicts with anthropogenic activities can occur. In this work, the presence, the distribution, and the habitat preference of the cetacean *Tursiops truncatus* were evaluated on a seasonal basis in the central Mediterranean Sea, using occurrence data collected on board of passenger ferries (FLT Med Monitoring Network project, ISPRA). Maritime traffic was also recorded and characterized, and the risk assessment analysis was performed. The species was regularly sighted during the 7 years of the study (2013-2019). MaxEnt analyses allowed to creation of models with good predictive capability (AUC>0.80), showing that distance from the coast, bathymetry, and sea surface temperature were relevant environmental variables shaping the species habitat. Ustica Island, together with Tunisian and Sicilian coasts were detected as the most suitable areas, with high seasonal differences in the last district. The potential risk represented by maritime traffic was higher in the Sicily Channel central part, along the Sicilian southern coasts, and near Egadi Islands. Our results underline the importance of the study area for *T. truncatus*, species considered vulnerable by the IUCN Red List, highlighting a seasonal pattern in habitat use and the risk likelihood. The main outcome further confirms the importance of these tools to more effectively guide the decision process for conservation actions.

NATURE-BASED SOLUTIONS FOR THE CONSERVATION OF MARINE BIODIVERSITY IN FUTURE CLIMATE CHANGE SCENARIOS

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Global and local stressors are the major causes of the current crisis of marine biodiversity, affecting ecologically important species, such as habitat formers and compromising the productivity of entire ecosystems. In this context, positive interspecific interactions can buffer the negative impact of environmental stressors on natural communities by improving their tolerance to harsh conditions. Therefore, harnessing positive interactions is a useful approach for ecosystem restoration in the context of ongoing global change.
The study aims to evaluate how increasing temperature influences the recruitment and growth of seaweeds of the genus *Cystoseira* and how different compositions of biofilm assemblages occurring on the substrate, themselves shaped by temperature, may positively or negatively affect their response to this stressor. To estimate it, aragonite topped supports will be deployed in the field for colonization by biofilm in three contrasting conditions: polluted, intermediate, and 'pristine' subtidal environment. Once colonized, the supports will be moved to laboratory tanks and exposed to different temperature conditions. In the meanwhile, the mature receptacles of *Cystoseira* will be collected and moved to the tanks allowing the gamete release on biofilm-colonized supports. The settlement and the germling survival rate will be assessed together with the biofilms' composition.
Whether the presence of biofilm on the substrate facilitates or hinder the recruitment of *Cystoseira* and which of these contrasting potential influences would prevail depending on the composition of biofilm assemblages is not yet known, but such a knowledge would have important implications for the success of conservation strategies focused on such habitat-forming macroalgae.

THE ROLE OF ECOSYSTEM ENGINEER DENSITY IN DRIVING ECOSYSTEM FUNCTIONING: A BIVALVE CASE STUDY ACROSS INTERTIDAL ROCKY SHORES

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Worldwide ecosystem engineer aggregations - as marine mussels - create stable local conditions both modulating energy fluxes and offering refuge for other species. They represent biodiversity hotspots as hosting communities characterized by higher values of species richness and diversity, when compared with adjacent communities. Such local aggregations of species based on ecosystem engineers offer great opportunities to infer around the relationship between biodiversity and ecosystem functioning (BEF) and to increase our understanding on ecological interactions and the ability to provide ecosystem goods and services. Here, we studied how three levels of density of the ecosystem engineer *Mitylaster minimus*, an intertidal bivalve, were able to affect the associated functional diversity (i.e. feeding trait-based diversity) and ecosystem productivity (i.e. sediment quality and quantity measured as Chl-a and biopolymeric carbon) at two intertidal rocky shores in Sicily. Our results highlighted a linear positive relationship between the density of bivalves and the associated functional diversity, with carnivores, grazers, deposit- and detritus-feeders increasing with the density of *M. minimus*. Similarly, the sedimentary composition changed positively with density up a density threshold characterized by constant values of quality and quantity. The same pattern was clear looking at the interactions between functional diversity and sediment quality, suggesting the importance of *M. minimus* density in modulating the ecosystem functioning. Outputs from this study offer new insights about the role of organismal density in driving the BEF and provide a useful baseline to inform biodiversity monitoring when designing management strategies.

Session II

Transitional and coastal waters ecology

Full Talk

SPATIAL PRIORITIZATION FOR FUCALEAN BROWN ALGAE FORESTS RESTORATION IN THE MEDITERRANEAN SEA

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In the marine environment, the processes of site selection and spatial planning have received scarce attention. Yet, beyond applying the most effective restoration techniques, spatial prioritization is critical to guide marine restoration efforts at large scale.

The loss of fucalean brown algae forests across the Mediterranean Sea is largely affecting the status of coastal ecosystems with severe effects on the associated ecosystem services. Introducing spatial prioritization to identify areas conducive to the forests recovery is strategic to support more effective restoration actions.

We adopted a multi-criteria analysis, overlaying three levels of information relevant to select areas where fucalean seaweeds restoration is likely to be effective: 1) absence areas, areas where the algae was present in the past and regression areas (by comparing the current and historical forests distribution); 2) suitable areas for hosting fucalean species (by developing a Habitat Suitability Model); 3) biotic, abiotic and socio-economic variables to assess the feasibility of restoration activities.

Our analysis allowed the prioritization of 242 sites spread across the Mediterranean basin and classified them into 5 priority classes: very low, low, moderate, high and very high priority. Within the highest priority class, only 10 sites were indicated as the best candidates for pilot restoration actions for these brown algae forests. Our results highlighted the large number of constraints in finding areas feasible for restoration and the high potential of introducing the spatial planning principles in marine restoration initiatives.

THE EFFECTS OF HYDROLOGICAL EXTREMES ON DENITRIFICATION, DISSIMILATORY NITRATE REDUCTION TO AMMONIUM (DNRA) AND MINERALIZATION IN A COASTAL LAGOON

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Hydrological extremes of unusually high or low river discharge may deeply affect the biogeochemistry of coastal lagoons, but their effects are poorly explored. In this study, microbial nitrogen processes were analyzed at three sites in the eutrophic Sacca di Goro lagoon (Northern Adriatic Sea) both under high discharge (spring) and after prolonged low discharge (late-summer) of the main freshwater inputs.

Under high discharge/nitrate load, denitrification was the leading process and there was no internal recycling. The site located at the mouth of the main freshwater input and characterized by low salinity showed the highest denitrification rate, mostly sustained by nitrification stimulated by burrowing macrofauna. In contrast, recycling processes dominated under low discharge, when denitrification dropped at all sites due to low nitrate concentrations, reduced bioturbation and nitrification. The highest recycling was measured at the sites characterized by high salinity and particularly within a clam cultivated area. At this site, internal recycling was sustained by ammonification of biodeposits, bivalve excretion and dissimilatory nitrate reduction to ammonium (DNRA), which represented 30% of nitrate reduction.

Flash floods and high nitrate loads may overwhelm the denitrification capacity of the lagoon due to the reduced residence time and to the saturation of microbial enzymatic activity, resulting in high transport of nitrate to the sea. Prolonged dry periods favor large internal recycling, due to a combination of high temperatures, low oxygen solubility and low bioturbation, which may prolong the extent of algal blooms with negative effects on lagoon biogeochemical services.

APPLICATIONS OF 'NEW' TECHNOLOGICAL SOLUTIONS FOR ANALYZING NEKTONIC COMMUNITIES IN THE DEEPEST AREAS OF THE VENICE LAGOON

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At an international level, increasing importance is given to the ecological assessment of transitional waters, like lagoons and estuaries. The nektonic communities of these environments are studied mainly in the shallow water areas, whereas the deepest areas remained less analyzed. In the Venice lagoon, for instance, all the fishing gears used for sampling the nekton, as gillnets and traps are forbidden in the main channels, typically used by maritime transport. The three inlets that link the lagoon and the Adriatic Sea play an important role in terms of exchanging of marine organisms between the sea and the lagoon and vice versa. Within this context, we propose the use of active acoustics, in order to analyze the nekton assemblages, to improve the understanding of the ecological role of the main lagoon channels. The inlets and the adjacent deep channels have been explored by using a scientific echo-sounder, endowed of split beam and broad band technologies, to assess the living organism movement patterns as well as their biomass. First results showed that the three inlets have a different composition in terms of fish density, probably because of their different deep and morphologic conformation. According to these observations it would be possible to suggest that the lagoon inlets could play a double role, as connection corridors with the sea, but also as habitat itself, nevertheless, in order to test this hypothesis, further monitoring surveys will be needed.

MECHANISMS DRIVING JUVENILES EELS' RECRUITMENT IN A SMALL ESTUARY OF THE TYRRHENIAN SEA

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The European eel, *Anguilla anguilla*, is a catadromous species of commercial importance. Its complex life cycle exposes its life stages to many risks, which, together with overexploitation, have determined their stocks' decline since the 1970s. To make light on the eel recruitment on a local scale, since 2017 dynamics of glass eels and elvers abundance were investigated in a small Tyrrhenian estuary (Rio Pramaera, Sardinia). The multivariate analysis of environmental factors including, among the others, water temperature, tides, oxygen availability, season, moon phases, and of the juveniles' abundance revealed that the greatest abundance of glass eels occurred in winter, when water temperature, tidal coefficient, moon phase and river mouth conditions explained most of the observed variation. Elvers' greatest abundance occurred in spring and was mostly explained by water temperature and dissolved oxygen availability.
My results suggest that the recruitment of juvenile eels can occur throughout the year with clear seasonal migration dynamics, but also that different factors are responsible for the peaks in abundance of the different life stages. As a corollary, I also report here a great variability of catches among the years and hypothesize that it could be related to the variability of marine currents facing the estuary.

Session III

Ecotoxicology

Full Talk

PHYSIOLOGICAL EFFECTS OF NICKEL IN TWO CONGENERIC COPEPOD SPECIES

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Copepods are ubiquitous small crustaceans, the most abundant components of mesozooplankton. Their ecological role as link between phytoplankton and higher consumers, makes them key organisms for investigating the effects of pollutants on alterations in biological and physiological processes (endpoints). The copepod *Acartia tonsa* is largely used in ecotoxicology to assess impacts of contaminants on marine biota. However, in the Mediterranean Sea, *A. tonsa* is an invasive species, introduced in the Adriatic Sea during the 80's through ballast waters, and potentially posing a threat for natural zooplankton communities in the area. The aim of our study is to compare physiological responses of *A. clausi*, the most abundant congeneric species in the Mediterranean Sea, with those of *A. tonsa,* when exposed to classic and emerging contaminants. The overall objective is to widen our knowledge on responses of *A. clausi* to anthropogenic toxicants and propose this species in ecological risk assessment of marine coastal areas where *A. tonsa* is not indigenous. We exposed both species to $NiCl_2$, a referent toxicant in standard ecotoxicology bioassays, and NiNPs (nickel nanoparticles), a recent emerging contaminant, under acute and chronic conditions. The standardised test protocols used for *A. tonsa* were applied to *A. clausi*, and physiological responses in terms of egg production, egg hatching success and larval mortality were assessed. Our preliminary results suggest that *A. clausi* might be more sensitive to toxicants with respect to *A. tonsa*; however, optimal rearing protocols should be better established in order to make this a suitable species for ecotoxicology assays.

UNRAVELLING THE EFFECTS OF MICROPLASTIC-ASSOCIATE BIOFILM IN THE UPTAKE AND IMMUNOLOGICAL RESPONSE IN THE SEA URCHIN *PARACENTROTUS LIVIDUS*

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Thanks to their peculiar surface properties, microplastics (<5 mm, MPs) are colonized by a microbial biofilm, representing a new habitat with a distinct biological community, known as “plastisphere”. Such colonization contributes to the continuous transformation of MPs in the marine environment. Although the microbial biofilm growing on MPs has been the object of several investigations, little is known about how this might affect MPs interaction and response in marine organisms. To this aim, adult sea urchins *Paracentrotus lividus* were exposed to either virgin or biofilm-covered polystyrene microbeads (micro-PS, 45µm) and the effect of microbial colonization on the uptake, biodistribution and immune response investigated. Bacteria were predominant in micro-PS biofilm as evidenced by Scanning Electron Microscopy and 16S rRNA sequencing. Colonized micro-PS were higher internalized in sea urchins compared to virgin ones, suggesting a role of the plastisphere in the micro-PS uptake. However, both colonized and virgin micro-PS showed the same distribution pattern inside sea urchin body and mainly retained by the digestive system. On the other hand, colonized micro-PS induced a significant increase in catalase and total antioxidant activities compared to virgin ones in digestive system of sea urchins. Furthermore, colonized micro-PS caused a significant decrease in the number of coelomocytes. Moreover, a general time-dependent increase of reactive oxygen species and decrease in nitrogen ones was observed upon exposure to both colonized and virgin micro-PS. Overall findings suggest that micro-PS colonization influences both uptake and toxicological responses of the Mediterranean sea urchin *P. lividus*.

ECOSAFETY DI NANOMATERIALI PER LA *REMEDIATION* DELL'AMBIENTE MARINO: VALIDAZIONE E SVILUPPO DI SAGGI ECOTOSSICOLOGICI CON IL RICCIO DI MARE

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Tra le innumerevoli e recenti applicazioni in campo ambientale di nanomateriali ingegnerizzati (ENM) vi è la *nanoremediation* marina, ovvero l'impiego nella bonifica di ambienti marino-costieri di ENM. Questi possono essere progettati con un'elevata specificità verso selezionate classi di inquinanti, offrendo una soluzione innovativa e competitiva per la loro rimozione dagli ambienti marini. Tuttavia, le recenti evidenze sulla tossicità degli ENM per le specie marine aggiunta alla scarsa conoscenza dei processi di progettazione e di sintesi costituiscono importanti limitazioni alla loro applicazione per trattamenti *in situ*. A tal fine, si propone di estendere l'approccio del *safe-by-design* alla valutazione del rischio ecologico degli ENM includendo la verifica della loro ecotossicità per le specie marine (*ecosafety)*. Tale valutazione non solo individua i rischi associati al loro utilizzo, ma può fornire utili informazioni per disegnare nuovi eco-friendly ENM (eco-design) e ridurre potenziali effetti negativi sugli ecosistemi marini. Una nuova classe di nanospugne cellulosiche (CNS), derivata dalla reticolazione di nanocellulosa per mezzo di polimeri poliamminici, rappresenta il primo esempio di ENM sviluppati per la bonifica degli ambienti marini contaminati da metalli seguendo l'approccio dell'eco-design. Nel presente lavoro, i saggi di spermiotossicità ed embriotossicità del riccio di mare sono stati applicati ed ulteriormente ampliati al fine di valutare le CNS incluse le nanofibre originarie in termini di ecotossicità (*ecotoxicity*) e sicurezza ambientale (*ecosafety*). Il framework proposto prevede la definizione di protocolli di riduzione dell'ecotossicità finalizzati ad eliminare ogni possibile rischio e ottenere ENM sicuri per l'ambiente e promuovere una nanoremediation eco-sostenibile.

THE ASCIDIAN *CIONA ROBUSTA* AS A MODEL TO STUDY THE IMPACT OF NANOPLASTICS IN MEDITERRANEAN COASTAL AREAS

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The growing concern around nanoplastics (NPs) has led to a wide investigation of their effects on marine life. The ascidian *Ciona robusta* is a marine sessile invertebrate which inhabits the Mediterranean coastal areas, playing an important role as filter-feeder. This species has been recently adopted as valuable biological models for ecotoxicity studies, thanks to the rapid embryonic and larval development, resemblance to vertebrates and a number of techniques and genomic resources. Here, we investigated the suitability of *Ciona* as model for nanoplastic ecological risk assessment by testing polystyrene nanoparticles (PS NP) as proxy for nanoplastic, at nominal concentrations of 50 nm amino-modified (PS-NH_2), on the embryonic development. PS-NH_2 affected *Ciona* larval development (EC_{50} (22 h) of 7.52 µg mL^{-1}) with various degrees of phenotype malformations, including hatching and swimming impairment. Induction of oxidative stress, linked to an increase of ROS production and the down-regulation of genes involved in stress response, were observed. The transcriptomic approach coupled with Adverse Outcome Pathways (AOP) framework was used to investigate cellular pathways affected by nanoplastic exposure and predict scenarios of disruption at organism and population levels. Several genes resulted dysregulated upon the exposure to PS-NH_2, while stress response, energy metabolism pathways resulted affected, leading us to propose an AOP model for PS-NH_2 based on oxidative stress and hypoxia as the Key Events (KE). This study provides knowledge of the response upon nanoplastic exposure on *Ciona* embryos, getting insights on potential ecological impact of nanoplastics for marine species living in Mediterranean coastal areas.

ACUTE TOXICITY OF PHENANTHRENE AND NAPHTHALENE ON NAUPLII AND ADULTS OF *ARTEMIA FRANCISCANA*

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Polycyclic aromatic hydrocarbons (PAHs) consist of a group of over 100 different organic compounds mainly generated and released by anthropogenic activities. They are formed by two or more fused benzene rings. Because of their low water solubility and hydrophobicity, they tend to be adsorbed and accumulated in sediment, where their degradation rate is very low. To the best of our knowledge, no studies have been carried out so far to investigate the effects of PAHs on *Artemia franciscana*. *Artemia* is easy to manage at lab scale, but it is not a really sensitive biological model considering the traditional endpoints (i.e., cysts hatching, mortality of nauplii). Thus, we focused on genotoxicity to investigate the potential effects of phenanthrene (PHE) and naphthalene (NAP). Nauplii and adults of *A. franciscana* were exposed to real concentrations (i.e., Pozzuoli Bay sediment, Italy) (0.36-2.3 E+2 mg/L for PHE; 0.025-10 mg/L for NAP).

Results showed that NAP and PHE affected the survival of nauplii both after 24 h and 48 h of exposure. Adults were sensitive to NAP and PHE only after 48 h of exposure. Real Time qPCR on five genes (*hsp26, hsp60, hsp70, COXI and COXII*), involved in stress response, revealed molecular effects, with almost all genes targeted both by toxicants.

MICROPLASTICS IN LACUSTRINE SEDIMENTS: THE CASE OF COMO LAKE

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Due to its outstanding features, plastic is one of the most used and produced material in the whole world. Besides benefits related to the introduction of plastic in everyday life, this represents one of the most troubled themes in environmental field. The mismanagement of plastic waste led to the releasing of plastic material in every natural compartment, resulting in a global issue. Aquatic ecosystems are surely the most impacted sphere: over than 4,800 million of tons of plastic enter the oceans every year. Although plastic is a durable material, once released in the environment, it is subjected to deterioration processes which lead to the formation of microplastics (MPs). The issue concerning the presence of MPs in marine and freshwater ecosystems is widely studied, allowing to gain knowledges about the impact of MPs on water. Despite this, MPs are not only present in water column. Indeed, due to different deposition processes, they also settle to the bottom sediments which are a fundamental sphere of the aquatic ecosystems. In this compartment benthic organisms represent a key component in littoral food webs. Moreover, particular conditions make sediments a sink for organic contaminant and anthropogenic metals.

REVIEW SUGLI EFFETTI SUB-LETALI DEI CONTAMINANTI AMBIENTALI NELLE API DA MIELE (*APIS MELLIFERA*), GAP CONOSCITIVI E PROSPETTIVE FUTURE

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Le api da miele (*Apis mellifera*) e i servizi di impollinazione che esse forniscono sono fondamentali per l'agricoltura e per la biodiversità. I prodotti fitosanitari e altre classi di contaminanti, come gli elementi in tracce e gli idrocarburi policiclici aromatici, contribuiscono al declino generale delle popolazioni di questi impollinatori. Risulta quindi fondamentale investigare gli effetti, ed in particolare gli effetti sub-letali, dovuti alla contaminazione ambientale. A tal fine, nella prima fase del dottorato di ricerca, è stata condotta una review della letteratura esistente sui tipi di effetti valutati in *Apis mellifera*, con particolare attenzione alle aree maggiormente investigate, ai vari approcci utilizzati nel campo della tossicologia, alle classi di contaminanti studiate e agli stadi vitali in cui sono stati condotti i suddetti studi. È emerso che l'Europa e il Nord America sono le aree in cui vengono maggiormente studiate le risposte biologiche di *Apis mellifera*, ed i composti più investigati risultano essere gli insetticidi. Le api, inoltre, sono state studiate per lo più in condizioni di laboratorio piuttosto che in studi di campo. Attraverso l'osservazione delle diverse risposte esaminate, è stato possibile notare che esistono diversi *gap* conoscitivi, in particolare riguardo le risposte molecolari ed enzimatiche, come quelle relative al sistema immunitario e alla genotossicità. È importante inoltre sottolineare che, per valutare l'impatto della contaminazione antropica su questa specie, c'è la necessità di sviluppare una metodologia di indagine integrata che combini risposte a diversi livelli, a partire da quelle molecolari fino ad arrivare al livello di organismo e di popolazione.

VALUTAZIONE DELLO STATO DI SALUTE ECOTOSSICOLOGICO DELLE SPECIE AVIARE *FALCO TINNUNCULUS* (LINNAEUS, 1758) E *PARUS MAJOR* (LINNAEUS, 1758) MEDIANTE UN APPROCCIO MULTI-BIOMARKER

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I prodotti fitosanitari, ampiamente usati in agricoltura, e altre classi di contaminanti di origine antropica, possono causare alterazioni reversibili o danni permanenti al biota, incluse le specie aviarie. Il gheppio e la cinciallegra, le specie selezionate per questa ricerca di dottorato, sono ubiquitari, hanno una buona rilevanza ecologica e la loro territorialità, non essendoci variabili derivanti dalla migrazione, può fornire informazioni puntuali su un dato territorio. L'impiego di un ampio set di *biomarker* in campo ecotossicologico è ormai divenuto uno strumento necessario per ottenere un quadro completo sullo stato di benessere delle specie marine e terrestri in generale. Lo scopo di questa ricerca di dottorato è quello di valutare lo stato di salute ecotossicologico di popolazioni di gheppio e di cinciallegra provenienti da aree urbane e agricole, attraverso lo sviluppo e l'applicazione di un approccio integrato. Il piano sperimentale comprende lo sviluppo di un set di *biomarker* non invasivi, su sangue ed excreta, capace di testare differenti risposte tossicologiche. Nello specifico, sono state sviluppate metodiche per valutare gli effetti genotossici (ENA assay, comet assay), neurotossici (inibizione delle esterasi), immunotossici (sistema del complemento), estrogenici (vitellogenina) e di stress ossidativo (TAS assay), indotti da composti potenzialmente presenti in zone urbane ed agricole. Oltre al monitoraggio in natura, vengono condotti studi *in vitro* per testare la tossicità di fitofarmaci commerciali e di altri contaminanti rappresentativi di aree urbane su queste specie aviarie.

Session III

Ecotoxicology

Flash Talk

MICROPLASTIC CONTAMINATION IN TWO BENTHIC DECAPOD CRUSTACEANS FROM SARDINIAN SEAS

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The rapid production and utilization of plastics in various ways has generated a drastic rise in its environmental release over the past few decades. Microplastics, which are plastic particles of dimension comprised between 1 and 5mm, have been widely detected in all oceanic matrixes, including *biota*. This study aims to assess and compare for eventual significant differences in microplastic contamination for two ecologically relevant decapod crustaceans dwelling in European Waters: the European spiny lobster *Palinurus elephas* (Fabricius, 1787) and the Norwegian lobster *Nephrops norvegicus* (Linnaeus, 1758). These species also have a remarkable economical relevance since both are internationally referred as gourmet food. Samples of the two specimens were collected at depths comprised between 50-100m for *P. elephas* and 400-660m for *N. norvegicus* from the island of Sardinia (Italy). As a preliminary investigation, a total of 4 and 9 digestive tracts were analysed for *N. norvegicus* and *P. elephas*, respectively, with more than 500 MPs-like particles isolated and sorted for polymer identification, performed by means of μFT-IR. The contamination of the two species was significantly different in terms of number of particles and relative size, while the polymeric composition did not show any significant difference, with polyethylene (PE), followed by polypropylene (PP), polyamide (PA) and polyester (PES) fibres being the dominant fraction of the ingested microplastic particles.

THE FATE OF SYNTHETIC AND NATURAL MICROFIBERS IN THE MARINE ENVIRONMENT AND BIOTA: DIFFERENCES AND AFFINITY WITH THE MICROPLASTICS

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The purpose of this Ph.D. project is to evaluate the microfibers distribution (both natural and synthetic origin) in the marine environment, their effects on organisms along the Mediterranean food chain, to highlight differences and affinities with microplastics presence. The project activities will be carried out as part of the implementation of the PRIN project: "Exploring the fate of Mediterranean microplastics: from distribution pathways to biological effects (EMME)". The first phase will consist to develop a specific protocol for sampling microfibers in the marine environment, that will be applied in different areas of the Tuscan Archipelago (starting from distribution models for microplastics, developed for the Tyrrhenian sea within the Plastic Busters project), to identify hot and cold accumulation spots of these pollutants. Also, representative marine species, of invertebrates and vertebrates, with a different trophic position, feeding strategy, and habitat (filter-feeders, herbivores, detritus- and deposit-feeders, carnivores, pelagic, benthopelagic, benthic) will be selected to evaluate the microfibers ingestion. Two sampling campaigns will be carried out, in spring and autumn, in all selected areas to determinate their distribution, composition in the marine environment and presence in the selected species. To evaluate the potential differences of microfibers and microplastics ingestion by trophic position, the carbon and nitrogen isotopes analysis will be performed. Moreover, the levels of plastic additives (e.g. Phthalates, Flame Retardants) and potential changes at molecular levels in different metabolic pathways and physiological functions (e.g. gene expression of different target tissues) correlated to microfibers and microplastics ingestion will be assessed.

LimnoPlast ITN: BIOLOGICAL EFFECTS OF MICROPLASTICS FROM BIODEGRADABLE PLASTICS IN FRESHWATER INVERTEBRATES

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The global challenge of plastic pollution has caught the attention of both scientists and the public. Despite the growing interest in this topic, a gap of knowledge remains when it comes to freshwater ecosystems. Hence, the main goal of the International Training Network (ITN) LimnoPlast is to address the issue of plastic pollution in freshwater environments with an interdisciplinary approach in order to provide a new understanding and innovative solutions. Among the different disciplines that are brought together in this project, we are investigating potential ecotoxicological implications of biodegradable polymers (BdP) from a biological perspective. To date, the investigation about the ecotoxicological effects of different conventional microplastic (MP) particles has been ongoing for several years, and harmful effects on different organisms have been reported. In contrast, hardly any research has been conducted to assess the potential toxicity exerted by BdPs, which are currently being discussed as a potential solution to the environmental problem represented by conventional plastics. For these reasons, the acute and chronic toxicity of different BdPs will be evaluated on diverse freshwater invertebrates. In particular, different key-species (*Daphnia magna, Dreissena polymorpha, Lumbriculus variegatus, Gammarus pulex*) from limnetic and lotic environments have been chosen as model organisms for our investigations. With this set of model organisms, we expect to acquire a more detailed insight into the potential effects that BdPs may have in different freshwater ecosystems.

PRELIMINARY DATA ON EUROPEAN EEL SKIN MUCUS AS TRAPPER OF MICROPLASTICS IN RIVERINE ECOSYSTEMS

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Accidental ingestion of microplastics (MPs) in aquatic fauna is widely documented, as a consequence of the consistent presence of these particles in their associated environment. Nevertheless, among possible interactions of MPs with aquatic *biota*, little is known about the potential role of skin mucous surface (SMS) on accumulation and carriage of micro-sized plastics. This study examined for the first time how MPs adhere in the SMS of European eel (*Anguilla anguilla*, Linnaeus 1758) wild specimens, collected from three rivers of the island of Sardinia (Mediterranenan basin). We found microplastics in each of the samples (n=4), with an average of 3.25 ± 2.63 SD MPs individual^{-1}. The majority of MPs recorded were in film shape. The chemical characterization through µFT-IR (micro Fourier Transform Infrared spectroscopy) showed an heterogenous composition of the MPs detected, which comprised not only the most frequent polymers in the aquatic environment like polyethylene and polypropylene, but also copolymer ethylene-vinyl acetate, polyoxymethylene and polyterpene synthetic resin. The averaged size of the plastic particles detected was approximately 282 ± 346 µm on length. More in-depth studies need to focus on European eels SMS potential to act as a MPs trap and vector, especially considering its catadromous life cycle that could potentially drive MPs dislocation among different aquatic environments.

Session IV

Microbiology

Full Talk

VARIABILITY OF MICROPLASTIC ABUNDANCES AND THEIR ATTACHED MICROBIAL COMMUNITIES IN AN URBANIZED COASTAL AREA

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Microplastics (MP) are a global threat for ocean and human health also in consideration of their physical, chemical and biological transformations which bring to fragmenting into pieces millimeter and even micrometers in size. Little is known also about their role as a vector of potential harmful organisms, in particular about the spatio-temporal variations and/or specificity to substrate of their attached communities in nature, generally referred to as the microbial plastisphere. We present here a comparison of MP in terms of concentration and chemical identification, together with characterization of microbial plastisphere of collected floating MP (< 5 mm) at three stations in the Gulf of Naples in 2018, 2019 and 2020. Microbial communities were characterized by Scanning Electron Microscopy (SEM) and Illumina 16S rDNA amplicon sequencing. MP were mostly represented by Polyethylene (PE) and were more abundant in summer than in the winter (6.20 vs 1.42 mp m-3 on average). Diatoms and bacteria were the most abundant microbes on MP, with different densities and components than free-living counterparts. PE-attached microbes appeared to be different both among different seasons and comparing with communities attached to other polymers, with Flavobacteriaceae, Saprospiraceae and Rhodobacteraceae bacteria always dominating but in different percentages and with very little overlap in terms of single OTUs. Plastisphere characterization has been carried out in particular to test the hypothesis that this community is sensitive to substrate, but also that environmental conditions in the surrounding waters and its structure composition may provide insights on the biofilm formation.

IDENTIFICATION AND EVOLUTIONARY ANALYSIS OF THE LOW-AFFINITY NITRATE TRANSPORTERS FAMILY NPFs IN DIATOMS, diNPFs

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Nitrogen (N) is an essential nutrient for all living organisms and it's taken up from the environment in different organic or inorganic forms. Diatoms, the dominant component of phytoplankton in the ocean are continuously subjected to fluctuating environmental conditions and nutrient concentrations including N. As other organisms, diatoms rely on a range of transmembrane transporters for N uptake. In this study we provide the first characterization of the Nitrate/Peptide Transporter Family (NPFs) in diatoms. NPFs are well characterized in many organisms where they recognize a remarkably broad range of diverse substrates, ranging from di- and tripeptides in bacteria, fungi and mammals to a wide variety of molecules in higher plants, such as nitrate or phytohormones. Since diatoms have a complex evolutionary history with a combination of bacteria, plant and animal-like traits, we investigated the evolution of diatom NPFs (diNPFs) to explore their relationship with the corresponding plant, animal and/or bacterial transporters.
Using a multilevel approach which integrated genomics and metaomics analyses, structural prediction and expression analyses, we unveil an unexpected complexity of these transporters, that might contribute to diatoms ability to thrive in the ocean in diverse environmental conditions**.**

Session IV

Microbiology

Flash Talk

SHEDDING LIGHT ON VERMICULATIONS: A KEY STEP TOWARDS THEIR CONSERVATION

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Caves are hostile environments for life development, due to the prohibitive abiotic factors. However, they host interesting ecological niches for extremophiles, perfectly adapted and specialized. They, in turn, might contribute to the formation processes of the cave and other structures, like vermiculations, enigmatic and still little known deposits, found worldwide on rock surfaces of underground environments.
This study, through an interdisciplinary approach, aimed to characterize vermiculations from Pertosa-Auletta Cave (southern Italy), understanding their genesis and nature, indispensable to actuate a protection plan of these singular biosignature.
XRD pointed out that they, apart from their colors and morphologies, are mainly composed of calcite, with a lower content of quarts and traces of clay minerals. Elemental analysis showed wide variations in Al, Ba, Ca, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, P, S, Si, Sr, Ti, V and Zn concentrations. NGS analysis highlighted that they swarm of microbial life (Proteobacteria, 48.0%; Acidobacteria, 11.6%; Actinobacteria, 7.1%; Nitrospirae, 5.8%; Firmicutes, 4.3%; Planctomycetes, 3.2%; Chloroflexi, 1.9%; Gemmatimonadetes, 1.1%; Archaea, 0.1%) and a significant percentage of it (13.1%) is likely not yet classified. Also microscopic surveys (CLSM and FE-SEM) revealed the presence of biological evidences, strengthening the hypothesis of a key role of microorganisms in their genesis and development.

Session V

Ecosystems: Resistance and resilience

Full Talk

NATURAL GRADIENTS AND SEAGRASS RESPONSE TO WARMING: THE NEED OF FINDING RELIABLE INDICATORS FOR THE SEAGRASS *POSIDONIA OCEANICA* VULNERABILITY

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Understanding the effects of future warming on seagrasses is pivotal to predict their distributional range and structure, as they are invaluable providers of coastal ecological services. The widespread decline throughout the Mediterranean basin experienced by the seagrass *P. oceanica* after recent summer heatwaves have seriously questioned about its persistence for the coming decades.
As a natural gradient of temperature water conditions was identified in Sardinia on each coast (about 2°C of difference during 1 May-31 October between west and east), the response of *P. oceanica* to a wide range of SST within a very low variation in latitude was examined. The response of *P. oceanica* morphometry (shoot density, number of leaves, leaf length, leaf width, % necrotic leaf) and productivity (number of scales, rhizome length, rhizome width, rhizome biomass per year) to temperature conditions was defined by a range of surveys and plant collections conducted at 10 m of depth in eight locations in Sardinia.
Some plant variables were significantly affected by the coast side, as on the east coast (the warmest) shoot density was lower, while the number of scales and leaf and rhizome width were larger. Among the descriptors of SST and Chl-a (proxy of nutrient availability) used, the mean SST seems the best predictor of *P. oceanica* performance, where the warmer is the environment, the lower would be the number of scales, and leaf and rhizome width, compensating the high shoot density. This effort has allowed estimating some natural adaptation of *P. oceanica* to warming.

INTEGRATIVE RESPONSES OF *POSIDONIA OCEANICA* TO MULTIPLE STRESSORS: A NEW PROSPECTIVE FOR FUTURE GLOBAL CHANGES

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Seagrasses are marine clonal plants with limited dispersal abilities that give rise to a sedentary habitat particularly susceptible to environmental changes. *Posidonia oceanica (L.) Delile (1813)* is an endemic species of the Mediterranean Sea, extremely vulnerable to the intensification of warming and eutrophication events that characterized this semi-enclosed sea. In this study, we explored for the first time in seagrasses, different responses degree of *P. oceanica* plants collected from two environments with different nutrient loads history to multiple stressors. For this purpose, collected shoots were exposed to temperature and nutrient enrichment in a multi-factorial experiment performed in a mesocosm system. Morphological and physiological performances of both plants were highly affected by the exposure to high nutrient concentrations alone, which induced higher effects in comparison to temperature treatment. The combination of high nutrients and temperature levels showed antagonist effects, promoting less negative impacts at structural and physiological levels. Local environmental conditions seemed to influence plant responses to nutrients, especially for seagrasses experiencing chronic exposure to eutrophication in natural environments that appeared more sensitive than nutrient-limited plants. These results provide new evidence in seagrass physiological responses to multiple stressors that should be taken into consideration to manage nutrient inputs into coastal marine ecosystems and to preserve seagrasses under a global changes scenario.

PHENOLOGICAL CHANGES OF THE SEAGRASS *POSIDONIA OCEANICA* TO ACTUAL VS. FUTURE MARINE HEAT WAVES

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Marine Heat Waves (MHWs) have been increasing in intensity and frequency because of the climate change. Their effects on the seagrass *Posidonia oceanica* need to be deeply explored in order to predict the future performance of the plant. Here the phenological change of the seagrass to actual and future MHWs was investigated in a descriptive and a manipulative field experiment. In the former the effect of actual MHWs on the plant at two sites (North and North-West Sardinia) was estimated as they were affected by two and one MHWs during summer 2020 (based on the respective climatology). Conversely, in the latter, future MHWs (more intense than the actual ones) were simulated in the field by transplanting *P. oceanica* shoots taken from two donor sites in a common garden in front of the power plant (releasing sea water up to 8°C warmer than the natural) so that three different MHW intensity were simulated (high, medium and control temperature). In both efforts, before, during and after the MHWs some phenological variables were measured. In the actual scenario a different performance was evidenced between plants subjected to one or two MHWs in a row, as between plants from different donor sites experiencing future MHWs intensities. The impact on *P. oceanica* performance of the natural and simulated MHWs suggests that the future summer temperature due to climate change projection will threat the plants, but that the impact will be context-dependent in relation to the pre-adaptation of the plants to the local conditions.

Session V

Ecosystems: Resistance and resilience

Flash Talk

MICROPLASTIC INGESTION AND ADHESION PATTERNS IN COELOGORGIA PALMOSA (ANTHOZOA; ALCYONACEA)

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Recently, research proved how microplastics pollution impacts coral reef systems in a diverse manner, threatening them physically, through physiological distress and increasing diseases on corals. However, most of the MPs studies focus on hermatypic reef-building corals. Due to the ecological importance, the implication in the medical field and the economical relevance in the aquarium trade, microplastics related studies should be applied also to ahermatypic non-reef-building corals. The present study reports for the first time the ingestion and the surface adhesion of microplastics by the Alcyonacea coral Coelogorgia palmosa. Feeding trials, carried out with 2 different concentrations of polyethylene (PE) microbeads, reported a wide range of surface adhesion, ranging from 3 to 1573 adhered PE microspheres. Mucus produced by C. palmosa acts here as a trap for microplastic beads, removing them from the surrounding water, suggesting a role as microplastic's sink for the microplastic present in the marine environment. In each treatment, the 40% of coral fragments ingested microbeads of PE, the highest values (5,4 ± 3,7) were found in the treatment with the greater concentration of microplastic. Our results may provide new insights on the health risks caused by microplastics to soft corals and may contribute to better understand how this widespread anthropogenic stressor can affect the reef ecosystems, claiming for further research on microplastic pollution influence on soft corals.

ASSESSMENT OF PIT LAKES IN THE PO RIVER BASIN: CHANGES IN WATER QUALITY FROM SATELLITE IMAGES AND LIMNOLOGICAL DATA

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During the Anthropocene intense extractive activity led to the formation of many pit lakes that have changed the morphology of the river basins. After cessation of extraction activities, pit lakes can evolve into valuable aquatic ecosystems that can be managed for reconstruction of aquatic habitats and ecological networks. In this context, the main objective will be to assess the water quality status of pit lakes in relation to anthropic pressures and in the context of climate change. To achieve this goal, satellite images with medium/high spatial resolution (e.g. Landsat, Sentinel-2 and PRISMA) will be elaborated for the realization of a thematic cartography showing the location and evolution of the pit lakes in the Po River Basin and for the evaluation of the colour of the waters and their transparency/turbidity. Changes in land use and riparian vegetation, as well as weather and climate data will also be analysed. The advantages offered by the remote sensing techniques, together with limnological data, will allow to obtain a consistent product for the monitoring of these environments in the broader context of land use and climate change. The innovation of this project lies in the integration of biogeochemical-limnological and remote sensing techniques for the analysis of water quality indicators of pit lakes and the factors responsible of water quality change. This in turn, will help to individuate strategies for the management and restoration of these artificial environments in order to maximize the ecosystem services formerly supplied by natural aquatic environments. This contribution is part of the PhD project in Evolutionary Biology and Ecology, cycle 36.

A SOCIO-ECOLOGICAL APPROACH TO DEPICT RESILIENCE OF ACCIDENTALLY CAUGHT BENTHIC SPECIES UNDER CHRONIC TRAWLING DISTURBANCE

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Bottom trawling is a major source of physical disturbance across marine benthic ecosystems worldwide affecting their biodiversity and functioning. Here, we used a socio-ecological informed approach to integrate the human dimension (i.e. fishermen Local Ecological Knowledge) into an experimental setup and disentangle the species functional traits (i.e. metabolic stress) responses across a gradient of trawling disturbance. The target species were non-target benthic species (by-catch) accidentally caught that are typically found on the continental shelf dominated by sandy-muddy bottoms (*Pennatula sp*., *Alcyonium palmatum, Galeodea echinophora*). The metabolic stress after fishing disturbance was evaluated by measuring the oxygen consumption rate on specimens captured along a gradient of trawling disturbance (three levels of fishing pressure), simulating the release at sea (first measurement) which was a proxy of early resistance to disturbance, and the recovery time (second measurement 24h after) as a proxy of resilience after disturbance. Responses at release stage were not significantly different for both soft corals specimens among the pressure levels analysed. *G. echinophora* exhibited significant different metabolic responses with the highest values at medium pressure levels. All the comparisons from the recovery stage were not significant, except for *A. palmatum*. Megafaunal species were more significantly stressed after the recovery time (when compared to release) showing the inability to recover. Our outcomes can be useful to inform the decision-making process on a heavily and chronically exploited, cross-border and economically valuable fishing grounds, underlining the importance to enhance the dialogue between fishermen and scientists when aiming at disentangling disturbance effects.

Session VI

Ecosystem services

Full Talk

URBAN PARKS REGULATING SERVICES ASSESSMENT IN THREE CITIES OF NORTHERN ITALY

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The well-being of citizens in urban ecosystems depends on the environmental quality and therefore by mitigating negative urbanization effect.
Urbanization effect together with to climate change accentuate negative impacts, such as urban heat island, air pollution increase, etc. Urban green infrastructure (UGI), by regulating the environmental conditions, can significantly mitigate such impacts. Indeed, UGI are well known to improve the ecological quality of urban areas.
This study aims to assess regulating services provided by urban parks in three cities of Northern Italy: Pavia, Ferrara and Rimini. All three cities are located in the Po Plain which according to the World Health Organization (WHO), is one of the European areas with the highest concentration of air pollution.
The regulating services analysed in our study are air pollution removal, evapotranspiration as heat wave mitigation, avoided runoff and carbon storage. Moreover, we analysed how these services are influenced by tree characteristics and tree diversity.
The results showed different pattern of regulating services related to the different urban context and microclimate area. Furthermore, the different ecosystem services provided by urban parks are related to the species composition and tree diversity. A high level of tree diversity covers a wide range of ecosystem services.

IMITATING THE LAGOON: ECOSYSTEM SERVICES AND THE *VALLI DA PESCA*

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The assessment of a wide set of Ecosystem Services (ES) has recently been developed for the Venice Lagoon ecosystem. Nevertheless, some lagoon areas, known as "*Valli da pesca",* have been excluded due to their position in the most confined parts of the lagoon, their artificial management, and the difficulties in obtaining data. These areas, as a matter of fact, are managed to maximize just one ES – fishing or hunting: this raises consequences both on other ESs, and on landscape characteristics.
This work presents a first GIS-based assessment of ES in the *Valli da pesca*, setting out a spatially explicit comparison of the effects that different management strategies and social contexts have on ES balance and on the landscape. Furthermore, the work discusses the challenge of mapping and classifying environments which are not included in the official environmental monitoring programs, and the usefulness of machine learning techniques that have been applied to reach a land cover/land use map, starting from high-resolution multispectral satellite imageries and data.

Session VII

Open session

Flash Talk

TRAITS UNDER PRESSURE: AN INTEGRATED APPROACH TO EVALUATE THE EFFECTS OF FISHING ACTIVITIES ON FISH VULNERABILITY

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Spatial management measures have represented the only effective solutions to manage marine resource exploitation in a Mediterranean based context. More often, solutions are based on abundance and biomass data, with a promising but less exploited trait-based approach. Here, we evaluated the vulnerability to fishing of four species: *Arnoglossus laterna*, *Mullus barbatus*, *Merluccius merluccius* and *Trachurus trachurus*; particularly targeted by commercial otter trawls operating across the southern Sicilian continental shelf (south-central Mediterranean Sea). Eight biological traits, linked with fishing disturbance, have been combined with fishing pressure values (as calculated by extracting fishing data from an Automatic Identification System annual dataset). All these data were integrated as inputs into a hierarchical fuzzy logic expert system to obtain a vulnerability index. To account for spatial and temporal dynamics, the vulnerability index was computed on *a priori* defined cells (surface 1km^2) covering the study area, and *per* each available month on the AIS dataset. The results showed a higher vulnerability of *T. trachurus* and *M. merluccius* and spatio-temporal vulnerability maps showed vulnerability *hotspots* in space and time. The applied hierarchical fuzzy expert system confirmed the advantage to represent uncertainty of knowledge, being also flexible in input data requirements and adaptable to future relations and information about inputs. The spatio-temporal vulnerability maps represent useful tools to support decisional process into the future, easy-to-read from stakeholders although based on a robust scientific-evidence.

NUTRIENT LOADS AND EUTROPHICATION RISK IN WATER BODIES OF THE PO RIVER WATERSHED

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In the last decades soil use change, increase in fertilizers use, simplification of the landscape and urban development have led to increased transfers of nutrients to surface waters and driven eutrophication of aquatic ecosystems with changes in their structure, ecological functioning and services provision. While the eutrophication of lentic environments is a relatively well studied process, the linkages between anthropic pressures, nutrient loads formation, concentration and stoichiometry and related rivers and streams ecological responses are understudied but important issues to characterize and predict the risk of eutrophication. Rivers and streams are, in fact, not only simple pipes that receive nutrients and sediment from terrestrial ecosystems and transport them downstream, but they actively transform and partially retain nutrients in a constantly changing and extremely dynamic environment. The main aim of this project is to study the eutrophication potential associated with human activities and the response of river ecosystem processes in different catchments of the Po river watershed, one of the most human impacted regions in Europe. Project activities will be focused on three main objectives: a) to assess the impact of anthropic pressures on eutrophication risks by analysing the relationship between nutrient inputs with water quality; b) to evaluate how different watershed features influence nutrients load formation and their ratios; c) to experimentally quantify the degree of autotrophy and heterotrophy and nutrient retention potential in lotic ecosystems in relation with nutrient loads and different morpho-hydrological features.

MICROPLASTICS INDOOR SPECTRORADIOMETRIC CHARACTERIZATION OF COMMONLY POLYMERS POLLUTING THE MEDITERRANEAN SEA

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The production and consumption of plastics in the world is growing since the last decades. Although Europe is involved in the waste management with strict rules, a portion of plastic waste still ends up in the sea. Microplastics at sea can have detrimental implications for biodiversity and ecosystem functioning seen that recent field surveys showed their ubiquitous presence of different nature such as Polyethylene (PET), Polypropylene and viscose (PP), EVA-ethylene vinyl acetate (EVA) and Polystyrene (PS), in most Mediterranean habitats, from water column to deep sediments. The improvement of operational detection of the microplastics directly *in-situ* through the development of new techniques should be the first objective to make monitoring programmes able to activate early warning systems. The main goal of this work was to spectrally characterize the microplastics polymers in dry conditions and floating on water surface using a full spectrum spectroradiometer. The microplastics analysed in dry conditions are high density polyethylene (HDPE), EVA, PET, PP and PS. Instead, in the water-floating experiment only HDPE, EVA and PP were analysed since the remaining polymers sink in the water. The spectral separability that may allow to determine optimal band combinations for imaging techniques monitoring was evaluated for each experiment. The separability analysis using the bands of some currently existing sensors was conducted aiming to use, operationally, satellite images deployed for remote sensing monitoring (WorldView-3 and PRISMA). This methodology could allow to study the impact of plastics pollution on the marine environment and the implication on the monitoring and mitigation strategies.

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