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ALIEN001

PRIORITIZING INVASIVE ALIEN SPECIES IN ITALY: SCREENING OF MARINE ALIEN SPECIES

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In the framework of the European Regulation 1143/2014 on invasive alien species (IAS), the Italian scientific community is working on a prioritization exercise to develop a list of IAS of national concern, to integrate the list of IAS of European concern currently including 49 species. In particular, the members of the Allochthonous Species Group of the Italian Society of Marine Biology (ASG-SIBM), in collaboration with the Italian Institute for Environmental Protection and Research (ISPRA), have conducted an overview of the regional records of the over 200 multicellular marine and brackish alien species recorded in Italy, have identified their population status and their introduction vectors, and have undertaken a "prioritization exercise" to identify species that are eligible for inclusion in the list of IAS of national concern. This exercise has also been applied to marine alien species that are not present in the country, but are expected to arrive in the next future, identified by means of a "horizon scanning" approach.

The exercise has involved the development of an agreed protocol to score the likelihood of a species to spread or generate environmental, economic and social impacts, as well as the feasibility of its management. The relevance of this prioritization exercise goes beyond the national level, since management of marine alien species is very poorly implemented at European and Mediterranean scale, and the identification of "worst marine IAS" is critical for policy-making and awareness raising. Therefore, the roadmap that Italy is currently tracing towards the possible inclusion of marine species in the list of IAS to be managed and controlled is also relevant for other European and Mediterranean countries.

ALIEN002

TAXONOMICALANDFUNCTIONALDIVERSITYPATTERNSOFNATIVEAND EXOTIC FISH SPECIES

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Exotic species are a major threat to biodiversity and have modified native communities worldwide. Invasion processes have been extensively studied, but studies on species richness and beta diversity patterns of native and exotic species are rare. However, taxonomic diversity patterns could be insufficient to describe the community changes and we hypothesized that functional diversity should be also taken into account. To that end, we investigated the patterns and environmental drivers of native and exotic fish communities along an altitudinal gradient and a hierarchical stream order ordination. We also investigated the relationship between functional diversity and species richness and the Local Contribution to Beta Diversity (LCBD).

Results indicated that both native and exotic species richness increased along an altitudinal gradient, although exotic species were mostly located in the lowlands. No strong LCBD patterns were found. A positive relationship was found between functional diversity and species richness, for both native and exotic species. A negative relationship was found between functional diversity and LCBD, for both communities, possibly highlighting an homogenization process. The functional diversity and LCBD patterns were related with different environmental features, such as the stream order, the total suspended solids and total phosphorus. These results can help to identify biodiversity drivers in exotic and native fish communities, which in turn could be useful to improve management and conservation actions.

ALIEN003

CLIMATE EFFECTS ON THE SPREAD OF BROWN ROT DISEASE: INSIGHTS FROM AN EPIDEMIOLOGICAL MODEL

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Brown rot, caused by Monilinia spp., is a major disease of stone fruit, which can cause important economic losses. We modified a compartmental, mechanistic epidemiological model of brown-rot disease in fruit orchards to include and discuss the role played by climatic conditions. All model functions and parameters have clear biological interpretation thus permit us to formulate and test multiple competing hypotheses on the possible relationships of epidemiological dynamics with the climate. We used a model selection approach (Akaike Information Criterion) to evaluate each hypothesis in terms of support from observed data. The selected model well reproduced the observed variations in terms of both disease epidemics and resulting yield, and assumes i) an infection rate, i.e. the probability that a fruit exposed to the pathogen progresses to the infected stage, which increases with wetness duration and peaks at an average daily temperature of 17 °C and, ii) a spore death rate and a fruit growth rate increasing with temperature. We used our best model to generate risks maps for brown rot disease in the Southern France under different scenarios of climate changes for various time horizons, from few decades to the end of the century. Our results reveal that the integration of epidemiology, plant physiology and meteorology do improve capability for climate change impact assessment and allow possible mitigation. Compared with other very major technological, environmental, and socioeconomic changes that are likely to affect fruit production during the near future, climate change is perhaps not the most important issue; it will, however, add complexity and uncertainty onto a system that is already difficult to manage on a sustainable basis.

ALIEN004

ENVIRONMENTAL DRIVERS OF PARASITE LOAD AND SPECIES RICHNESS IN INTRODUCED PARAKEETS IN AN URBAN LANDSCAPE

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Introduced species represent a threat to native wildlife worldwide, due to predation, competition and disease transmission. Concurrent introduction of parasites may also add a new dimension of competition, i.e. parasite-mediated, by the occurrence of spillover and spillback dynamics. Urban areas are major hot spots of introduced species, but little is known about the effects of urban habitat structure on the parasitic dynamics of introduced species. Here we investigated such environmental effects on the parasite load, richness and occurrence of spillback on two widespread invasive parakeets, Psittacula krameri and Myiopsitta monachus, in the metropolitan area of Rome, central Italy. By testing a total of 231 parakeets, we found that invasive parakeets host arthropod ectoparasites both from their native and introduced ranges. In both species, parasite load was positively influenced by host abundance at local scale, while environmental features such as the amounts of natural or urban habitats, as well as richness of native birds, influenced parasite occurrence, load and richness differently in the two host species.

Therefore, we highlight the importance of population density and habitat composition in shaping the role of introduced parakeets in spreading both native and introduced parasites, highlighting the importance of active surveillance of these introduced species and their parasites, to timely assess parasite-mediated competition dynamics as well as potential spread of vector-borne diseases.

ALIEN005

IN OR OUT: ARE SHALLOW LAGOON HABITATS A SUITABLE PLACE FROM CLIMATE CHANGE EFFECTS?

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The Lessepsian bivalve Brachidontes pharaonis colonized in the last few decades several Mediterranean marine ecosystems by taking advantages of local hotspots to continue its spread in the western Mediterranean basin. It represents an aggressive competitor for resource and space towards native bivalves like Mytilaster minimus. The most western report of this species is represented by lagoon hyperaline (> 45 PSU) pond (the Stagnone di Marsala), where it colonized intertidal and subtidal hard substrates. Brachidontes is an active suspension feeder that filters and removes particles (seston) from the environment and provides a valuable service in recycling energy and matter in shallow water ecosystems, assuming the role of a foundation species capable of hosting high biodiversity levels. The species now reached an equilibrium in regulating suspended and sedimentary organic matter other than primary production within the ponds. Here, we used the Dynamic Energy Budget (DEB) model designed for B. pharaonis to study the effects of increasing temperatures (in a COP21 context) and varying food on the possible future spread in the lagoon system of this species. Our sensitivity-based comparisons allowed us to compare the different growth rates of this species inside the pond, in the lagoon and outside, leading us to identify the reason behind its massive presence inside the ponds rather than in the lagoon or in the external environment. According to our simulations Brachidontes inside the lagoon achieved a 65% higher total length compared to the outsiders, reaching the maturation in 95 days, while the previous did not reproduce. Specimens inside the pond instead reached a 131% higher total length compared to the outsiders, maturing in 72 days and laying four times more eggs. We then further tested the effects of temperature and food with the aim to provide quantities for the management of marine activities at local scale.

ALIEN006

ECOLOGICAL AND ECONOMIC IMPACT OF AN INVASIVE FISH SPECIES: THE ROLE OF THE PHYSICAL HABITAT AND INTERSPECIFIC INTERACTIONS

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Invasive fish can have adverse ecological and economic impacts on invaded ecosystems. However, mechanisms determining the success of their invasion remain largely unknown, limiting our ability to manage invaders and quantify their impact. Native to North America, the largemouth bass (Micropterus salmoides) is an invasive opportunistic predator in Mediterranean freshwaters. Here, we explored the trophic niche of M. salmoides and its interactions with autochthonous fish species in a volcanic lake (Lake Bracciano, Italy), including two species of commercial value: Perca fluviatilis and Atherina boyeri. Our study was supported by C and N isotopic analyses, twenty years after the introduction of the bass into the lake. Samples were collected in littoral areas varying in terms of physical structure and resource availability at lower trophic levels in the food web. This made it possible to explore mechanisms linking environmental conditions and antagonistic interactions between the invader and remaining fish species.

M. salmoides had a predominantly piscivorous diet and occupied a higher trophic position in the less productive area (North). In turn, trophic niche interference with other fish at intermediate trophic levels was higher in the most productive area (South), due to a higher consumption of invertebrate prey. Here, the sub-population of the bass was 7.3 times more limited (with respect to its carrying capacity) than in North. As a consequence, its economic impact, measured as the biomass subtracted to P. fluviatilis and A. boyeri multiplied their commercial value, was 8.4 and 17.1 times greater in North than in South respectively. These results indicate that (i) physical variations in the habitat were associated with differences in antagonistic interactions among native and alien species, and (ii) a reduction in productivity and biodiversity at lower trophic levels in lake food webs may favor the success of opportunistic invasive fish, increasing the cost of their invasion.

ALIEN007

A META-ANALYSIS INVESTIGATION OF EFFICACY IN CONTROLLING INVASIVE SPECIES IN AQUATIC ECOSYSTEMS

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The impact of invasive alien species (IAS) has been amply investigated. Their spread causes huge environmental and socio-economic damages, affecting human health and livelihoods. Determining effective and sustainable methods to control invasive species is therefore a fundamental global priority. However, we lack systematic revisions on the real effectiveness of control actions based on quantitative evaluations, especially considering temporal success rates. To do this, a meta-analysis framework was performed in order to delineate the effective success of control actions using biotic quantitative variables and valuate their effects on native species over time. We focused on freshwater and transitional ecosystems, considering studies published from 2013 to 2017. We correlated habitat types (i.e. river, lake, estuary or wetland), control methods (i.e. mechanical, physical, chemical, biological, or combined) and success rates in form of change in species diversity, abundance and coverage in before-after-control-impact studies (both considering manage and control conditions). A total of 40 articles for a total of 260 cases were included in the analysis. Our results suggest a negative significant effect of all the control actions analyzed on invasive species that means a strong reduction of them (mechanical > combined > chemical > physical > biological), with higher achievements for rivers > wetlands > estuaries > lakes. However, a neutral effect emerges in the medium-long term. In particular, mechanical and combined actions exhibited the higher success rates, suggesting the necessity of recovery programs following the management of invasive species. In conclusion, our analysis stresses as how IAS eradication or control measures are not enough to resolve the problem of invasive species and restoration plans should not aim exclusively at the elimination of alien target species, but also focus on the preservation of overall ecosystem and its resilience.

ALIEN008

MACROFOULING ASSEMBLAGE COMMUNITIES FROM PORT AREAS OF THE HIGH TYRRHENIAN COAST OF LIVORNO (TUSCANY, ITALY): AUTOCHTHONOUS AND ALIEN SPECIES.

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The construction of port areas originates new environments characterized by a high internal spatial heterogeneity and influenced by several anthropogenic activities. In this regard, the study of macrofouling communities in these environments can help to evaluate the effects of different types of impact in port areas. Since port areas are one of the main points for the arrival and introduction of alien species, the qualitative and quantitative determination of the presence of these species in the macrofouling communities, related to different types of disturbance, can help to identify possible sensitive areas that could facilitate the settlement of non-native species. Within the Livorno harbour seven sites have been identified, according to their destination use, and three additional sites have been selected in three marinas (Molo Nazario Sauro, Ardenza and Antignano) located south of Livorno harbour. Fouling assemblages have been sampled in April 2016 by scraping docks and submerged artificial walls. All samples have been fixed in 70% ethanol for subsequent sorting and species determination. For each sample, the main habitat formers were also identified to evaluate their influence on benthonic communities. The analysis of samples showed a marked heterogeneity both in terms of habitat formers and in terms of the community structure related to the sampling site. Twenty-five non-native or cryptogenic species are founded, some of which have not yet been recorded for this area, or have been recorded only recently. From the data obtained, the ALien Biotic IndEX (ALEX) was calculated to evaluate the impact of alien species, in each sampling sites, on autochthonous communities. The statistical data analysis was carried out using multivariate statistical tests with PRIMER 6 software to calculate the main diversity indices, to verify the similarity between samples related to different site and to test the significance of factors taken into consideration (site and habitat formers).

ALIEN009

THE COMPARISON OF THE EPIPHYTIC MICROBIAL COMMUNITIES OF THREE SYNOPTIC SEAGRASS SPECIES HIGHLIGHT A HIGHER DIVERSITY IN THE INVASIVE (HALOPHILA STIPULACEA) AND PIONEER (CYMODOCEA NODOSA) SPECIES

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The study of the seagrass holobiont is arousing an increasing interest as microbes (i) are fundamental to nearly all the aspect of the seagrass(host) physiological functions, and (ii) play an important role in the enhancement of seagrass(host) capabilities and its adaptiveness, that is of particular importance for sessile organisms. Little information is available on the recruitment and selection of the microbes in the 'construction' of the holobiont.

In this work, it has been investigated the seagrass microbial epiphytes of three syntopic species in Cyprus (33.1305277 N, 34.7083621 E). There, the Lessepsian migrant Halophila stipulacea harboured alongside two endemic species: Posidonia oceanica, and Cymodocea nodosa, mixed together in small patches, suggesting that Posidonia is in regression.

We collected the microbial epiphytes from seagrass leaves and the microbes from the surrounding seawater. They were analysed by NGS (Illumina platform) and MacQIIME v.1.9.1, to evaluate if the microbial epiphyte community in different seagrass species from the same site is shared or changes according to species.

The Cyprus sea stretch seems quite polluted: the seawater microbial community is mainly constituted by Gammaproteobacteria (89% of the OTUs) and this, in turn, affects the seagrass microbial community composition (87% Gammaproteobacteria), the genus/families of seagrass associated microbes are different in the three species, suggesting a selection of epiphytes.

Obviously, the great majority of OTUs on the seagrass are in common with the seawater, however, each plant species showed unique OTUs, even not found in seawater. Cymodocea and Halophila share high diversity and many unique OTUs (90 and 78, respectively), mainly Bacilli, Gammaproteobacteria and Alphaproteobacteria, while Posidonia showed a microbial profile more similar to the seawater one (88% Gammaproteobacteria) and only 43 unique OTUs.

The invasive (Halophila) and pioneer (Cymodocea) species, hence, were able to harbour a wider, more diverse and more selected microbial community than Posidonia.

ALIEN010
EXOTIC FRESHWATER FISH SPECIES IN ITALY – STATUS, TRENDS AND ECOSYSTEM EFFECTS

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Italy has a long history of freshwater fish introductions through the last century, typically performed to enhance fisheries but, in some cases, also a result of unintentional releases. While our knowledge on the timing and type of species introduced is relatively detailed, there is a rather surprising knowledge gap on the consequences of these introductions. During the last year, our research unit has tried to partially fill this gap and produced a significant amount of publications, which I will try to link and summarize in this talk. I will offer a broad scale view on the dynamics and effects of freshwater fish invasions in Italy, with a particular focus on the Po River basin. First, I will present some long-term trends in species introduction and dispersion, as well as discuss some of their potential drivers. I will illustrate some of the invasion process outcomes, with a focus on dispersion pathways and distribution patterns, including the existence of exotic hotspots. I will then discuss the drivers of this exotic invasion and its impact on native species, offering potential explanations on the patterns observed and propose some useful management tools to prioritize conservation actions. Drawing from the outcomes of our most recent work, I will outline how some potential new invasions could be happening under the radar and how some aspects of past introductions might have been overlooked and underestimated. Ultimately, I will show how the current situation of the freshwater fish fauna affects national obligations under the WFD, and offer a different perspective on ecological indicators that could constitute a way forward.

ALIEN011

COLLATING EVIDENCE TO INFORM FUTURE NON-INVASIVE SPECIES MANAGEMENT AND TO ADDRESS CONSERVATION ISSUES

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The need for mitigation, control and conservation measures when informing Non-Indigenous Species (NIS) management and risk assessment tools and strategies is mandatory and worldwide recognised by lots of directives at various geographical scales, generally recording a wide consensus between scientists and stakeholders. The need to preserve and protect the endemic biodiversity from NIS should pass through a prompt, comprehensive and accurate knowledge of the biodiversity status. This becomes crucial when monitoring the biodiversity hotspots associated with organisms that are known as foundation species such as the mussels. Here, we interrogated the scientific literature to analyze the up to date effort done by scientists, and related research programs, in monitoring two mussel foundation species and to highlight potential knowledge gaps to be filled in the future. Our target species were the NIS B. pharaonis and the indigenous Mytilaster minimus potential competitors for habitat and resources, known to reach high density (mussel beds) hosting biodiversity hotspots across the intertidal Mediterranean rocky shores. To do it, we collated evidence from the available literature, through a systematic map (SM), a strong approach of literature search, screening and synthesis. A discrepancy on available scientific evidence was highlighted with respective knowledge gluts and gaps. The temporal trend of the published literature suggests a minor interest on the endemic species while only few studies reported the contextual presence of both species in the habitats looking at the competition for space and resources. NIS literature focused mostly on first record papers, followed by functioning and modelling studies (mesocosm), in contrast in situ studies mostly focused on the indigenous distribution and associated assemblages. SM was confirmed as one of the more effective tool to provide scientific evidence when informing management and conservation plans, as well as when dealing with stakeholders and policy-makers engagement.

BEF001

HOT MOMENTS AND HOT SPOTS OF BENTHIC NITROGEN CYCLING ALONG ENVIRONMENTAL GRADIENTS

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Benthic nitrogen (N) cycling consists of microbially-mediated processes, strongly affected by physical factors and by the presence of macrofauna and primary producers. N cycling was studied in detail in benthic ecosystems characterized by low species and functional diversity, often by means of oversimplified experimental set up. Such approach does not allow to disentangle all the various interactions within a community, and often leads to large, unidirectional fluxes of energy and matter. Aim of this work is to analyze how three interplaying factors (light, background nutrient levels and biodiversity) regulate the coupling of benthic N transformations. This was tackled along a gradient of increasing complexity, taking into account emerging properties associated to the interactions among species as well as hot moments and hot spots where key N-processes occur. Measurements are based on paired light and dark incubations of mesocosms collected from freshwater, brackish and marine environments, including sediments and different primary producer growth forms and macrofauna functional groups, and along nutrient gradients. N-related process (uptake, denitrification, DNRA, ANAMMOX, N-fixation) were quantified by addition of 15N stable isotopes (30N2, 15NH4+ and 15NO3-) to the mesocosms. Results from this work suggest that in healthy benthic ecosystems N paths are scattered in a wide array of multiple processes regulated by trophic and community interactions. Complex communities tend to minimize both N imports (i.e. fixation) and loss (denitrification) and optimize N recycling. The outcomes of this work add to the international literature a new generation of holistic experiments targeting the relationships among benthic diversity and N cycling in aquatic environments. A deeper knowledge of these relationships may help to understand how anthropogenic pressures and species loss affect N turnover in benthic ecosystems.

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Domanda di Borsa di partecipazione al Congresso

ORAL

BEF002

BIOGEOCHEMICAL VARIABILITY IN THE NORTHERN WESTERN ADRIATIC COASTAL SYSTEM OF NORTH MARCHE STRONGLY INFLUENCED BY THE PO RIVER LOAD

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Long-term time series (1997–2017) of biogeochemical parameters, including chemical-physical (CTD), nutrients (nitrate, nitrite, ammonium, total phosphorus, orthophosphate and silicate), phytoplankton biomass (chlorophyll "a") quantification and hydrological determinations (Po flow) were analysed from a multivariate ecological perspective to compute a climatological description of seasonal dynamics for two coastal sites located in the northern western Adriatic Sea and directly influenced by Po and local river inputs. Data were collected at surface in the north-western area of the Adriatic Sea along the transects of the Foglia and Metauro Rivers. Monthly evolution of biogeochemical properties in the sites showed a substantial similarity in the spatio-temporal evolution of the variables between the two transects ($p < 0.001$) reflecting common hydrodynamic and trophic conditions. PCA ordination performed on Euclidean distance captured both the increase of nutrients, chlorophyll "a" and dissolved oxygen concentrations occurring in the periods (November-April) characterized by higher riverine input, lower temperatures, and the decrease in nutrients, chlorophyll "a", and dissolved oxygen concentrations in the periods (May-October) with minor riverine input and higher temperatures (strong thermocline). The analysis of evolutive trends of nutrients showed a significant decrease for the orthophosphate (0.005 µM P/year), total phosphorus (0.017 µM P/year) and ammonia (0.033 µM N/year). The analysis of salinity time series showed three significant temporal shifts in the years 2003 (increasing, $p < 0.05$), 2009 (decreasing, $p < 0.0005$) and 2016 (increasing, $p < 0.001$) allowing the identification of four main regimes: 1997-2002, 2003-2008, 2009-2015 and 2016-2017. The analysis of the Po flow time series showed three temporal shifts in 2003 (decreasing, $p<0.001$), 2008 (increasing, $p<0.01$), 2015 (decreasing, $p<0.05$) providing the identification of four main regimes:1997-2002, 2003-2007, 2008-2014 and 2016-2017. The high similarity detected between timing of salinity and Po flow regimes is a clear evidence of the Po load influence, more than local Foglia and Metauro rivers, on the trophic and hydrodynamic conditions of the North Marche area.

ORAL

BEF003

MODELLING THE TROPHIC STRUCTURE OF THE MARINE FOOD WEB IN THE GULF OF TARANTO (NORTHERN IONIAN SEA, CENTRAL-EASTERN MEDITERRANEAN SEA)

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An Ecopath mass-balance model was applied to identify the trophic structure and the keystone species of the demersal and pelagic compounds in the marine food web of the Gulf of Taranto (Northern Ionian Sea, Central-eastern Mediterranean Sea). Biomass data (ton/km2y) mostly derived from the standardized biomass index of demersal species in the time series EU MEDITS, Landings (ton/km2y) and Discards (ton/km2y) data of commercial species derived from the time series EU DCF, together with Production, Consumption and Diet data, were used to model the food web in its stationary state during the period 2010-2014. A total of 60 functional groups (FGs) were identified as structuring the marine food web over the 7745 km2 from Santa Maria di Leuca to Punta Alice between 10 and 800 m of depth. The trophic level, omnivory index and keystoness index were estimated together with the exploitation rate calculated as indicator of the fishing impact by métier. The higher trophic levels were observed for the FGs anglers, bathyal sharks and bathyal squid for the demersal compound and striped dolphin, large pelagics and other odontocetes for the pelagic compound. Lower omnivory index were estimated for the FGs anglers and hake indicating a higher specialist feeding habits. On the contrary, the FG bathyal sharks resulted a generalist group of consumers. The macrozooplankton and macrobenthic invertebrates resulted the most important keystone groups in the modelled food web. In addition, the bathyal squids, anglers and nectobenthic shrimps resulted relevant keystone species in the demersal compound. Whilst, the FGs medium pelagic fishes and striped dolphin in the pelagic compound. The FGs red mullet, hake, deep-water rose shrimp, red giant shrimp, blue-red shrimp, sharks and rays benthic feeders and coastal scorpionfishes as well as the large pelagics were confirmed to be in overfishing condition within the demersal and pelagic compounds, respectively.

BEF004

ASSESSING THE FOOD WEB STRUCTURE OF A DEEP OLIGOTROPHIC SUBALPINE LAKE MERGOZZO (PIEDMONT) BY C AND N STABLE ISOTOPES ANALYSES

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Stable isotopes analyses (SIA) is worldwide recognized as a useful tool to study trophic relationships of aquatic organisms. In this study, we applied SIA to describe the food web structure of the deep (81m) and relatively small (1.84 km2) subalpine oligotrophic Lake Mergozzo, located nearby of Lake Maggiore, in the Province of VCO (Piedmont).

We considered mussels and Ephemeroptera as organisms representative of isotopic carbon baseline of the littoral zone, while Daphnia spp. of the pelagic baseline. Samples of zooplankton, benthos and all fish species inhabiting the lake (15 species, divided in small, medium and large sized if possible) were collected in October 2016.

SIA showed a clear depletion in isotopic carbon content from more typical littoral species (i.e. perch, rudd, roach, largemouth bass) to pelagic (coregonids, shad and bleak) and sublittoral (alpine char, bullhead, burbot) species. Among tipically littoral species, d15N‰ reaches highest values in piscivorous fish such as pike, largemouth bass, pikeperch. Still, highest N values are also reached in typical sublittoral species such as burbot and char.

Among the same species, roach, largemouth bass and perch show clear difference among sizes. Young roach and largemouth bass had a isotopic carbon fingerprint more related to the littoral (less carbon depleted) than adults, whilst adult perch instead were more 15N-enriched than younger specimens, indicating a shift in the diet toward a more pronounced piscivory. Results among and within species are likely linked also to the lake morphometry, characterized by a very steep shore and a very narrow littoral shallow area.

Finally, our data indicate a significant food niche overlap among the native perch and non native roach.

Compared to the nearby oligo-mesotrophic Lake Maggiore, Lake Mergozzo zooplanktonic organisms were more nitrogen depleted, reflecting the different trophic status of the two lakes.

BEF005

AN OUNCE OF PREVENTION IS WORTH A POUND OF CURE: MANAGING MACROPHYTES FOR NITRATE MITIGATION IN IRRIGATED AGRICULTURAL WATERSHEDS

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Although ubiquitous elements of agricultural landscapes, the interest on ditches and canals as effective filters to buffer NO3- pollution has been raised only recently. The aim of the present study was to investigate how in-ditch denitrification supported by emergent aquatic vegetation (Phragmites australis, Typha latifolia, Glyceria maxima) may affect watershed-scale N dynamics in a worldwide hotspot of NO3- contamination and eutrophication, i.e. the lowlands of the Po River basin, Northern Italy. The effectiveness of N abatement in the canal network (~18,500 km) was evaluated by combining reach-scale denitrification measurements obtained in a wide range of environmental conditions (e.g. NO3- availability, water velocity, temperature, presence of biofilms) and GIS-based upscaling. Scenarios of variable extents of vegetation maintenance were simulated and compared to the current situation when the mechanical mowing, a routine ditch management practice performed yearly to preserve hydraulic efficiency, has led to the almost complete disappearance of in-stream vegetation.

Outcomes demonstrated that agricultural N excess may be efficiently controlled by the ecosystem function of denitrification in the ditch networks if vegetation conservative management practices are properly implemented and coupled to hydraulic needs. For example, the removal of almost half of the N surplus could be expected if vegetation is maintained throughout the growing season in one quarter of the total ditch length. Due to the intertwined action of macrophytes and microbial communities promoting N processing and sustaining the natural depuration capacity, vegetated ditches may offer new management opportunities for effectively decreasing NO3- loads in surface waters, with positive effects in term of improved water quality at the watershed level and in the coastal zones. In conclusion, an artificial feature characterizing highly hydraulic-regulated and simplified agricultural landscapes, can assume a relevant role as metabolic regulator and provider of ecosystem services.

BEF006

INTERACTION BETWEEN HOST AND PARASITES: HOW AVIAN MALARIA AFFECTS BARN SWALLOW ORNAMENTATION, BREEDING SUCCESS AND AGING.

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Infections are key factors driving sexual selection and life-history evolution. In wild animals, the cost of disease is most apparent during acute infection, when the host becomes inefficient in, for example, avoiding predators or finding food. After surviving the acute phase, either the infection is cleared or it may become chronic. Haemosporidian blood parasites are common in vertebrates and have been shown to vary in their effects on host fitness traits. In this study we investigated infection of adult barn swallows (Hirundo rustica) by avian malaria during the chronic stage of infection and the consequences for host fitness traits and aging. Infection did not affect the expression of male ornaments (tail length and ventral plumage coloration), but was associated with paler ventral plumage coloration of females, suggesting that females may advertise infection status in a species where assortative mating occurs. Moreover, we found a negative effect of infection on feather growth rate in older but not in yearling individuals. Because feathers are moulted during wintering in Africa where infection occurs, the present results suggest that male secondary sexual traits have little potential to reveal acute-stage infection whereas plumage coloration of females may advertise their infection status; therefore, the present results suggest that infection can influence the course of plumage moult. In addition, infection did not affect female breeding dates, but was associated with a reduction in their breeding success. Lastly, no effect of infection was observed on annual survival and on telomere length in both sexes. Thus, our results add to the observations of negative effects of haemosporidian infection on fitness traits, but likely not aging, in birds and provides evidence that these effects can vary among fitness traits and according to age and sex.

BEF007

INTEGRATIVE TAXONOMY, EVOLUTION, AND ECOLOGY OF SYMBIOTIC ZANCLEIDA (HYDROZOA, CAPITATA)

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Hydrozoans belonging to the superfamily Zancleida are characterised by a relatively simple anatomy and diverse ecological and reproductive traits. The taxonomy of most species is hampered by their rarity, the difficulty in observing their complete life cycles, and the recurrent presence of cryptic species. Several species, mostly belonging to the families Zancleidae, Cladocorynidae, Sphaerocorynidae, and Milleporidae, are involved in symbiotic relationships with other organisms, including scleractinian corals, octocorals, sponges, bryozoans, and algae. Little is known about the diversity of these symbiotic hydrozoans, and the relationships with their hosts or symbionts are largely understudied. Therefore, an integrative approach was used to characterise these enigmatic taxa. Specifically, detailed morphological and morphometric analyses of classical and newly discovered characters, together with DNA taxonomy techniques, phylogeny reconstructions, comparative phylogenetic analyses and ecological surveys, allowed to shed light on different aspects of symbiotic Zancleida. For instance, in different groups the genetic diversity is better explained by the host specificity rather than the classical morphological features, even though a detailed morphometrical analysis of nematocysts and other peculiar structures statistically supported the genetic distinction of some lineages. In other cases, the systematics of entire families was updated, thanks to phylogenetic assessments, description of previously unknown life stages, and discovery of new genera and species. Finally, certain taxa were investigated from an ecological point of view, describing their prevalence and preferences, and assessing their possible roles in the association in which they are involved. All together, these results suggest that the biodiversity of tropical symbiotic hydrozoans, as well as their ecological importance, are underestimated and require further attention.

BEF008

AGLEASONIANECOLOGICALSUCCESSIONISTHERESPONSIBLEOFTHE PURPLE SPOT DAMAGE OF ANCIENT PARCHMENTS

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The preservation of cultural heritage is one of the major challenges of today's society, and parchments, a semi-solid matrix of collagen produced from animal skin, are a significant part of the cultural heritage, being used as writing material for many centuries. Due to their animal origin, parchments can undergo biodeterioration, with irreversible loss of value and/or information. A frequent parchment's alteration is the so-called purple spot, isolated or coalescent spots of purple coloration, more crowded on the flesh side, that often leads to the detachment of the superficial layer and the loss of the written content.

The biological dynamics responsible of purple spot damage remained unknown for centuries, although the several efforts to shed light on the biodeterioration process. Recently, an interdisciplinary approach including NGS, Raman spectroscopy and Light Transmitted Analysis gave the first insight on a possible model of biodeterioration by analysing a purple damaged roll dated back 1244 AD, the A.A. Arm. I-XVIII 3328, belonging to the oldest collection of the Vatican Secret Archive (Fondo Archivum Arcis). The hypothesized model of biodeterioration consists in a microbial succession acting in two phases: a first one, common to all the damaged parchments and characterized by halophilic and halotolerant bacteria fostered by the salty environment within the parchment environment (brining is still used for hide preservation); and a second one which, according to a Gleasonian successional model, depends on the individual history of each parchment and determines the identity of colonizers. This successional model in ancient parchments, has been validated by applying the same multidisciplinary approach used in the first study on three dramatically damaged parchments belonging to a collection named "Faldone Patrizi A 19" (Secret Vatican Archives, XVI-XVII century AD). The first and second phase colonizers were identified in these parchments and the dynamics of the collagen degradation was unravelled.

BEF009

EXPERIMENTAL EXTREME EVENTS INDUCE ALTERNATIVE STATES IN ROCKY SHORE BIOFILMS

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Research on regime shifts has focused primarily on how changes in the intensity and duration of press disturbances precipitate natural systems into undesirable, alternative states. By contrast, the role of recurrent pulse perturbations, such as extreme climatic events, has been largely neglected, hindering our understanding of how historical processes regulate the onset of a regime shift. We performed field manipulations to evaluate whether combinations of extreme events that differed in their identity, order of occurrence and degree of temporal clustering generated alternative states in rocky intertidal epilithic microphytobenthos forming biofilms on rocky shores. The likelihood of biofilm to shift from a vegetated to a bare state depended on the degree of temporal clustering of events, with biofilm biomass showing both states under a regime of non-clustered (60 days apart) perturbations, while collapsing in the clustered (15 days apart) scenario. Our results indicate that time since the last perturbation can be an important predictor of collapse in systems exhibiting alternative states and that consideration of historical effects in studies of regime shifts may largely improve our understanding of ecosystem dynamics under climate change.

BEF011

EXPERIMENTAL EVIDENCE OF SPATIAL SIGNATURES OF APPROACHING REGIME SHIFTS IN MACROALGAL CANOPIES

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Developing early warning signals to foretell regime shifts in natural systems is a central issue in contemporary ecological research. While there are many studies addressing temporal early warning indicators, research into spatial indicators is far behind, with field experiments even more rare. Here, we tested the performance of spatial early warning signals in an intertidal macroalgal system, where removal of algal canopies forced the system toward a tipping-point, marking the transition between a canopy- to a turf-dominated state. We performed a two-year experiment where spatial early warning indicators were assessed in transects where the canopy was differentially removed (from 0 to 100%). Unlike Moran correlation coefficient at lag-1, spatial variance, skewness, and spatial spectra at low frequency increased along the gradient of canopy degradation and dropped, or did not show any further increase beyond the transition point from a canopy- to a turf-dominated state (100 % canopy removal). Our study provides direct evidence of the suitability of spatial early warning signals to forestall regime shifts in natural ecosystems, emphasising the importance of field experiments as a powerful tool to establish causal relationships between environmental stressors and early warning signals.

BEF012

URBANIZATION SHIFTS SPECIES AND TRAIT COMPOSITION IN CARABID COMMUNITIES AT MULTIPLE SPATIAL SCALES

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The increasing conversion of agricultural and natural areas to human-dominated urban landscapes is expected to cause a severe biodiversity decline worldwide, mainly due to the alteration of several environmental parameters in urban environments compared to the surrounding landscape. In particular, urban areas show increased temperature and high isolation and turnover rates of natural patches, which likely select species with traits that make them pre-adapted, but also filter out maladapted species. We here take advantage of a replicated, spatially nested sampling design to investigate the effects of urbanization on carabid communities in Belgium. In particular, three local-scale (200 x 200 m) urbanization levels were repeatedly sampled across three landscape-scale (3 x 3 km) urbanization levels for a total of 81 sampling sites. Our results showed that communities sampled in the most urbanized sites displayed a distinct species composition compared to the most rural ones. By analysing the response of community-wide mean trait values along the urbanization gradient, we showed that urban communities were mainly composed by species preferring higher temperatures and with better dispersal capacities compared to rural communities. In addition, we detected a shift towards smaller species along the urbanization gradient due to higher ambient temperature, which increases metabolic rates, but this shift is even intensified for carabids since smaller organisms also show higher dispersal capacity. Overall, our results demonstrate that urbanization exerts a strong filtering effect on species traits with a consequent change of ground beetle community composition. Since most carabids are predators that can exert a significant top-down control on invertebrate communities, changes in their trait values may have strong repercussions on lower trophic levels, and as such impact ecosystem goods and services.

ORAL

BEF013

MAPPING SUPPORTING ECOSYSTEM SERVICES TO OPERATIONALIZE ECOSYSTEM BASED-MARITIME SPATIAL PLANNING IN ADRIATIC

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Ecosystem Services (ES) quantification and mapping is a practice recognized for its effectiveness in informing conservation and management plans, even though such approach is often omitted by planning processes. Ecosystem based Marine/Maritime Spatial Planning, which is acknowledged to be a powerful mean for the achievement of both environmental and socio-economic objectives, incorporates ES information. In this study, we proposed a methodological approach to operationalize ES incorporation in EB-MSP to quantify and map supporting ES delivery in Adriatic Sea. Supporting ES are recognized as fundamental for the supply of all ecosystem services, and their incorporation in management plans allows the inclusion of a wide range of ES at once, not incurring in ES classification problems. Supporting ES delivery hotspots and coldspots were identified in all the three marine domains (sea surface, water column and seabed) to consider the marine environment in all its multidimensionality. We produced relevant information to orient conservation priorities and maritime uses allocation. We tested the applicability of our operational method for conservation purposes at different spatial scales, by comparing the identified ES delivery hotspots with areas under or not conservation regimes. We found the pelagic realm highly valuable for supporting ES supply, confirming that MSP and conservation plans should incorporate such domain and prioritize the vertical zoning when needed. We confirmed the need to deepen the knowledge on ecological processes and functioning in deep-seas to address conservation and management plans in these marine areas. This methodological approach aims at informing and supporting EB-MSP to achieve sustainability and conservation goals.

BEF014

CONSERVATION BEYOND MARINE PROTECTED AREAS THROUGH MARITIME SPATIAL PLANNING

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The European Integrated Maritime Policy focuses on supporting Blue Growth in European seas. Though lacking of an agreed definition, the concept of Blue Growth is associated to the sustainable use of marine resources. Interpretations on the level of sustainability open for a series of challenges in enlarging the perspective of supporting conservation, beyond establishing marine protected areas.

This study focuses on the challenges of the identification and recognition of Other Effective Conservation Measures (OECMs), recently defined by the UN Convention on Biological Diversity. OECMs refer to areas that are not nature reserves or protected areas, and yet significantly contribute to conservation, because marine communities benefit there from access restrictions established due to safety or security concerns. Efforts to address the designation of OECMs include further definition of the term, the development of typologies of OECMs, and the definition of operative screening tools that can be applied to identify potential OECMs. While the recognition process of OECMs is still unclear, especially in the marine environment, we propose a decision process that can be used to identify specific types of OECMs as part of the maritime spatial planning (MSP) process. We applied the suggested process in two case studies of the Italian Northern Adriatic and the Israeli Mediterranean seas.

Results are discussed in relation to the challenges of data availability and reliability, of identifying OECMs in relation to "in-situ" or "ex-situ" conservation, and of ensuring that the conservation outcomes from OECMs endure over time. The recognition of OECMs becomes highly controversial, especially if it is considered at the expense of establishing marine protected areas. Therefore, we suggest that while spatial targets for conservation should focus mainly on areas dedicated for marine reserves, OECMs – especially of the type for ancillary conservation discussed in this paper – can be achieved through MSP.

BEF015

WATER FRAMEWORK DIRECTIVE: FROM LAKE MONITORING TO THE VALIDATION OF THE BENTHIC QUALITY INDEX (BQIES)

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Since WDF comes into force in 2000, the ecological status of water bodies become a relevant index of the structure and functioning of ecosystems. In particular, the assessment of lake ecological status includes physico-chemical aspects, quali-quantitative biological structure of the community, and hydro-morphological characteristics, in order to guarantee the interdisciplinary nature of monitoring. This presentation is focused on the development of the Benthic Quality Index based on macroinvertebrates, which are generally known as indicators of water quality. Between 2007-2013 a sampling method and a standardized protocol were developed. In 2016, as part of the activities of the intercalibration exercises at European level, Italy submitted the classification method adopted. The BQIES index considers the eutrophication as a pressure still significant at national level. The results of six years of cooperative work among researchers and operators of the National Environmental Agencies, the statistical approach adopted for the analyses, the procedures to be followed and the criteria to be adopted during BQIES application, are here presented. The method is now accepted at European level and will be included among the methods to be intercalibrated.

The WFD requirements are to evaluate the diversity, the abundance and the tolerant/sensitive species ratio to define the five classes of ecological quality (high, good, moderate, poor, bad) of lakes. Therefore, the BQIES method proposed requires detailed taxonomic knowledge at least for chironomids and oligochaetes. Thus, the main objectives of this presentation are to: i) describe the sampling method to derive the taxonomic composition, the abundance and the diversity related to each site and/or lake; ii) describe the index, explaining how to separate species into tolerant/sensitive; iii) present the data obtained up to date, which have been used for the ecological classification; iv) describe the choices researchers made to define the class boundaries.

BEF016

INDIVIDUAL BASED MODELS FOR THE COCREATION OF CLIMATE ADAPTATION STRATEGIES FOR EXPLOITED POPULATIONS: THE CASE OF THE LAKE GARDA FISHERY.

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The dynamic of exploited populations depends on both environmental drivers and human activities, in a synergistic manner. As a consequence, the effects of climate change can be influenced (mitigated or exacerbated) by the management policies of the resource, and -on the other side – changes in climatic drivers can put at risk the outcome of the management efforts and hence the sustainability of the exploitation of a given resource. Therefore, when studying the impacts of climate change on exploited populations it is important to include in the analysis also the possible policy responses. To ensure that these possible adaptation measures to climate change are viable management solutions, accepted by all the possible stakeholders, it is important that they are involved in the analysis since the beginning of the process. In this study we present the case of the fishery in lake Garda focusing mostly on the European Whitefish fishery, analysed within the H2020 project ClimeFish, by adopting a co-creation approach. We present the process followed within the project, strongly based on the use of Individual Based Models, which allow to develop mechanistic descriptions of the main process characterizing the life histories of individuals, using empirically based knowledge and tracking the dynamic at population levels. The preliminary model outputs were then exposed to a heterogeneous stakeholders panel, allowing to collect comments and concerns of all the people potentially involved in the process. Collected observations represented the basis upon which the further development of the case study is being built. In this way, it was possible to ensure that the main features of the problem are included in the case study and to put the basis to develop together a set of management guidelines, to anticipate and to be ready to cope with the possible effects of climate change.

BEF017

SUSTAINABLE MANAGEMENT OF SMALL-SCALE FISHERIES IN THE NORTHWESTERN MEDITERRANEAN SEA

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Devising sustainable fisheries management policies is particularly challenging, due to the complex interactions between the dynamics of spatially structured fish populations and fishing pressure across heterogeneous seascapes. SafeNet, a research project funded by the European Commission, aims to identify coherent networks of Marine Protected Areas (MPAs) whose emergent properties (i.e. the interactive effect of scaling-up MPAs in networks) can help achieve the targets of the Common Fisheries Policy in the northwestern Mediterranean Sea. In this context, we developed an age-structured, spatially explicit metapopulation model to describe the spatio-temporal dynamics of three highly relevant coastal species (Diplodus sargus, Diplodus vulgaris and Epinephelus marginatus) in the northwestern Mediterranean Sea. The model accounts for larval connectivity, as well as the main life-cycle processes such as reproduction, body growth, natural and fishing mortality, settlement, and recruitment. Larval connectivity within the study area was assessed via Lagrangian simulations carried out over the period 2004–2015, taking into account the available knowledge regarding the main biological traits influencing the dispersal of early life-history stages (e.g. spawning schedule, pelagic larval duration). The spatial configuration of the model includes the MPAs currently established in the Mediterranean Sea, allowing the assessment of their contribution to the biological conservation of the species and the productivity of their fisheries. The model provides therefore a valuable basis to explore alternative spatially-explicit management policies (like the establishment of coherent networks of MPAs and other area-based fisheries management rules) aimed to pursue the sustainability of Mediterranean small-scale fisheries and to assess their performances (with respect to both conservation and socioeconomic objectives) in the long run.

BEF018

A METAPOPULATION MODELLING FRAMEWORK TO ASSESS THE SUSTAINABILITY OF EUROPEAN HAKE FISHERIES IN THE LIGURIAN AND TYRRHENIAN SEAS

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Pursuing sustainability goals in fisheries management requires a trade-off between biological conservation and socioeconomic objectives. The spatial interaction between the dynamics of biological resources and fishing effort dynamics makes it difficult to assess the actual consequences of candidate management measure in a realistic way in the absence of quantitative tools appropriately describing those dynamics. We developed a modelling framework to describe the metapopulation dynamics of the European hake (Merluccius merluccius) and support the identification of candidate areas for protection. First, we reconstructed spawning grounds in GSA 9 (Ligurian and North Tyrrhenian Sea) and 10 (South and Central Tyrrhenian Sea) via Lagrangian backtracking from hake nurseries identified by the MEDISEH project and then we used forward Lagrangian simulations to investigate larval connectivity across the area. Second, we developed a spatially explicit model to describe the interaction between the spatiotemporal dynamics of the stock in GSA 9 and fishing effort. The model incorporates current knowledge about biological traits, the results of the connectivity analysis and spatially explicit information about fishing pressure exerted by different fishing métiers. It was calibrated against the results of the stock assessment carried out by the GFCM Working Group on the stock assessment of demersal species (WGSAD 2017). The model provides a tool to forecast the effects of spatial closures on recruitment, spawning stock biomass and fishery productivity. Results obtained by simulating the closure of the fishery in 200-km 2 -wide sectors (under the hypothesis that fishing effort is uniformly redistributed over the entire region) suggest that the benefits of protection may extend well beyond the area subject to closure, with benefits (in terms of both spawning biomass and fishing yield) also on the surroundings. This study provides a starting point for the assessment of protection networks in the Mediterranean.

BEF019

RESOURCE PARTITIONING AMONG SYMPATRIC ELASMOBRANCHS IN THE SARDINIAN CONTINENTAL SHELF (CW MEDITERRANEAN)

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Present work analyses resource partitioning among 7 elasmobranch species inhabiting the continental shelf of the island of Sardinia: Dasyatis pastinaca, Raja asterias, R. brachyura, R. clavata, R. miraletus, R. polystigma, Scyliorhinus canicula. A total of 1680 samples was collected through both scientific and commercial trawl surveys conducted over a bathymetric range comprised between 26 and 200 m depth, from 2005 to 2014. Data were analyzed for the overall populations, sex, season (winter and summer) and size groups (identified on the basis of the maturity stages). Generally, being batoids "continuous feeders", a good number of stomachs were found to be full (%CV≤17%). All species were mesopredators, and the highest trophic levels were found in those attaining largest sizes (TROPH ± s.e.= 3.83 ± 0.65 in R. brachyura). The Levins' index values were comprised between 0.23 in R. asterias, considered as moderately stenophagous and 0.45 in R. polystigma, a moderately euryphagous species. Particularly, the species living in shallower waters (characterized by a narrower bathymetric range) were the most stenophagous. The main prey taxa, in terms of %PSIRI, were Crustacea, Osteichthyes, Mollusca and Polychaeta. A limited number of recurrent preys was found: Gastrosaccus sp., Lophogaster typicus, Solenocera membranacea, Liocarcinus sp., Gymnammodytes cicerelus, Glossanodon leioglossus. Different predatory behaviours were observed: species were able to prey on endobenthic and/or epibenthic organisms; in addition, some made limited movements in the water column. The nMDS analysis highlighted the presence of 4 groups of predators. General low levels of interspecific niche overlap were found, as highlighted by the low levels of the Morisita's index. Difference in diet was only related to size and not to sex or season. During growth some species became more euryphagous (D. pastinaca, R. asterias, R. polystigma), while the others had an opposite behaviour. General high levels of intraspecific diet overlap were noticed.

BEF020

STABLE ISOTOPE ANALYSIS CLARIFIES DIFFERENCES BETWEEN CULTURAL RESIDUES OF MAIZE BT AND ITS ISOGENIC PLANT

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Genetically modified (GM) crops are considered a good tool to reduce the harmful insecticides use, suppress some regional key agricultural pests and improve food safety. Nevertheless, effects of GM plant residues on soil animals are still poorly understood. Zea mais L. hybrids with Bacillus thuringiensis Berliner subsp. kurstaki (Bt), are largely cultivated against maize borer populations. Different biochemical characteristic of Isogenic (ISO) and Bt- maize dead leaves can influence their decomposition rates and palatability. Therefore, food webs of soil communities associated to both maize line cultural residues and to native weeds were studied. We hypothesized different trophic attractiveness of basal resources (Bt, ISO AND WEEDS) that could influence trophic relationships among macroinvertebrate colonizers of crop residues. The research was carried out in experimental fields of Lleida University (Spain). Data from C and N stable isotope analysis were used to study food niche at different trophic levels and food webs reconstruction. Similar temporal dynamics in Bt- and ISO- food webs organization were found. The higher soil fauna abundance promoted trophic generalism. The organic matter depletion, faster in Bt- than in ISO-maize, caused a decrease of abundances and an increase of generalism degree of detritivore communities. The latter allowed to predators to increase their specialism degree. Nevertheless, niche metrics analysis, isotopic signatures distributions and mixing models applied, suggest that ISO-predators diet could include also C3-chain derived food sources. In contrast, the higher availability of detritivores per capita allowed to Bt-predators to maintain a diet mostly based on Bt-maize chain. The investigation of detritivores and predators carbon and nitrogen isotopic signatures allowed to explore and compared food web structures of soil communities, pointing out the potential of the stable isotope technique as a useful method also to obtain information about ecological roles and effectiveness use of "natural enemies" for the biological pests control in the agroecosystem.

BEF021

TRICHOPTERA BIODIVERSITY OF FRESHWATER ECOSYSTEMS IN NORTHERN APENNINES (MODENA)

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The community of freshwater macroinvertebrates, even if they are interested by an increasing effort of sampling in the bio-monitoring activities, their knowledge at the species level is decreasing. The reasons are: first because often the determination at family level is sufficient in bio-monitoring and the genus or groups of species are rarely required, than because the morphological approach in taxonomy is losing interest.
As the trichoptera are one of the most important orders of freshwater insects, the aim of this work is to increase the knowledge of this biocoenosis in the High Apennines of Modena. The study area has been chosen because it is not very much investigated and because of the high diversity of freshwater ecosystems. In this study one stream, one spring, one peat bog and one high altitude pond were investigated. To determine species level, adults sampled with light traps were used. 5790 individuals were collected and 14 families, 32 genera and 72 species were identified. Of which 17 are new reports for Emilia Romagna and 23 are on the Swiss red list. The ecosystem with the largest number of new reports (9 species) and species belonging to the red list (12) is the Ospitale stream. Among these 12 species all those belonging to the critical risk category (4 species) were included as well as 4 of 6 species considered threatened. These results underscore the important role of high mountain stream ecosystems for this insect order protection with such a functional key role within the whole community.

BEF022

THE INFLUENCE OF WATER QUALITY, HABITAT AND SEASON ON MACROINVERTEBRATE COMMUNITIES IN PRE-ALPINE RIVERS AND STREAMS. IMPLICATIONS FOR MANAGEMENT AND RESTORATION

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Benthic macroinvertebrates are widely used as indicators of the health of freshwater ecosystems, responding both to water quality and hydromorphological alterations. In the last years the complexity of biological indices used in the European countries increased greatly, but in most cases they still do not allow to understand specific causal effects among stressors and biological metrics. The definition of the relationships between macroinvertebrate community characteristics and environmental gradients (as flow variability, nutrient supplies and local habitat conditions) is fundamental to understand ecological dynamics. This is the basis for predicting changes in ecosystem functions, ultimately achieving a proper management of the riverine ecosystems.

45 sites, along 11 pre-Alpine rivers and streams, were surveyed for macroinvertebrate and water chemistry, collecting a total of 380 samples. Habitat conditions were assessed along a 500 m stretch in each site using a standardized methodology and used to describe different features of channel, banks and vegetation that can be relevant for management purpose.

Macroinvertebrate community characteristics were summarized both with structural (density, diversity and taxonomy-based indices) and functional indicators (ecosystem attributes derived from functional trait analyses). Quantile regression was then used to describe the effects of potential limiting factors on macroinvertebrate community.

River categories, nutrient availability, temperature and basin size played an important role in the description of community metrics. However, it was possible to select some metrics which enable the assessment of habitat loss. These metrics may help to raise a better awareness in the evaluation of river restoration success and, thus, in the support of decision-making processes.

In this framework, quantitative models have been developed to predict the potential characteristics of macroinvertebrate community as a function of selected environmental variables. These relationships can be used to plan the best strategies for river restoration to protect and/or recover macroinvertebrate diversity and ecosystem processes.

BEF023

FIRST REPORT OF THE MEIOBENTHIC AND FREE-LIVING NEMATODE DISTRIBUTION WITHIN THE PROGRAM OF NATIONAL INVESTIGATION OF MARINE ECOSYSTEM IN KOREA

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In Korea, to limit the possible biodiversity loss and preserve marine ecosystem goods and services, numerous protected areas as well as the law of Conservation and Regulation of Marine Ecosystems were recently established. This latter brought to the creation of a biomonitoring program (National Investigation of Marine Ecosystem) to document long and short-term changes in Korean waters. So far, there are a few information on the biological response of benthos in this country and they mainly refer to macrobenthos. Thus, the data collected during a survey of this program were used to document the structure and biodiversity of the meiobenthic and nematode communities from these coasts. The study area was located in the Southern West and Western coasts of South Korea and the sampling was carried out during 2015. A total of 68 sites were investigated for meiobenthic community and 34 of them were selected to study the nematode community composition. The results obtained by both the communities highlighted the higher human disturbance and vulnerability of the Southern Korean coast compared to the Western sector. Meiobenthic and nematode diversity did not appear significantly affected by anthropogenic impact even if their values were lower in the Southern area. Instead, the maturity index calculated on the nematode community resulted to be a valuable tool for the biomonitoring of the coastal systems being an index that can summarize the ecological state of the communities and is poorly influenced by the effect of natural variables.

BEF024

MEIOFAUNAL BIODIVERSITY IN SUBMARINE CANYONS OF THE MEDITERRANEAN SEA: A META-ANALYSIS

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Deep-sea canyons include highly heterogeneous habitats characterised by a large variability in terms of geomorphological, oceanographic end ecological features. Despite the increasing efforts conducted in the last decade to investigate deep-sea canyon ecology, patterns and drivers of their biodiversity are still controversial. Here, we carried out a meta-analysis of meiofaunal abundance, biomass, richness of higher taxa and taxonomic composition from 18 Mediterranean canyons, located in the Western (Balearic, Catalan, Ligurian margins), Central (South Adriatic margin) and Eastern (Cretan margin) basins. We also compared Mediterranean canyons with 2 canyons located in the European margins of the Northern Atlantic Ocean. Our results revealed the presence of weak differences in terms of meiofaunal abundance and biomass among canyons and their adjacent slopes. However, their biodiversity (expressed as expected richness of higher taxa) was higher and composed by different taxa in canyons than in open slopes. The results of the meta-analysis also indicate that the most important drivers of the observed patterns were water depth, regional setting and geomorphological characteristics of the canyons. We conclude that deep-sea Mediterranean canyons, through their morphological complexity and geomorphological heterogeneity, contribute significantly to promote the high deep-sea biodiversity at both regional and wider scale in Mediterranean Bain.

BEF025

A BRACHIOPOD-DOMINATED BIOTOPE AT THE SHELF BREAK OF THE SOUTHEASTERN ADRIATIC SEA OFFSHORE ALBANIA

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In the recent, brachiopods are often associated with shallow to bathyal habitats at times in great number, but only seldom dominate the benthic communities. This holds true for the Mediterranean Sea as well that hosts ca. 15 species of Brachiopoda, with two terebratulid species especially known to form dense populations under favourable circumstances, i.e. Gryphus vitreus (Born, 1778) and Megerlia truncata (Linnaeus, 1767). The latter is a eurybathic species settling rocky outcrops, coral frames or other hard substrates. A community dominated by Megerlia truncata has been identified in 2013 by Remotely Operated Vehicle (ROV) exploration of the southeastern Adriatic margin offshore Albania, supported by the EU Project CoCoNet (cruise COCOMAP13 of RV Urania). The complex stratigraphy of the outer shelf includes rocky highs between 110-130 m, blocks and concretions surrounded by vast stretches of coarse biogenic-detrital sediment enriched in rhodoliths. The rocky substrate displays areas intensely exploited by M. truncata which may attain a density >300 individuals/m2 with a dominance upon other sessile macrofauna sharing the same habitat, as serpulids and sponges (Hymerhabdia typica and Hexadella pruvoti). Calcareous red algae are almost ubiquitous and encrust preferentially sectors of the substrate with minimal brachiopod presence. Mobile macrobenthos comprehends the echinoderms Centrostephanus longispinus, Stylocidaris affinis and Peltaster placenta. The living brachiopod community shed post-mortem parts to the sediment next to the cliffed outcrop but this skeletal contribution quantitatively rarefies quickly moving a few meters away for the home substrate. This Megerlia biotope is a novel finding for this part of the Mediterranean Sea but shares similar traits with situations in the Western Basin, such as Banc de l'Esquine (Calanques National Park, France) recorded in a similar depth range and using a comparable substrate. Research contributing to the EU Projects 'Ever-est' and 'Idem'.

BEF026

EXPLORING A DEEP-SEA VULNERABLE MARINE ECOSYSTEMS: THE ISIDELLA ELONGATA (ESPER, 1788) ASSEMBLAGES IN THE WESTERN-CENTRAL MEDITERRANEAN

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Deep-sea corals play an important role in marine benthic ecosystems as biodiversity hot spots and also provide Essential Fish Habitats for commercial fish and invertebrate. The bamboo coral Isidella elongata is a near-endemic species of the Mediterranean Sea, also recorded along the Spanish and Moroccan coasts of the Atlantic Ocean. The species is distributed on the bathyal soft bottoms, mostly deeper than 500 m, where it characterises a typical facies. I. elongata is currently considered "Critically Endangered" by the IUCN Red-List and the mud facies with this species is also included in the list of Vulnerable Marine Ecosystems (VMEs) by FAO. Despite its important ecological role, I. elongata has been severely impacted by fishing activities, because it is often associated with the red shrimps Aristaeomorpha foliacea and Aristeus antennatus, which are the main targets of the deep-sea trawling. The structure and distribution of I. elongata assemblages were mostly explored in the westernmost Mediterranean, while no comprehensive studies on this VME are available so far for the Western-Central Mediterranean. In this work, a 5 year time-series of data collected in the framework of MEDITS (Mediterranean International Trawl Survey) project was used to localise the presence of this bamboo coral and to characterize the associated megafauna in four areas of the Western-Central Mediterranean (Sardinia Seas, central-southern Tyrrhenian Sea, western Ionian Sea and southern Adriatic Sea). The availability of data on both the presence of I. elongata and the abundance of its accompanying species allowed to characterise hot spots of this VME on a wide spatial scale. Furthermore, this analysis was combined with estimates of the fishing effort levels in the studied areas, in order to detect the actual fishing pressure on these vulnerable deep-sea communities.

BEF027

SOIL MICROBIAL DIVERSITY, BIOMASS AND ACTIVITY AS AFFECTED BY DIFFERENT-INTENSITY PRESCRIBED BURNING IN PINE PLANTATIONS OF SOUTHERN ITALY

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Soil microbial community plays a key role in maintaining ecosystem functions, such as organic matter decomposition and nutrient cycling. Microbial diversity is critical in assuring these functions. This study aims to investigate the relation among microbial diversity, biomass and activity in soils of pine plantations treated with different-intensity prescribed burning. Fire treatments, carried out to reduce the risk of summer wildfires, were applied in plots (about 0.5 ha) of P. pinea and P. pinaster plantations of Southern Italy. In P. pinaster plantation having greater amount of litter fuel (1.4 ± 0.1 kg m-2), compared to P. pinea one (0.7 ± 0.1 kg m-2), a higher temperature was reached in the litter layer during fire treatment (about 600 °C vs 350 °C). During the first year after prescribed fire, fermentation layer and underlying soil (5-cm depth) were sampled in burned and near unburned (control) plots of both plantations. In each sample, total microbial biomass, fungal mycelium, microbial activity (as soil respiration) and bacterial genetic diversity (16S rDNA PCR-DGGE) were evaluated. Fire treatment caused a temporary decrease of total microbial biomass (up to 40 d), fungal mycelium and soil respiration (in the first 3 h) in the fermentation layer and soil of P. pinaster plantation, compared to control. On the contrary, no negative effect was found in P. pinea plantation, where fire intensity was lower. In both plantations, prescribed burning did not alter bacterial genetic diversity, evaluated as band richness, Shannon index and evenness. The unchanged bacterial genetic diversity in burned plots could explain the fast recovery in microbial growth and activity also after high-intensity prescribed burning. Results also indicate that the effect of a stress/disturbance factor on soil microbial community is better clarified by considering together indicators of microbial diversity, growth and activity.

BEF028

QUERCUS ILEX L. LEAF MORPHOLOGY AND AGE AFFECT THE AMOUNT OF INTERCEPTED AIR PARTICULATE MATTER

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In urban area, plants play a fundamental role in improving air quality as leaves are considered sink of air pollutants. The amount of air particulate matter that can be intercepted by leaves is strongly affected by exposure time and leaf traits. After interception, air particulate matter is only temporarily stored on leaf surface. In fact, after that, it can be resuspended in the air by wind action or washed off into the soil through precipitations. The aims of the research were: i) to discriminate the amount of PM10 and PM>10 intercepted by Quercus ilex L. leaves; ii) to assess if time exposure or leaf traits affect the amount of intercepted air particulate matter. To reach the aims, one- and two-years old leaves were sampled on April 2018 at different sites of four municipalities in the surrounding of Naples. The amount of PM10 and PM>10 as well as several leaf traits (i.e. length, width, petiole length, leaf area, thickness, dry-matter content) were evaluated for leaves of both the ages. In addition, the circularity index was calculated. The relationships between leaf traits and the amount of intercepted air particulate matter were evaluated by single and multiple regressions. The results highlighted that the mean values of intercepted PM10 and PM>10 were 34.0 and 382 µg cm-2, respectively, and did not statistically vary according to leaf exposure time (one and two years). A lower leaf dry-matter content and higher circularity index favour the interception of both PM10 and PM>10; whereas, shorter leaves favoured only the interception of PM10. In conclusion, leaf traits rather than exposure time affected air particulate matter interception.

BEF029

CHLOROPHYLL A FLUORESCENCE AS A TAXONOMIC AND ECOLOGICAL FINGERPRINT OF TREE SPECIES.

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The effectiveness of plants in ecosystem functioning is connected to their functional traits (FT), physiological, chemical and morphological. Among physiological traits chlorophyll a fluorescence (ChlF), provides a measure of photosynthetic efficiency. The photosynthetic apparatus is a conservative element of the plant cell, having a potential capacity to reflect taxonomic differences among plant species (adaptation), but contemporary its features are highly variable between species and responsive to environmental factors (acclimation). Moreover, the function and efficiency of the photosynthetic machinery is associated to other traits such as chlorophyll content, N/C ratio and leaf mass per area. This contribute explores the suitability of selected FT, assessed in young plants grown in nursery conditions, for the classification of 12 Mediterranean tree species according to their taxonomy, ecological characteristics and successional role. Drought treatment was applied to verify if a stress factor changes the effectiveness of ChlF to rank the species in accordance with their taxonomy and ecological characteristics. The JIP-test parameters showed a strong and positive correlation to assimilation rate and chemical traits such as relative Chl content and nitrogen at leaf level. ChlF is quite efficient in discriminating species on both taxonomic and ecological basis, but the JIP-test parameters that play a key role in species ranking changed. The adaptation process that led to the taxonomic distinction involved the maximum quantum yield of photosystems II, whereas the acclimation, that describes the physiological responses to the changing environment, and the successional position, pivot on electron transport and on the end electron acceptors efficiency. Drought treatment highlighted that species belonging to the Fagacae and Betulacae families (order Fagales) had similar changes in ChlF parameters, whereas species belonging to the Oleacae and Salicacae families changed the ChlF parameters following species-specific pattern.

BEF030

THE INFLUENCE OF ENVIRONMENTAL FACTORS ON SOIL CHARACTERISTICS?

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Soil quality can be defined as "the capacity of the soil to function as a vital living system, within ecosystem and land-use boundaries, to sustain biological productivity, promote the quality of air and water and maintain plant, animal, and human health". Different vegetation covers, specific microclimatic conditions or human impacts can influence soil physical-chemical and biological characteristics and consequently determine the health of ecosystems. The objective of the research was to identify the environmental factors that mainly affect several soil characteristics such as pH, water and organic matter contents, C, N and heavy metal (Cr, Cu, Ni and Pb) concentrations, microbial activity, and fungal and microbial biomasses. The research was performed in the Vesuvius National Park surrounded by a densely populated area. Surface soils (0-10 cm) were collected inside the Alto Tirone Reserve (far from the main roads) and along two roads, leading to the cone: Ercolano, characterized by continuous and various traffic, and Matrone, crossed by a limited period and only by tracked vehicles. The soils were collected, in 2015, 2016 and 2017, at the end of the touristic season (autumn) and at the beginning of the next one (spring) at approximately 600 m and 900 m of altitudes. Altitude and plant cover mainly affected the soil biological characteristics; whereas, altitude and traffic typology/intensity mainly affected the soil metal content. In particular, high altitude and sparse vegetation cover negatively influenced soil microbial biomass and activity, and soils at low altitude with greater touristic impact and traffic flow showed high metal accumulation. Finally, the findings highlighted that specific microclimatic conditions and, then different vegetation covers, are the main drivers of soil biological characteristics, whereas human impact is the main driver of soil chemical characteristics.

BEF031

THE FRAME-BUILDING DENDROPHYLLIA CORNIGERA SCLERACTINIAN CORAL IN A CHANGING MEDITERRANEAN SEA.

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Global climate changes influence marine ecosystems at all the levels of biodiversity, i.e., individuals, populations, communities, ecological networks and ecosystems. The Mediterranean Sea is experiencing at present a dramatic degradation of its marine ecosystems being one of the regions most exposed to climate-induced deep-sea habitat alteration. The fate of mesophotic to bathyal habitats is getting special attention since those are considered less impacted by global changes than shallow-water counterparts. Recent focus on Mediterranean mesophotic ecosystems provides scientific background on their role as biodiversity hot-spots and related ecosystem services. In fact, understanding the needs in habitats characteristics for mesophotic species and the relationships among these species plays a crucial role in make suppositions on the future scenarios for such ecosystems. This is particularly important for corals, which enhance the three-dimensionality of habitats.

The branching scleractinian Dendrophyllia cornigera (yellow coral) is a considerable component of Mediterranean mesophotic habitats well extending its presence down to bathyal depths. Whilst engineering large bioconstructions at intermediate water depths (ca. 80-200 m) as is the case on the Amendolara Bank in the Ionian Sea, it also occurs in the 'white coral' grounds (such as the Santa Maria di Leuca and Southern Adriatic Cold Water Coral provinces).

We examined the seafloor morphometric variables and oceanographic characteristics to disclose preferential habitats' controlling factors. Furthermore, we analysed trophic habits of macro- and megabenthos associated with D. cornigera. Encrusted filters (e.g., sponges) prevail at shallower sites where D. cornigera produce large bioconstructions, whilst there is a relative abundance of erected filter-feeders at CWC-dominated situations. Finally, comparing the information about the habitat and the biological community surrounding D. cornigera with the forecasts for climate- induced alterations in the Mediterranean Sea, we provided a first evaluation of of D. cornigera distribution vs potential future modification. Research contributing to the EU Projects 'Ever-est' and 'Idem'.

BEF032

IS WATER CURRENT VELOCITY A KEY FACTOR AFFECTING LEAF-LITTER BREAKDOWN AND CRENIC ASSEMBLAGES? PRELIMINARY RESULTS OF AN EXPERIMENTAL STUDY IN TWO NEARBY REACHES (EROSIONAL AND DEPOSITIONAL) OF THE VERA SPRING (CENTRAL ITALY).

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Leaf-litter breakdown is an ecosystem process that generally occurs through four steps: (i) leaching of soluble compounds (ii) conditioning by microbial colonization (iii) invertebrate shredding and
(iv) fragmentation by physical abrasion. Although these stages are often analyzed separately, they are not temporally distinct but are interdependent and overlap in time. The importance of physical abrasion in influencing the rate of detritus decomposition was rarely investigated, literature data mainly refer to laboratory or manipulative field experiments. Therefore, we conducted a comparative experiment aimed to assess the rate of leaf-litter breakdown and the structure of crenic assembalges in two nearby reaches (erosional vs. depositional) of a natural rheocrene spring. The two zones are characterized by similar environmental conditions and chemical-physical variables, but with significant differences in hydrological parameters: water current velocity was four times greater in the erosional reach.
The percentage of leaf mass loss was significantly higher in the erosional zone. However, substantial differences were also found in the structure and functional organization of crenic assemblages in the two reaches, with shredders more abundant in the erosional zone.
Our preliminary results indicate that water current velocity may have a key role in affecting both invertebrate community structure and ecosystem processes in the studied spring, also at small spatial scale. Water flow may promote a faster decomposition of leaf detritus in the spring erosional reach through direct (physical abrasion) and indirect (different composition of the detritivore guild) effects.

BEF033

PROMOTING BIODIVERSITY ENHANCEMENT BY RESTORATION OF CYSTOSEIRA POPULATIONS – ROC POP LIFE PROJECT

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The genus Cystoseira C. Agardh, brown algae belonging to the order Fucales, is distributed along the Mediterranean and Atlantic coasts from the intertidal to the lower sublittoral. This genus is ecologically relevant as an ecosystem engineer, and plays a key functional role in controlling spatial habitat heterogeneity, productivity, and nutrient cycling in temperate rocky reefs. Currently, some Cystoseira populations (depending on species and location) are declining/lost throughout the Mediterranean, largely due to multiple human impacts such as urbanization, overfishing and climate change, emphasizing the urgency to develop an active intervention to restore this endangered habitat. ROC Pop Life project aims at triggering the recovery of Cystoseira populations in two Natura 2000 sites: the Marine Protected Areas (MPAs) of Miramare (Northern Adriatic Sea) and Cinque Terre (Eastern Ligurian Sea), where this taxon was present, as proven by museum and scientific literature records. Disappearance causes have been presently removed and the protection is guaranteed by the MPAs. The project will develop non-destructive and eco-compatible protocols, which include an innovative outplanting approach that consists in the production of germlings in the laboratory to be introduced in the areas to be restored, starting from small portions of macroalgae fertile apexes. This approach, particularly convenient in terms of time, costs and ecological impact, will cause no harm to donor populations in Landscape Park Strunjan, Slovenia (for N Adriatic) and Portofino MPA (for Ligurian Sea), which is essential given the critical conservation status of the species. The proposed process is appropriate to large-scale application and replication in other Mediterranean areas is desirable in a project capitalization perspective. Preliminary results about the restoration experience during summer 2018 will be presented.

BEF034

REINTRODUCTION OF THE LIMPET PATELLA FERRUGINEA IN THE LIGURIAN SEA (RELIFE PROJECT): ENVIRONMENTAL COMPATIBILITY OF DONOR AND RECEIVING SITES

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Patella ferruginea, an endemic proterandric gastropod mollusc from the Western Mediterranean, is one of the most endangered invertebrates of the entire basin. Historically, this species was present along the Ligurian coasts in the upper intertidal, habitat strongly threatened by seawater pollution and by human harvesting for food and baits, yet presently is reported as extremely rare. The project RE-LIFE, funded by the LIFE Programme (EC), aims at reintroducing P. ferruginea along the Ligurian coasts, within the Portofino Marine Protected Area (MPA) and in the other Ligurian MPAs (Cinque Terre and Bergeggi), by transferring adult specimens from the Tavolara MPA (Northern Sardinia), where a rich population in good health is still present. Donor and receiving sites have been selected responding to several basic requirements: 1) the receiving sites are located in MPAs, where human threats for P. ferruginea have been removed; 2) donor and receiving sites have very similar environmental conditions, so that the transplanted population will not face large changes in the environment, potentially affecting the adaptation of the organisms. During summer 2017, a study for assessing compatibility of environmental characteristics of donor and receiving sites has been performed, with specific attention to the site that will first receive the translocated specimens, the Portofino MPA. The environmental status has been assessed through the CARLIT Index (WFD 2000/60/EC), while the composition of the intertidal community has been studied by way of visual quadrats. In terms of ecological status, Portofino and Tavolara A zones were both ranked high environmental quality. Additionally, they turned out to be very similar in terms of biodiversity of the intertidal community, supporting the selection of those area for the collection and transplantation of P. ferruginea.

BEF036

HOTSPOT IDENTIFICATION AND CONNECTIVITY TRENDS FOR THE ENDEMIC SEAGRASS POSIDONIA OCEANICA IN THE MEDITERRANEAN SEA

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The endemic seagrass Posidonia oceanica is a crucial component of the coastal seascapes of the Mediterranean Sea, playing fundamental ecological, physical and economic roles in the Mediterranean large marine ecosystem. Although policies exist that protect P. oceanica meadows, either directly or indirectly, the species has been rapidly and steadily declining in the recent past because of both human activities and climate change. Here, we quantitatively analyze basin- wide connectivity patterns for P. oceanica and assess trends in connectivity over a climatically consistent period of
30 years. Building on a Lagrangian approach to simulate dispersal of P. oceanica fruits operated by marine currents, as described by a physical reanalysis of circulation fields driven by Earth observations, we identify the most ecologically connected areas for the species across the Mediterranean Sea, thus singling out hotspots of connectivity that may serve as priority targets for conservation actions. Our results indicate that P. oceanica connectivity hotspots are unevenly distributed in all of the four main sub-basins of the Mediterranean Sea, and along both the European and the African coastline. Also, although statistically significant trends in connectivity are quite infrequent across the whole Mediterranean basin, we find that they are relatively more prevalent in connectivity hotspots, which suggests that the role played by these sites in structuring P. oceanica dispersal dynamics might be changing over time as well. The present study represents a step forward in the application of a quantitative, scalable and replicable methodological framework for the prioritization of conservation actions in the Mediterranean large marine ecosystem, a challenging environment characterized by complex socioeconomic boundary conditions and high sensitivity to the localized effects of global climate change.

BEF037

MULTI-APPROACH INVESTIGATION OF MACROPHYTES OF ISEO LAKE COMBING REMOTE SENSING WITH STRUCTURAL AND ELEMENTAL DATA

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In the framework of the project funded by the CARIPLO Foundation "ISEO: Improving the lake Status from Eutrophy towards Oligotrophy", a multi-approach characterization of the macrophyte communities of the Iseo Lake (northern Italy) were carried out. Based on a systematic investigation of available data, mainly collected in the frame of WFD monitoring activities performed by ARPA Lombardia, a standardized protocol was developed to map the spatial gradients of macrophytes and to estimate their contribution to the littoral metabolism.

During the period 2015-2017, based on satellite data (Sentinel 2 A-B) and in-situ measurements, we have reconstructed the extent and density of littoral vegetation – largely dominated by Vallisneria spiralis, Najas marina and Ceratophyllum demersum. We focused our attention to the southern sector of the lake (between Iseo and Clusane) which was the one characterized by shallower waters and higher macrophyte colonization rates. In total, 20 different sites were identified for six different macrophytes (V. spiralis, N. marina, C. demersum, Lagarosiphon major, Myriophyllum spicatum, Chara globularis) for each of which biomass samples were collected using known surface frames by SCUBA diving or by modified rakes. In addition, a series of random samplings (n = 12 for both years) were carried out aimed at measuring the species' elemental content of nitrogen, phosphorous, and carbon. Samples were analyzed in laboratory for determining fresh and dried biomass and nutrient content using standard procedures.

Here we presented the main outputs of the work, discussing the reliability of satellite-derived maps, biomass evaluation and the role of macrophytes in regulating the lacustrine nutrient cyclization.

BEF038

NATURAL VARIABILITY OF CLOACAL MICROBIOMES LINKED TO ECOLOGICAL FEATURES OF INDIVIDUALS IN THE BARN SWALLOW

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Microbiomes, the ensemble of the genes of the microorganisms that live in association with an organism, are considered "second genomes" that code for traits that hosts had not to evolve by themselves. Their study has gained interest in recent years thanks to the technological advancements in sequencing techniques. In humans, variation in microbiomes has been associated to several physiological conditions, including a number of pathologies, and currently it is accepted that microbiomes can affect host physiology, behaviour and survival, and can therefore have an important role in natural selection.

We investigated the cloacal microbiomes (CMs) of the Barn swallow (Hirundo rustica), a small insectivorous passerine and a long-distance migrant that breeds semi-colonially mostly in rural buildings of European farmlands. In May-July 2016, we captured and ringed adult and nestling barn swallows at one colony near Milan and collected CM samples using sterile DNA-free microbiological nylon swabs. CMs were then characterized by Illumina sequencing of the V5–V6 hypervariable regions of the bacterial 16S rRNA gene. CMs were dominated by bacteria belonging to the phyla Proteobacteria, Firmicutes, Actinobacteria, Tenericutes and Bacteroidetes. CMs of nestlings were more similar to one another than those of adults, but showed higher alpha diversity. Sibling nestlings, in particular, had more similar CMs than non-sibling ones. CMs also differed between adult males and adults females, but not between male and female nestlings. Finally, surviving adults had less differentiated CMs than non-surviving ones.

This is among the first Italian investigations of CMs of a bird species in the wild and shows that CMs are related to important traits of individuals, such as survival. Microbiomes should therefore be included among the traits investigated by animal and behavioural ecologists, since the currently available technologies allow their investigating at an unprecedented level of detail and at affordable costs.

BEF039

BIODIVERSITY AND ECOSYSTEM FUNCTIONING EVIDENCE FROM THE MEDITERRANEAN AREA

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Biodiversity is the major determinant of community and ecosystem dynamics and functioning. In fact, changes in specie richness and composition have negative consequences for ecosystem functions such as primary productivity, soil fertility, water and air quality, biogeochemical fluxes and ecosystems habitability. Since 1990, the perceived pressing and increasing loss of biodiversity has inspired a wide number of studies attempting to describe the biodiversity and ecosystem functioning relationship (BEF). Among these, many manipulated the species richness and analysed some ecosystem responses and most experimental studies were carried out in temperate zone, within USA and NW Europe.

Here, through a systematic map (SM) technique, we collated evidence from the available literature on the experimental BEF studies in a Mediterranean context, with the final aim to produce a knowledge baseline on this topic and to highlight potential knowledge gaps and gluts. The SMs strive to produce rigorous guidelines and have been proposed to reduce bias in ecological research. After performing a scoping exercise, we created a complex search string that we run on specific literature databases. A total of 100 sources was retrieved over a temporal windows of 21 years, from 1998 up to date, with an increasing trend and a peak in 2017. The largest amount of studies was focused on terrestrial communities and ecosystems, with a noticeable lack of marine studies. Our results suggest an increasing interest in measuring functioning by applying an experimental approach and highlight the need to increase ecological knowledge of marine experimental biodiversity–ecosystem functioning studies. Finally, SM was confirmed as an effective tool to search, screen and synthetize evidence when replying to open-framed scientific questions to build knowledge baseline.

BEF040

ROVING PREDATORS EXTEND THE RESERVE EFFECT ON SEA URCHINS BEYOND THE BOUNDARIES OF A MARINE PROTECTED AREA

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Reserve effect strongly influences the intensity of predator-prey interactions in benthic marine communities. Inside MPAs, high fish abundance and biomass potentially increase predation risk on prey. However, close to the boundaries of Mediterranean MPAs, fish farms are often present and they may critically alter the higher trophic functions. In this study, we estimated variation of predation risk on the functional key species Paracentrotus lividus among the MPA of Tavolara-Punta Coda Cavallo (Sardinia, Western Mediterranean Sea) and the neighbouring area, where mussel fields and fish farms are active from decades. We measured survival rate to predation of vulnerable size sea urchin in nine sites across different levels of protection (full, partial and absent) and both in seagrass and rocky habitats. We then correlated sea urchin abundance with predation rate and biomass of the main predators (sparid fish and whelks). Survival analysis reveals high fish predation activity on rocky habitat of the full-protection level and outside the MPA, where sparid fish biomass is lower due to the lack of protection. Contrarily, whelks' biomass results significantly higher outside mpa, near the fish farms, but their predation was low and unpredictable in both seagrass and rocky habitat, independently of the level of protection. Our results evidence that effectively predation risk on sea urchins is strongly correlated to the biomass of the main fish predators (sparid fish Diplodus spp.) in rocky habitat in the full protection level. However, surprisingly, outside the MPA where sparid fish is estimated to be low in biomass, fish predation was similarly high. These results suggest that the effects of roving predators, as no habitat-associated fish with a high mobility, spill over the MPA towards the farm fields, and consequently can shape the distribution of their preys, such as the key stone P. lividus sea urchin, even in the neighbouring areas.

BEF041

THE SCIENTIFIC RESEARCH ON ECOSYSTEM SERVICES: A BIBLIOMETRIC ANALYSIS

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The scientific research on ecosystem services has grown substantially over the past ten years, making more evident the vital role played by natural ecosystems in support of human economy and well-being. Several studies showed that biodiversity represents a fundamental part of the Earth's life support system. Indeed, biodiversity considerably affects ecosystem functioning while contributing to the provision of different types of ecosystem services. The increasing ecological awareness of scientists, citizens, and policy makers on the importance of natural capital stocks and ecosystem services flows boosted nature conservation strategies and the development of more environmental friendly production processes. In this study, we explored the global scientific literature on ecosystem services over the last thirty years. The software VOSviewer was used to create maps based on network data of scientific publications, scientific journals, researchers, research organizations, and countries. Specific keywords were finally used to explore the co-occurrence of different terms connected to the research on ecosystem services. This approach allowed the identification of the main areas characterizing the scientific literature and research on ecosystem services.

BEF042

GROWING OCCURRENCES OF TROPICAL SPECIES IN THE NORTHERN IONIAN SEA (MEDITERRANEAN SEA)

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The human interference on geographical barriers, combined with climate change and increased seawater temperatures are deeply changing the fish community in the Mediterranean basin considered one of the main hotspots of marine bioinvasion on the planet.

Among the new fish arrivals in the Mediterranean, one of the most emblematic is the case of species belonging to the Tetraodontiformes order distributed mostly in tropical and subtropical areas of the Atlantic, Indian and Pacific Ocean.

Samples of Sphoeroides pachygaster (blunthead puffer) and Balistes capriscus (grey triggerfish) were collected during experimental trawl surveys carried out in the northern Ionian Sea between 10 and 800 m in depth in the framework of national (GRUND) and international (MEDITS) projects on the assessments of the demersal resources from 1985 to 2017.

A total of 59 individuals of S. pachygaster and 36 of B. capriscus were caught from 1991 to 2017. The total length (TL, mm) and weight (g) were measured for all specimens captured; for blunthead puffer sex and maturity stage of gonads were also detected. S. pachygaster occurred between 66 and 400 m in depth. The sampled specimens ranged between 92 and 370 mm TL and the 46% resulted in mature condition. The specimens of B. capriscus were sampled between 13 and 72 m of depth and measured between 143 and 607 mm TL.

After the first finding of S. pachygaster and B. capriscus in the Ionian basin in 1991 and 2006 respectively, a significant increase in the catch of these species has been observed over time. The occurrences and growing of both species refer to the recent increase of temperature and salinity recorded in the northern Ionian Sea, confirming the effect of global warming in the Mediterranean.

The authors discuss the finding of these two species also related to their morphology and trophic niche.

BEF043

METALCONTAMINATIONDEGREEANDENVIRONMENTALRISKOFSOILS INSIDE THE VESUVIUS NATIONAL PARK AND URBAN AREA

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Soil is the foremost constituent of the terrestrial environments and performs fundamental ecosystem services. In addition, soils of high quality guarantee organism wellness and maintain the environmental quality. Urban soils, and most recently soils of natural areas, result slightly or strongly contaminated by heavy metals, deriving from different anthropogenic inputs (tourism, overexploitation, industrialization and urbanization), that cause soil degradation. During the last decades, single or integrated pollution indices as well as environmental risk indices are often applied to evaluate soil quality. The aim of the present research was to compare the contamination degree of soils collected inside the Vesuvius National Park (NP) and at urban areas (U). The surface soils (0-10 cm) were collected at six points for each site typology and analysed for total concentration and the available fraction of Cd, Cr, Cu, Ni and Pb. In addition, to estimate the contamination degree and the environmental risk, the Contamination Factor (CF), the Pollution Load Index (PLI) and the Risk Assessment Code (RAC) were calculated. The results showed that the metal contents at NP and U were comparable with the exception of total Cr and Ni concentrations that were statistically ($P < 0.05$ and $P < 0.0$, respectively) higher at NP and the Cu available fractions that were statistically ($P < 0.01$) higher at U. The CFs highlighted that, with the exception of Ni, the other investigated metals contaminated the soils of both NP and U. The PLI values, statistically ($P = 0.01$) higher at NP, identified the soils of the Vesuvius National Park as more contaminated than those of the urban area. Anyway, on the whole, the soils of both site typologies did not show environmental risk, although the urban soils appeared more exposed to environmental risk for Cu and Cd.

DEA001

EDUCATION 3.0: SERIOUS GAMES AND WEB COMPETITION FOR GAME-BASED LEARNING ON ECOLOGY.

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Our societies are witnessing to a raising awareness on the importance of ecosystems mainly towards the younger people. The awareness comes from the fact that knowledge and information for students are indispensable, even if not sufficient, to become tomorrow's conscious adults, attentive to ecological issues and environmental problems. Unfortunately, ecology and environmental issues, in general, hardly find their place in curricular Italian schools' programmes. On the other hand, today science and technology provide the basis for the fundamental advances in education; in the new educational environment of the 'distance education', Information and Communications Technology (ICT) represent one of the main tools to teach and learn. Here we present some experiences carried out with students of intermediate and high school, from 2007 at national scale and 2011 at European scale. We proposed to students serious games and web competition, combined to experimental work to apply the scientific method to ecological issues. The aim of the initiatives is to stimulate the interest of people on ecosystems that provide our society with goods and services; moreover, we try to awake young people to problems regarding the health of our biosphere. Climate changes, biodiversity, ecosystem goods and services, sustainability, Marine Strategy Framework Directive are some of the ecological subjects of interest of the serious games and competitions. Excellent results were obtained in the previous competitions both at European and national scale, in terms of schools and teams participating to the initiatives. We believe that situated learning and learning by doing, as proposed in our initiatives, are effective methodologies involving students in competitions and tournaments on relevant ecological issues.

DEA002

THE ROLE OF CONSUMERS' KNOWLEDGE ON THE SUSTAINABLE SEAFOOD CONSUMPTION: A CASE STUDY IN THE ARGENTARIO AREA

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Over the last decades there has been an increasing decline of seafood resources, but consumers seem to play a key role in the biodiversity conservation. In this context, it is clear as consumers' education and information about ecosystems and nature conservation are essential processes, even though the precise role that knowledge plays is still not clear in the literature.
Our aim has been to investigate the citizens' knowledge about seafood resources and their pattern of consumption. So, in order analyse the role of education and knowledge in developing consumers' sustainable behaviour it has been realised the questionnaire "Survey on consumers' knowledge and the cognitive, attitudinal and behavioural basis for the choice of seafood resources", administrated in the Argentario area in 2016.
Results show that our sample had overall satisfactory knowledge about marine sustainability, marine species, factors related to fishing and the choices that negatively impact the environment. In particular, the analysis showed a significant capacity to recognise marine species and an important awareness of the ecosystem concept regarding how the elements of the ecosystems are strictly connected to each other. Unfortunately, in spite of their knowledge of sustainable marine products, people still purchase more unsustainable than sustainable marine products.
So, although education may be able to lead people to more sustainable actions, the study seems to confirm that an increase in knowledge of the environmental education doesn't necessarily lead to changes. In this context also other variables have to be deepened, as experiences with nature during childhood, that have an effect on adult assessments of the importance of nature conservation and can direct behaviour toward sustainability in adult life, and in this specific case towards the sustainable purchase of seafood resources.

DEA003

FROM BIOPHILIA TO NATURALIST INTELLIGENCE THROUGH PERCEIVED RESTORATIVENESS AND CONNECTION TO NATURE

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This study looks at how the affective bonds and the cognitive benefits at the basis of the relationship between human beings and Nature can be a solid starting point for an environmental education program aimed to foster naturalist intelligence. Here we propose a theoretical model that considers two constructs - perceived restorativeness and connection to Nature - which make up biophilia. Naturalist intelligence is strongly intertwined with biophilia, as Nature fascination (a construct of perceived restorativeness) and affiliation for life (otherwise called connection to Nature) nurtures naturalist intelligence. Evidences from studies of years of joint research in evolutionary biology and environmental psychology fields, show a plausible overlapping between the Biophilia Hypothesis and the Attention Restoration Theory around the crucial (and measurable) constructs of perceived restorativeness and connection to Nature. Biophilia, as the evolutionary legacy, and naturalist intelligence, as the potential goal of education, can be considered the two poles of an environmental education journey where perceived restorativeness and connection to Nature play a significant role.

DEA004

CALIBRATING THE CONNECTEDNESS TO NATURE SCALE IN CHILDREN AGED 6-10: A TOOL TO IMPROVE ECOLOGICAL LITERACY IN SARDINIAN SCHOOLS

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Contact with Nature is less and less frequent and this is a risk in particular for children, who progressively lose sensitivity to natural environments. Nowadays there is a greater awareness of the importance of increasing environmental education activities especially for children. In this study we used the Connectedness to Nature Scale adapted to children (CNS-ch) in an attempt to calibrate this tool in a Sardinian-school context to improve ecological literacy and encourage pro-environmental behaviour. Connectedness to Nature represents the relationship of the Self with the natural environment and has been made operative using different scales. The study involved about 400 students of the primary schools in Sassari (North Sardinia). Two approaches have been conducted differentiating them for the two age groups (6-7 and 8-10): the first using a self-administered questionnaire, composed of 25 items written in the form of a 5-point Likert-type scale with statements concerning nature and our relationship with it; in the second pictures with different landscapes were shown (following a gradient from the urban environment to the natural one). In both children could express their opinion and feelings. On the basis of the results obtained, it will be possible to define a methodology to detect the level of connection and perception of children with natural environments and to define appropriate pedagogical tools to stimulate naturalistic intelligence and pro-environmental behaviour. This study represents the first attempt to calibrate the use of a scale to detect the connection with nature in children and improve the effectiveness of ecological literacy activities in the Sardinian schools.

IDRO001

LARGE-SCALE DISTRIBUTION OF AQUATIC INVERTEBRATES IN PERMANENT AND INTERMITTENT STREAMS

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Flow regime and its alterations deeply affect macroinvertebrate communities, especially considering the shift in conditions that is occurring in several mediterranean and temperate rivers due to the combined effect of climate change and anthropogenic pressures. This topic has been deeply explored in mediterranean systems, but the effect of regime shift is less known in temperate areas and seldom considering it in the framework of metacommunity ecology, incorporating also space in explanatory variables. With this in mind, we did our work aiming to understand the effect of flow intermittence on the large-scale distribution of benthic invertebrates and the differential importance of explanatory variables related to different spatial scales in permanent (P) versus intermittent (I) watercourses. We carried our work in 24 Apennine watercourses (11 intermittent and 13 permanent) of the Po River Basin (N Italy) before the summer dry phase. We applied mixed effect modelling and spatial ordination techniques in order to evaluate the variation of metrics and community structure between I and P streams and variance partitioning for assessing the relevance of the different spatial scales in I versus P. Communities of I streams resulted characterized by a greater variability than in P streams with, in general, greater levels of diversity in P ones. Moreover, we found out that both in I and P streams, local environmental variables are the most powerful predictors of community structuration. Our findings represent valuable insight in the effects of flow alterations in the perspective of best-strategy planning to face the regime-shift phenomenon.

Candidato Premio Marchetti

IDRO002

EFFECTS OF INTERMITTENCE ON ALPINE STREAMS ECOSYSTEMS: HYPORHEIC ZONE AND RESILIENCE

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Over the last few years, a significant portion of rivers in Northern Italy have been progressively shifting from naturally perennial to intermittent systems, with prolonged dry phases occurring in summer and also in winter . However, the aquatic communities of Alpine rivers lack strategies and adaptations to survive such hydrological and physico-chemical changes. Aim of this study is to explore the impact of intermittence in previously-perennial Alpine stream reaches, considering biodiversity, taxonomic and functional aspects. In detail, we aimed to assess the role of the hyporheic zone in increasing the resilience of these aquatic systems to drought. The hyporheic habitat was monitored in 2017 in two sites (one perennial and one intermittent) in the upper course of the Po River (Val Po, Cuneo province) with piezometers installed in the riverbed, reaching -1 m (both sites) and -3 m depth (intermittent site). Sampling was conducted from July to March 2018 at short time intervals to follow the strongest drought recorded in the area from the 1800s. Sampling was resumed at both stations in January 2018 following the onset of winter precipitations, and conducted at short time intervals during the rewetting phase, and monthly after both stations were permanently submersed. Relative and total abundances of hyporheic and benthic invertebrates changed differently in the two stations during the different phases of the hydrological cycle, suggesting that the hyporheic and benthic communities respond quickly to the onset of the drought. As expected, where water is permanent, the hyporheic communities are abundant; conversely, increasingly harshness (i.e, reduction of the water table) affects hyporheic communities and increases the use of the hyporheic habitat as a refuge by benthic taxa.

IDRO003

RESILIENCE OF MACROBENTHIC COMMUNITIES IN PERENNIAL AND INTERMITTENT LOWLAND RIVERS AND CHANNELS

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Climate change significantly affects aquatic lowland ecosystems through altering precipitation patterns and increasing frequencies of extreme events. Moreover, water withdrawals for multiple uses may further exacerbate water level fluctuations. These phenomena are particularly evident in the river Po basin, and particularly in the canal networks of agricultural basins.

While many studies dealt with the impacts of climate change on macrobenthic communities in headwater streams (sensu Minshall), there is a gap of knowledge on the effects of hydraulic variation on lowland waters.

This study analysed the structural and functional composition of macrobenthic communities in 12 lowland rivers and canals, selected according to morphological (i.e. water depth, channel width, altitude and climatic conditions), physical-chemical (i.e. water quality negatively impacted by surrounding urban and agricultural land) characteristics and their hydraulic regulation: 5 had a constant water level and 7 were subjected to emptying in autumn and winter. Sampling was performed in May-June and taxonomic classification reached the family level.

A total of 53 families were found. The results showed that hydraulic variation does not significantly affect macrobenthic communities, except for higher density values (ind m-2) observed in non-perennial systems. The macrobenthic communities were found to be highly resilient to hydraulic variations, both in terms of structural and functional diversity. However, significantly higher abundances of shredders were observed in perennial channels, while higher abundances of gathering collectors were found in non-perennial ones. Moreover, the communities of the two system types showed differences in their biological traits. Resilience of non-perennial systems is guaranteed by the presence of fast growing, short life span, univoltine taxa and by the recolonization through the irrigation water from the Po, at the beginning of spring.

IDRO004

RESILIENCE OF MACROINVERTEBRATE COMMUNITY TO ANTHROPOGENIC DROUGHT IN THE TREBBIA RIVER

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Intermittency has emerged as an important feature of river networks globally. This is particularly true in Italy due to both the local effects of climate change (i.e. prolonged summer drought events) and the water abstraction for urban, industrial and agricultural uses. In this context, an improvement of the knowledge about the recolonization pattern of organisms is needed in order to propose reliable strategies for the management and conservation of freshwater ecosystems. The aim of this work was to assess the resilience of macroinvertebrate community to anthropogenic drought in the Trebbia River, a 120 km length tributary of the Po River. To this purpose six sampling sites were identified along the last 20 km of which two (St1, St2) were located upstream and four (St3, St4, St5, St6) downstream of the main water withdrawals, respectively. The former four sites (St1, St2, St3, St4) were perennial while the latter two (St5, St6) were intermittent. During summer 2017, temperature data loggers were placed in both riffle and pool mesohabitats in order to measure the extent of the drought period. Macroinvertebrate samples were collected during December 2017, nearly 2 months after the flow resumption, and late June 2018, before the drought period. Ten replicates were gathered in the main stem with a surber net of 0.05 m2 frame area in both riffle and pool mesohabitats. Taxonomic richness was significantly lower in intermittent sites in December while a partial recover was highlighted in the June sampling campaign. This study contributes add knowledge about macroinvertebrate community dynamics in intermittent rivers and provides information for defining ecological flows in rivers with multiple competing interests.

IDRO005

POST-DROUGHT RECOVERY OF MACROINVERTEBRATE COMMUNITIES IN ALPINE RIVERS

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Water scarcity is one of the most relevant threats for rivers around the world, given the combined effects of climatic and anthropogenic pressures on water supplies. Also "historically perennial" watercourses, like Italian Alpine streams, now are shifting from permanent to intermittent systems. This represents a recent phenomenon caused by local (i.e. water abstraction and damming) and global (i.e. climate change) impacts. As a consequence, the resilience of benthic communities to drought in such lotic ecosystems is still poorly understood. Here we present results on the post-drought recolonization of stream macroinvertebrates in two Alpine watercourses: the Pellice river and the Po river (Piemonte, Italy). In April 2017, during the field activity of the PRIN "No Acqua" project, quantitative samples of benthic invertebrates were collected from these rivers. Then, both rivers experienced one of the most severe drought recorded in the investigated area over the last decades: in fact, the selected sampling sites dried out completely from July 2017 to January 2018. As the water resumed, we collected again the macroinvertebrates to monitor their temporal recovery (January–March 2018). In general, the macroinvertebrate communities of the two rivers showed a quite similar and progressive recovery over the time both in terms of taxa richness and total abundance of invertebrates. However, we also found some differences between the two rivers: on average, the recovery pattern in the Pellice river was faster than that observed for the Po river. The distance from the up-stream permanent section and the amount of precipitations were the factors that mainly accounted for the observed differences, underlying the influence of river-specific characteristics on the recovery process.

IDRO006

SOME LIKE IT CONSTANT: THE COMBINED EFFECT OF MACROFAUNA AND WATER INTERMITTENCY ON ORGANIC MATTER MINERALIZATION

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A large number of permanent stream are becoming intermittent due to climate change and the increase of water abstraction. Shifts from perennial to intermittent flow regimes modifies the abiotic characteristics of benthic systems, plant, animal and microbial communities, resulting in changes of the benthic ecosystem functioning such as organic matter retention or mineralization. In stream leaf litter breakdown is facilitated by feeding activities of shredders, that play a key role in nutrient recycling and translocation along lotic food webs. The presence of shredders can be especially important for the microbial-detritus compartment, by stimulating microbial growth on the leaves and can strongly regulate productivity within ecosystems.

In this study we performed a laboratory experiment using microcosms to test the effects of feeding activity of shredder larvae on leaves decomposition and nutrient recycling, in permanent and intermittent (dry phase followed by rewetting) conditions. We incubated leaves disks (Populus nigra) in presence and absence of Limnephilidae larvae (Trichoptera) and under different hydrological regimes (permanent vs intermittent). For each condition we used leaves of different dimension (1 and 5 cm of diameter), assuming a different colonization by bacterial communities, that influence leaf litter palatability and consumption by shredders. The aims are to measure benthic metabolism (respiration and nutrient fluxes) before and after drought, to quantify organic matter mineralization rate and to test the effects of decomposer on leaf litter consumption. We hypothesize that drought event affects the organisms involved in organic matter recycling, alters decomposition rate and ecological interactions between shredders and microbial community, resulting in different nutrients availability in water.

This work is part of a PRIN project: NOACQUA-risposte di comunità e processi ecosistemici in corsi d'acqua soggetti a intermittenza idrologica (PRIN 2015 - Prot. 201572HW8F).

IDRO007

N AND P BIOAVAILABILITY IN RIVERBED SEDIMENTS OF INTERMITTENT STREAMS IN RELATION TO HYDROLOGICAL VARIABILITY

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Aquatic environments subjected to hydrological fluctuations are common ecosystems worldwide. However, the flooding and drying patterns for many streams and rivers have changed as a consequence of regulation and water abstraction. Furthermore, climate induced changes in precipitation patterns is expected to further alter the flow regimes, of both regulated and unregulated streams. This can lead to flow cessation, the formation of isolated pools and ultimately to streambed desiccation and the emergence of dry sediments, with strong concomitant changes in the biogeochemical processes responsible for nutrient transfer and cycling. For example, sediment exposure to air and drying changes moisture content, influences sorption–desorption P processes by exposing redox-sensitive metals to oxygen or by changing their mineral forms and affect the activity of microbial communities involved in nitrogen redox transformations.

In this work, funded by the PRIN2015 NOACQUA (Risposte di comunità e processi ecosistemici in corsi d'acqua soggetti a intermittenza idrologica, Prot. 201572HW8F), we examined changes in the biogeochemical characteristics of surficial sediments in streams during the summer period. The study was carried on in three streams draining the Apennine side of the Po river (Trebbia, Taro, Enza) which have wide variations in water discharge and experience summer disconnection phases characterized by the persistence of small pools and exposed sediments. Here we present the main outputs of the work, discussing in particular the effect of hydrological disconnection on organic matter content, inorganic P and N content and their bioavailability and the short term effect of hydrological reconnection on nutrients mobility and stoichiometry.

IDRO008

IMPACT OF DROUGHTS ON ALPINE LOTIC COMMUNITIES: FIRST DATA FROM NOACQUA PRIN PROJECT

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In recent years, an increasing number of Alpine streams are changing from perennial to intermittent systems due to global climate change effects combined with local impacts, such as increasing water abstraction, with expected long-term detrimental effects on stream biodiversity and functionality. As part of the PRIN NOACQUA project, we here examined whether benthic communities i.e. macroinvertebrates and diatoms, experiencing recurring droughts show alterations even after complete flow resumption in 13 mountain streams in South-Western Italian Alps. In each stream, benthic communities were sampled after complete flow resuming in April 2017 in a control section, i.e. a reach with permanent flow, and in a disturbed section, which experienced drought during summer. We tested for differences in terms of community composition, diversity and functional groups between permanent and intermittent sections. Our results showed a significant alteration of benthic invertebrate, but not diatom communities in intermittent sections, with different species composition and low diversity values due to the replacement of monovoltine taxa, with aquatic respiration, preferring medium to fast flowing, oligotrophic waters by plurivoltine taxa, with aerial respiration preferring lentic habitats. Such results underlay how benthic communities in intermittent sections of alpine streams are currently under pressure and further investigations in mountain areas are required in the next future to better unravel these processes.

IDRO009

STATUS OF FISH COMMUNITIES IN CHANNELS SUBJECT TO FLARE: A MODEL FOR STUDYING THE EFFECTS OF HYDROLOGICAL INTERMITTENCY IN NATURAL SYSTEMS.

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Hydrological intermittency affects both natural and artificial systems, especially in Mediterranean regions and in arid climate. This phenomenon has been occurring with increasing frequency in permanent watercourses in continental contexts and in the low-level watercourses and artificial canals that, by their nature, are periodically filled and emptied. Hydrological intermittency has significant effects on habitats and species of conservation interest and on the regulation processes of the biogeochemical cycles of the main elements. The aim of this study, included in the PRIN project "NOACQUA-community responses and ecosystem processes in WATER courses subject to hydrological intermittency" was analyzed the effects of hydrological intermittency in 13 artificial, permanent and intermittent canals, of the Po basin, using fish fauna as a biological descriptor. The fish fauna was sampled using standard transect networks, identified according to the characteristics of the watercourse. The fish material caught on each sampling sites, was classified at species level, measured and weighted. The data were expressed in terms of composition, abundance (numerical and biomass) and diversity. The results showed a fish community characterized by 21 fish species, 8 indigenous and 13 allochthonous, composed in biomass for 80% by only 4 species: Silurus glanis, Abramis brama, Carassius auratus and Cyprinus carpio. The results also suggested that the hydrological intermittency regimen penalized S. glanis, a large-sized general predator, favouring the detritivorous alien cyprinids (C. auratus, C. carpio and A. brama). In the constantly invaded channels, the greater depth promoted the S. glanis, which has a much higher percentage of biomass, reducing consequently the presence of cyprinids such as C. auratus and C. carpio for which also a size selection occurred. From this first analysis, it is hypothesized that in natural systems the hydrological intermittency promotes the selection phenomena of native and exotic species.

IDRO010

EFFECTS OF HYDROLOGY AND ANTHROPIC STRESSORS ON WATER GROUNDWATER/SURFACE WATER INTERACTIONS AND ON WATER QUALITY OF HIGHLY IMPACTED WATERSHED (OGLIO RIVER, NORTHERN ITALY)

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Quantifying the effects of climate change, land use and other multiple stressors, that may also act in synergy, on freshwater ecosystems is challenging, due to the complex interactions within blue water components (groundwater, lakes, rivers, springs) and to the lack of tailored field campaigns for the contemporaneous measurement of hydrological, chemical and ecological parameters. Concurrent effects with several stressors, such as the variability in hydrology, agricultural or industrial activities and waste water treatment plants, have not been explored at depth, so far. These pressures on biogeochemical cycles, ecosystem functionality and quality are growing worldwide, and reducing their effects on the water 'availability' and quality is one of the major societal challenges.

We present a study (Fondazione Cariplo grant n° 2014-1282) on blue water of the Oglio River sublacual basin (Lombardy Region – Northern Italy), aiming to analyze the processes that affect blue water quality and quantity with a key focus on the interactions within its different components using the inter-disciplinary approach.

The study area shows a significant variability in terms of land and water use and hydrological driving forces: this allows us to use this basin as a benchmark for testing and validating models of ecological functioning, pollutant cycling as well as the effects of new water policies and water management strategies.

More than 60 sampling sites have been monitored seasonally for three years, measuring hydrological, hydrochemical (ions, nutrients, heavy metals) and isotopic features on the lake, river, aquifer, and springs to produce a quantitative water balance to evaluate the sources of water, the travel time and the mixing degree between surface water and groundwater, and among the confined aquifers.

IDRO011

EFFECT OF HYDROLOGICAL VARIATIONS AND LAND-USE EVOLUTION ON CHLORIDE TREND: A LONG-TERM ANALYSIS IN THE OGLIO RIVER-LAKE ISEO SYSTEM (NORTHERN ITALY)

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Variation of lake watershed hydrology and discharge within the river network can affect biogeochemical dynamics in both the catchment area and the lake ecosystem. Climate change is reported to enhance hydrological variation and thus the analysis of these parameters is gaining even more importance. Many long-term studies have identified a chloride increase in different lakes worldwide, resulting from a response to climate and anthropogenic influences, with a negative impact on lake ecology and ecosystem services. However, the relationship between chloride concentration and the hydrological parameters and their variability, that can account for the Cl- positive trend, were rarely taken into account. We analyzed a long-term dataset (1993-2017) of hydrological parameters, such as discharge flow, precipitation, average air temperature, in the Oglio River watershed and we investigated their relationship with lake chloride concentration. Moreover, to obtain a complete framework of the causes of chloride rise and to attempt to assess the possible sources, GIS analyses of the watershed area have been performed, delineating the land use and the evolution of population dynamics in the lake catchment system. A positive temporal trend of chloride could be highlighted in Lake Iseo with an increase of about 25% over the twenty-four years analyzed. Inflow data did not show a positive trend and the cross-correlation did not highlight a direct relationship with Cl- concentration. The only way to put in relation discharge data and concentration of chemicals is to evaluate the compounds load. Indeed, a more informative and exhaustive characterization can be obtained through the analysis of load instead of concentration. For this aim and to make available a useful and easy-to-use tool, we developed a new open-source R package, called RiverLoad, to perform the load estimation with different methods (i.e., averaging methods, ratio estimators, and regression methods) through 12 different implemented algorithms.

IDRO012

A PALEOLIMNOLOGICAL INVESTIGATION OF THE IMPACT OF CATCHMENT DYNAMICS ON PELAGIC COMMUNITES IN A DEEP SOUTH-ALPINE LAKE (L. ISEO)

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Catchment area changes (e.g. river hydrology, nutrient loads, land use), driven by climatic variation or anthropic activities, can have a strong impact on lake ecosystems. In particular, extreme flood events can bring a lot of sediment in lake basin affecting physical and chemical water features, biocoenoses and food webs. In previous studies, it has been verified that impact is amplified in lakes with a large ratio of drainage basin and lake areas. Lake deposits provide ideal archives to study the past catchment dynamics and the answer of lake ecosystems. In particular, subfossil Cladocera remains are a valuable biological proxy, able to provide information on lake responses to hydrology- and climate-related environmental perturbations. Lithological analyses combined with subfossil remains can reveal responses of lake ecosystems to changes in the catchment area. The aim of this work is a paleolimnological reconstruction of human, climate and hydrological impacts on a deep subalpine lake (Lake Iseo, northern Italy) during the XX century. We study the lithological parameters and Cladocera and diatoms subfossil remains record in an 80 cm long sediment core spanning from the early 1920s to 2014. We compare the sediment records with historical information on major hydrological events during the last century, and with climate-related limnological data. As already observed in other lakes, the sediment records of Lake Iseo suggest that catchment related processes are able to decisively affect the food web dynamics and the lake functionalities. In particular, we observed that a series of flood events in the period between the '70s and '80s resulted in a decrease in the Cladocera total abundance and a prevalence of the littoral species over the pelagic one. The decline of the pelagic species has been attributed to the transport of inorganic material from the catchment area to the lake.

LIFE001

TOWARDS A MULTI-OBJECTIVE APPROACH TO DESIGN EFFECTIVE BIOSECURITY PLANS FOR LIVESTOCK EPIDEMICS

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The epidemic spread in livestock farm systems is a major concern, causing the culling of a large number of animals and negative economic and social impacts. Thus, to prevent and control livestock epidemics it is crucial to design effective biosecurity plans, accounting for a multiplicity of objectives. In this context, quantitative epidemiological studies can help explain the possible disease transmission patterns and assess the role of farms in the diffusion process.

Here, we evaluated the potential functional role played by farms in shaping the pattern of epidemic spread. As a focal case study, we considered the dairy system in the Emilia Romagna region (Northern Italy). We developed a data-driven daily temporal network model with nodes representing farms, the epidemiological units, and links describing the potential routes of pathogen transmission. We grouped links in two layers, one for direct contacts due to the movement of live cattle and the other for indirect contacts generated by contaminated trucks visiting several farms. We simulated the diffusion of epidemics on the network through a Boolean Susceptible-Infected model.

The role of each farm was assessed with respect to a set of objectives focusing on different aspects of the infection process. Then, in a multi-objective space, we identified the set of the most critical farms, where the implementation of biosecurity measures may reveal to be more effective. Trade-offs between the objectives did emerge, showing that the identification of key farms is not trivial and may crucially depend on the specific measures applied.

LIFE002

HARMONIZED OBSERVATIONS IN ECOLOGY DISCIPLINE: A SEMANTIC AND STANDARDIZED SOLUTION

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Observations are a starting point for supporting a scientific theory. In ecology, both in monitoring or research activities, observations are the pillar of the discipline. In this work we follow a high-level approach where an observation is regarded as any "action whose result is an estimate of the value of some property of the feature-of-interest, at a specific point in time, obtained using a specified procedure" (After Cox 2008 cited by INSPIRE Cross Thematic Working Group on Observations & Measurements, 2011).

The aims of our work are: (i) to evaluate implementing rules and technical guidance specifications for the provision of measurement data in the European INSPIRE Directive (2007/2/CE); (ii) to suggest best practices to ecologists that usually are not accustomed to technological practices, in order to share observations with Open Geospatial Consortium (OGC) standards and to be compliant with other solutions adopted in thousands of European and global projects; (iii) to propose a technological solution, especially for the LTER network, for achieving interoperable interaction among infrastructures, networks, or institutions.

These objectives will be sustained by practical examples utilizing real field data, in this manner we will: (i) show how the O&M OGC schema is indicated for ecological observations; (ii) explain, with practical examples and the use of open-source software, how to move from data collection to data provision via international standards; (iii) describe how the types of observations indicated in O&M data model can be used in the field of ecology; (iv) enrich observation with semantic annotation.

LIFE003

COSMI - COLLECTION OF SEA MICROORGANISMS AT TRIESTE, A SOURCE OF LIVING MATERIAL TO IMPROVE THE KNOWLEDGE OF MICROORGANISM BIODIVERSITY

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The Collection of Sea Microorganisms - CoSMi - is part of the Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS) at Trieste. It is a facility within the infrastructures of LifeWatch-Italia and EMBRC-Italia; additionally, it is part of the BioMarine Lab ECCSEL ERIC and is an integral part of the Observatory System: Gulf of Trieste.

CoSMi is a bioresource center comprising many species of unicellular (autotrophic and heterotrophic) eukaryotes isolated in the Gulf of Trieste (Northern Adriatic Sea, Mediterranean Sea), such as toxic dinoflagellates, diatoms and ciliates. Included in the collection are also microalgae used in acquaculture and ecotoxicology.

CoSMi's mission is to isolate, taxonomically and genetically identify marine microorganisms, and cultivate them. In many cases a definitive taxonomic determination is exclusively possible on cultured material. Several species have already been newly described or rediscribed using CoSMi cultures. Cultures are made available to the scientific community and to different industry sectors: aquaculture, pharmaceutical, nutraceautical and energy.

CoSMi's team is active in outreach and communication activities on the topic of microalgae and microorganism biodiversity and their importance in the marine food web structure and environmental dynamics. CoSMi collaborates at national and international level and supports experimental studies for Master and Doctorate degree projects.

LIFE004

SHARING WATER AND SEDIMENT SAMPLES METADATA: AN EXAMPLE FROM THE LTER-ITALY MARINE AND FRESHWATER SITES

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Water and sediment samples (also called specimens) are key observational units in environmental sciences, particularly in marine ecology and geosciences, hydrobiology and limnology. Such samples must be maintained in the medium/long term and require to be easily discoverable through unique identification standards and metadata catalogues which are, at the moment, lacking.
We present here both best practices and technological solutions for representing and sharing sample descriptions, using as an example water and sediment samples from a number of marine and freshwater sites belonging to the Italian Long-Term Ecological Research network (LTER-Italy). In LTER-Italy, observations are stored and shared following ISO 19156:2011 (O&M). We propose to enhance this practice by introducing the use of the physical samples metadata model identifying with International Geo Sample Number (IGSN) proposed by CSIRO.

Information available for each physical sample includes, among the others, the sample name, type, the sampling location and method, and the indication of the sub-samples collected, with the relative sampling methodologies. Moreover, when the samples are analysed, for each of them a list of other information becomes available together with environmental variables data, including measures obtained directly in the field.
We present here a proposal that provides a way for describing, archiving, visualising and sharing samples and allows connecting the different related entities, such as sampling methods, persons, instruments, and observations representations. A hyperlinking approach is tested as a valuable solution to manage all the information, giving the possibility to move among them, learning more about the data life cycle. Applying this approach makes it possible to refer each entity to the other, describing not only the relationships between them but also those among the different sub-entities generated from the same samples (e.g. from the sediment core to the slide with recognized foraminifera or from the water sample to the phytoplankton sample).

LIFE005

PHYTOPLANKTON TRAITS COMPUTATION AND SIZE DISTRIBUTION IN THE PHYTOPLANKTON VIRTUAL RESEARCH ENVIRONMENT (PHYTOVRE).

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Phytoplankton plays an important role in aquatic ecosystems because it accounts for most of global primary production and affects the biogeochemical processes, process and function of the ecosystem.
We have developed the Phytoplankon Virtual Research Environment (PhytoVRE), a collaborative working environment for researchers interested in phytoplankton community structure, organization and ecological function. PhytoVRE consists of i) an Atlas of phytoplankton, a taxonomic Atlas including illustrative cards from phylum to species level; i) an Atlas of shapes characterized by a set of 51 geometric models, including specific shape linear dimensions and biovolume and area formulas; ii) a data template to harmonize raw data compilation and iii) computational tools for Phytoplankton Traits, Phytoplankton Size Distributions, Phytoplankton indices. The first tool allows to calculate morphological and demographic traits (hidden dimension, biovolume, surface area, surface-volume ratio, cell carbon content, density, carbon content and total biovolume); the second allows to perform Modality (Hartigans' dip test), Normality or LogNormality (Anderson-Darling test, Cramer- von Mises) tests of Phytoplankton Biovolume (expressed as μm3) or Cell carbon content (expressed as pgC*cell-1) distributions, at different level of data aggregation (i.e. spatial, temporal, taxonomic); the third allow to calculate simple and multimetric indices to assess the ecological status of marine and transitional ecosystems.
PhytoVRE provides users with a suite of tools and services that will enable them to: a) obtain harmonized data on taxonomy and morpho-functional traits; b) do computational massive analysis on fundamental characteristic for phytoplankton communities studies and monitoring programs; c) share dataset and results with community LW users, and then to improve the knowledge on phytoplankton. The obtained results help scientists, stakeholders and users to better understand the ecosystem variability in the prospective of the future environmental change.

LIFE006

THE PROJECT ABC2: COORDINATED DISTRIBUTED EXPERIMENTS ASSESSING THE POTENTIAL OF BENTHIC HABITAT-FORMERS TO AMELIORATE CLIMATE-DRIVEN STRESS

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Habitat-forming species have been widely shown to enhance the persistence of associated species in otherwise unsuitable areas through the reduction of physical stress. Nonetheless, the role of facilitation in modulating species response to climate change remains unexplored. Several knowledge gaps hinder our ability to predict how habitat-formers may contribute to sustaining marine biodiversity in the face of increasingly adverse environmental conditions. As part of the activities carried out within the framework of the Foresight Workshop POSTCLIMA, funded by the European Network for Marine Research (EuroMarine), 17 ecologists from 14 Institutions have designed 'coordinated distributed experiments' aiming to assess how intertidal canopy-forming seaweeds modify the intensity and spatial variability of environmental stressors (i.e. temperature, desiccation and hydrodynamic-forces) and shape benthic biodiversity. A call for participation to the program is currently open and details of the main objectives and of the sampling protocol are available at https://www.euromarinenetwork.eu/documents/abc2projectsamplingprotocol.

LIFE007

TESTING THE POTENTIAL OF A CONSUMER-GRADE DRONE FOR HIGH-RESOLUTION CARTOGRAPHY OF LITTORAL ROCKY-SHORE COMMUNITIES

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Benthic communities associated with rocky littoral habitats are considered sensitive species and good bioindicators of water quality. The occurrence of these species is widely used in the Mediterranean Sea for the assessment of the ecological status of water bodies according to CARLIT method (Cartography-of-littoral-and-upper-sublittoral rocky-shore communities).

In this study, we tested new application from drone technology to establish a detailed cartography of the littoral habitats in order to support and implement the CARLIT index along the Sinis Peninsula (Western Sardinia).
To test this new approach, we used a DJI Phantom4, a consumer-grade drone. Take-off and landing were controlled manually from a small boat. To test the flying feasibility and cartographic rendering (ID, Accuracy, distortion, coverage) 4 different geomorphological settings were surveyed. During the surveys we collected 2,500 high-resolution photos, from a fixed altitude of 15 m, along 3 km of coastline. All the images were processed using a photogrammetric software and Structure from Motion (SfM) techniques in order to obtain high-resolution ortho-mosaics (0,5 cm/px) and digital terrain models (DTM) of the surveyed area. Optical DTM were analysed using GIS software to get the areal cover of the shallow subtidal algal communities and terrain attributes (slope, aspect, rugosity).
Results allowed us to estimate the CARLIT index and the surfaces covered by the most abundant assemblages with a decimetric accuracy through a sampling effort of 1.5 h/km. This method produced a detailed baseline for future CARLIT assessments. Moreover, high-resolution models of the rocky coastal area will allow to follow temporal dynamics, e.g. the early detection of macroalgal community shifts.

PAES001
CONSERVATION ECOLOGY OF SUBTERRANEAN LANDSCAPES

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Subterranean ecosystems are environments with peculiar hydro-geological and ecological characteristics, considered among the most fragile natural ecosystems in the world. They host valuable resources (i.e. groundwater) and provide suitable habitats for numerous rare or endemic species. Despite this, their importance has been so far largely ignored leading to resources overexploitation, and habitat and biodiversity loss. Existing protection rules that protect the single caves are often not adequate to reflect the complexity of the ecosystem. Moreover, the majority of the studies focused on specific species or single caves, with difficulties in give a complete understanding of large-scale subterranean systems. A complex system of ecosystems, as a "landscape" is defined, is a model in which subterranean systems can easily be integrated. Caves are in fact ecosystems themselves but connected to each other in extensive and complex systems (landscapes). Here, much of the connectivity between the units of the landscape is underground, with aquifers and caves that form a continuous layered tissue whose accessibility and 'invisibility' have contributed to make it among the less studied natural landscapes (and hence known) in the world. In this presentation we aim to provide a new conceptual framework to address the research on the conservation of the subterranean environment by applying principles of landscape ecology. This imply to identifying the main karst elements and functions, the threats to the karst landscapes and in which way the structure, functioning and provisioning of ecosystem services are affected. Finally, we aim to discuss the effectiveness/limitations of the existing conservation normative tools and their possible implementation at the light of a more comprehensive approach.

PAES002

CULTURAL BENEFITS PROVIDED BY URBAN GREEN AREAS: COMPARISON OF PEOPLE, PARK MANAGEMENT AND CULTURAL ASSOCIATION PERSPECTIVES.

Padoa-Schioppa E., Canedoli C.

Both cultural and biological diversities underpin resilience and sustainability of cities. Human health and well-being, and the amenity values of most cities are strongly related to the quantity and quality of urban green areas. Within these areas, the assessment of cultural ecosystem services (CES) is less frequent than other ES assessment, in part because of methodological constrains and conventional biophysical and economic assessments that often resulted not adequate to capture cultural values. As a consequence, they may be underestimated and threatened, when land-use planning and management decisions are based on inadequate information. This study aimed to present a methodology to integrate cultural benefits with decision support using public participatory GIS techniques (PPGIS) and comparison analysis. Mapping cultural benefits was informative to detect conflicts or not between nature conservation and recreation that happen in particular around densely populated areas. Moreover, comparison analysis informed about matches or mismatches between different actors' perception of cultural benefits (citizens, cultural associations, park management) resulting in spatially explicit data informative for park planning. The methodology was also proposed as a monitoring tool to investigate changes on cultural benefits perception over time. Finally, the study discussed the utility of the data acquired to effectively implement urban parks planning.

PAES003

NEW INSIGHTS IN PLANT ECOPHYSIOLOGICAL PERFORMANCE: THE COMBINED ACTION OF LIGHT QUALITY AND BIOFERTILIZATION

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The increasing of the human population requires solutions for sustainable agricultural practices to preserve the environment. Appropriate "eco-friendly" fertilization protocols, applied in growth chambers or greenhouse, could maximize the crop yield avoiding the massive utilization of chemicals in agriculture. Soil microorganisms (i.e. mycorrhizae and rhizobacteria) could represent a promising solution enriching soil with beneficial compounds. At the same time, the choice of specific light quality regimens during growth also may be considered a suitable tool in improving crop production increasing photosynthesis. Some light wavelengths affect the formation of mycorrhizas in soils, promoting plant growth and physiological performance. This study aimed to asses if the modulation of light quality may influence the plants-microbe interaction, determining changes in physiological, morphological and biochemical traits in Spinacia oleracea L. plants. At this purpose, not-inoculated (NI) and inoculated (I) spinach seeds with a mix of fungi and rhizobacteria were grown in a climatic chamber under four different light quality treatments: white (W), Red (R, 100%), Red-Blue (RB, 60:40% Blue), Red-Green-Cyan (RGC, 60:20:20%) at light intensity of 350 □mol photons m-2 s-1. Plant growth has been followed up to 100 days after sowing (DAS) and leaf functional traits, photosynthesis, pigments and bioactive compounds were measured. Light spectrum composition and biofertilizer influenced plant growth through a different morphology and biomass allocation. More specifically R and RGC induced a greater leaf area and stem elongation, while RB and biofertilizer promoted roots development. The combination light quality/biofertilization positively affects gas exchanges and determines significant changes in antioxidants. The results of this study may be considered encouraging in the planning of new fertilization protocols for the cultivation of crop species on a broad scale in the framework of sustainable agriculture.

PAES004

L'ECOLOGIA DEL PAESAGGIO INCONTRA L'ARCHEOLOGIA. I MODELLI DI DISTRIBUZIONE DI SPECIE E I DATI SATELLITARI PER LO STUDIO DEI PAESAGGI ARCHEOLOGICI

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Le strutture prodotte dalle attività umane in epoca preistorica e storica risultano in componenti spaziali antropogeniche dei paesaggi attuali. Lo studio delle caratteristiche dei paesaggi archeologici è funzionale sia allo sviluppo di politiche di protezione del patrimonio culturale alla gestione efficiente dell'impatto del rischio archeologico inerente alla pianificazione infrastrutturale. In questa prospettiva, i modelli per la stima della probabilità di distribuzione di specie stanno assumendo grande importanza per lo studio dei paesaggi archeologici. Inoltre, anche l'uso dei dati telerilevati si sta affermando in questo tipo di modelli, sia in ambito archeologico che ecologico. Sulla base dei dati di sola presenza, sono stati testati, integrati e valutati per applicazioni archeologiche a diverse scale nel caso dei paesaggi neolitici del Tavoliere delle Puglie (Italia meridionale) due approcci di modellazione predittiva induttiva, un'analisi spaziale multi-parametrica in ambiente di sistema informativo geografico (MPSA-GIS) e il Maximum Entropy Model (MaxEnt). I dati sulla presenza includevano sia siti identificati tramite tecniche di rilevamento da remoto e sia quelli derivati da indagini archeologiche. Le variabili ambientali includevano attributi derivati da attributi topografici, geomorfologici e di telerilevamento. Criteri ripetibili contrastanti (quali coefficienti di correlazione, le statistiche prodotte dal modello MaxEnt, e analisi spaziale delle componenti principali - sPCA) sono stati utilizzati per selezionare variabili ambientali non ridondanti. Inoltre, è stato utilizzato il Criterio informativo di Akaike (AIC) per selezionare le configurazioni più parsimoniose dei modelli. Un'analisi di soglia dei dati di presenza è stata eseguita sul modello migliore per definire la dimensione minima del set di dati di presenza rispetto all'ampiezza dell'area di studio e la quantità relativa di dati di risposta derivati da rilevamento remoto per raggiungere una prestazione stabile di il modello. I risultati mostrano prestazioni migliori per i modelli MaxEnt rispetto a quelli MPSA-GIS, indipendentemente dalla scala, a indicare che i due approcci non possono essere considerati alternativi. Le configurazioni più parsimoniose di questo modello indicano che, a seconda della scala, entrambe le statistiche sPCA e MaxEnt soddisfano lo scopo di selezionare in modo obiettivo le variabili di input non ridondanti. L'analisi di soglia suggerisce che, per il caso di studio illustrato, è necessaria una densità di 0,2 siti di presenza / km2 e il 45% di siti individuati attraverso il telerilevamento per migliorare e stabilizzare le prestazioni del modello. Vengono evidenziati i problemi critici e le opportunità per il progresso nell'esecuzione dell'approccio MaxEnt in un contesto operativo per l'archeologia. Ciò si traduce in suggerimenti per le parti interessate che si occupano di modellizzazione predittiva prima dell'impegno sia per lo sviluppo del territorio (protezione dei siti archeologici) che per le indagini scientifiche sul campo.

ORAL

PAES005

EFFECTS OF LAND COVER AND LAND USE CHANGES ON ECOSYSTEM SERVICES OF RIVER ADIGE BASIN

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Mountain landscapes are important providers of a comprehensive set of Ecosystem Services (ES) that support local well-being. These areas are subject to socio-economic drivers that alter their landscape pattern and ecological functions. This study aims to assess the changes in land use and land cover (LULC) occurred during the period 1960-2012 and their consequences on the ES provision capacity in the river Adige basin (Northern Italy).

Two different periods were analysed: 1960-2000 and 2000-2012. The results highlight important land cover changes (48.8% of total area) during the first period, mainly involving transitions from pastures to other land cover types, while the second period was characterized by a substantial maintenance of the landscape pattern (changes in only 3.54% of total area). However, changes in land use intensity, namely amount of fertilizer applications, significantly varied during the total period. The combined effects of land cover and land use changes were modelled to investigate variations in the ES provision. The enhancement of food production led to significant alterations of ecological functions in the Adige basin, by inducing changes in both land cover and management practices. Moreover, the ES provision is also expected to be sensitive to climate changes. Results are discussed with respect to landscape management at river basin scale.

PAES006

LANDSCAPE APPROACH AND BEETLES TO ASSESS THE CONSERVATION STATUS OF A MEDITERRANEAN METROPOLITAN AREA

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In the recent years, a growing need to incorporate nature into urban planning suggested to adopt multiple approaches to design appropriate regional planning strategies for the protection of the remaining natural areas and the species therein. Accordingly, we investigated the relationships between landscape fragmentation and the species richness of selected beetles in the Metropolitan area of Cagliari (Italy), to test a methodology suitable to i) assess the fragmentation and conservation status of the whole study area and of the single municipalities ii) study the relationship among landscape conservation status and beetle richness (iii) give useful information to mitigate the negative effects produced by fragmentation and land use change at landscape and at species level. At the scale of the Metropolitan area of Cagliari, for each municipality, we calculated landscape metrics both at class and landscape level; hence, multivariate analysis were performed to evaluate fragmentation rate and Landscape Conservation State (ILC). For the species scale, fourty beetle target species were selected and divided into four groups according to their biogeographic, conservation value, ecological and management (i.e. alien, synanthropic or anthropophilic species) value; more than 3000 original records were georeferenced. We observed a significant relationships between beetles richness and fragmentation rate: the occurrence of species with a high conservation value and species selected with management criteria provided the most significant relationships between the Landscape Conservation State (ILC) and fragmentation rate. Results suggest that landscape and class level metrics can provide biologically relevant information about the corresponding beetles richness. Further studies are needed to sustain scientifically-sound decisions to design appropriate planning strategies for the preservation of biodiversity in the Mediterranean Metropolitan areas.

TOX001

THE BIOLOGICAL RESPONSE CHAIN TO POLLUTION ASSESSED WITH THE LIVERWORT LUNULARIA CRUCIATA

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Bryophyte show an high capability to accumulate metals because of the high surface/volume ratio and the presence of a thin cuticle. It is well known that these organisms do not have proper roots: their rhizoids do not primarily contribute to the uptake of substances from the substrate; therefore, most elements absorbed by bryophytes originate from atmospheric deposition, thus, the levels of specific elements in bryophytes reflect the total deposition and can be used to monitor air pollution in space and time. Many studies used bryophytes to investigate the levels of environmental pollution (Tyler 1990; Harmens et al. 2008), and pollution-tolerant species have been used to investigate the environmental pollution in highly contaminated sites (Basile et al. 2005, 2008, 2012, 2013). The liverwort Lunularia cruciata, known for being a species tolerant to pollution able to colonize urban areas, was collected in the town of Acerra (South Italy) to investigate the biological response chain of air pollution in one of the three vertices of the so-called Italian Triangle of Death. The response chain was investigated considering vitality, photosynthetic efficiency, functionality of PSII and PSI, heat shock protein 70 (Hsp70) induction and gene expression levels, chlorophyll degradation, oxidative stress, antioxidant enzyme, DNA damage and ultrastructural alterations. All the alterations observed in specimens collected in Acerra were compared with samples collected in the city center of Naples and in a small rural site far from sources of air pollution (Riccia, Molise, Southern Italy). The whole chain of response from the ultrastructural organization to the enzymatic response to oxidative stress to DNA damage, as well as for the functionality of photosystems, can be strictly related to the environmental pollution conditions in the three sites. The results could be interpreted in relation to the use of these parameters as biomarkers for environmental pollution.

TOX002

FRESHWATER POLYPS HELP TO DETECT TERATOGENIC THREATS IN RIVERINE HABITATS

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We performed a new indoor/outdoor ecotoxicological experiment for testing the presence of teratogens in running waters (collected in field at regional scale) by exploiting the regeneration capability of Hydra vulgaris, since using living organisms is to date considered a good practice in environmental monitoring for detecting detrimental pressures. Our outputs on the Hydra toxicological assay were integrated with those obtained by the application of the two traditional biotic indices Index Biologique Macrophytique en Rivière and Extended Biotic Index (based on macrophytes and macroinvertebrates, respectively) widely used to assess surface water environmental health. Specifically, we promoted an integrated approach to improve the links between biological and ecological responses to anthropogenic impacts, since bioindicators and biomarkers seem to be complementary in achieving the best evaluation of ecosystems' health (although they may provide information at different levels). In particular, in this study individuals of H. vulgaris were reared (after cutting off the hypostoma by a bistury) in waters collected in diverse southern-central Latium rivers. Additionally, we surveyed several physical-chemical parameters to have an environmental characterization. The regeneration rate and the amount of aberrations were evaluated every 24 h for 5 days to obtain the Teratogenic Risk Index score. The last one was correlated with physical-chemicals and biotic indices. Our findings indicated that the Hydra assay did not act as a prognostic tool for generalized freshwater disturb levels (such as bioindicators at cenosis level) but as biological test model to reveal the presence of teratogens in running waters.

TOX003

UPTAKE AND TOXICITY OF MICROPLASTICS ON FRESHWATER MUSSEL DREISSENA POLYMORPHA: A SUMMARY OF BRUSAROSCO AWARD

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Microplastics (MPs) represent an emerging worldwide issue for aquatic environment. Considering the few information in scientific literature regarding the potential adverse effects of these contaminants on freshwater organisms, in the present study we evaluated both the uptake and chronic toxicity of polystyrene, one of the main MP classes detected in freshwater environment, on the filter-feeder zebra mussel (Dreissena polymorpha). Therefore, to investigate the potential mechanism of action of these contaminants, we exposed mussels for 6 days at two mixtures of polystyrene microbeads, with a size of 1 and 10 µm, containing respectively 1 × 106 MPs/L and 4 × 106 MPs/L. The uptake was assessed using advanced microscopy techniques, while the potential adverse effects of MPs were evaluated using biomarkers of cellular stress (activity of antioxidant/detoxifying enzymes superoxide dismutase, catalase, glutathione peroxidase and glutathione-S-transferase), oxidative damage (levels of lipid peroxidation and protein carbonylation), neurotoxicity (levels of neurotransmitters dopamine, serotonin and glutamate, activity of neuro-enzymes acetylcholinesterase and monoamine oxidase) and genotoxicity (frequency of micronuclei). We observed the presence of both 1 and 10 µm MPs in the gut lumen of exposed mussels, as well as their translocation to the tissues, in particular in the digestive gland and hemolymph. In addition, we found a low increase of the oxidative status of mussels exposed to the less concentrated mixture of polystyrene, as well as a significant increase of dopamine level in mussels exposed to both mixtures. In detail, this latter effect should be associated to a filtration reduction in an attempt to reduce the MP uptake, according to the dopamine role in the cilia movement modulation reported, in particular, in bivalve gills.

TOX004

GOURMET FOOD IN THE PLASTIC ERA: MICROPLASTIC INGESTION IN NEPHROPS NORVEGICUS AND ARISTEUS ANTENNATUS

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Since 1960' synthetic plastic plays such an integral role in daily life, that, since that time, a mark has been recorded in the timeline of human race: the "Plastic Era". The ingestion of small fragments of plastic, known as microplastics (MPs) has been reported in a wide variety of organisms. However, its spatial occurrence and effects on wild populations remain quite unknown. Present study targets economically and ecologically key species dwelling in deep-sea habitats of the Mediterranean Sea: the deep-water shrimp Aristeus antennatus and the Norwegian lobster Nephrops norvegicus, which are both internationally appreciated as gourmet food. Samples were collected by means of trawl survey around the island of Sardinia in 2017, over a depth range comprised between 500 and 800 m depth. A total of 70 and 60 samples of stomachs were collected for A. antennatus and N. norvegicus, respectively.

In N. norvegicus, over 85% of sampled individuals showed the presence of MPs, with an average value of 2.7 ± 0.3 items per stomach. Films and fragments of polyethylene were the most common typology MPs, followed by films of polypropylene. A. antennatus showed a lower occurrence (which was however higher than 50%) and abundance: 1.6 ± 0.2 items per stomach. Fragments of polyethylene were the most abundant category of MPs, followed by filaments of polyester. Overall, MP ingestion was confirmed to cover a wide spatial range over a deep bathymetry (500-800 m), pointing out the ubiquitous presence of these pollutants. Both species are characterized by a close relation with the sea bottom which might enhance MPs exposure and ultimately lead to accidental ingestion. However, the different feeding behavior of N. norvegicus being a scavenger, rather than A. antennatus being benthophagous, could explain the different occurrence and accumulation rate in the stomachs of these species.

TOX005

A MULTIDISCIPLINARY APPROACH TO ASSESS THE EFFECTS OF PERFLUOROOCTANOICACIDUSINGCARPASANEXPERIMENTALMODEL

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Perfluorooctanoic acid (PFOA) is a micropollutant of emerging concern due to its ubiquitous occurrence and persistence in environment, ability to accumulate in living organisms, and its not completely known mechanism of toxicity and endocrine disruption activity. Adult common carp were exposed sub-chronically to an environmentally relevant concentration of PFOA (200 ng/l) and main target organs were examined. Comparisons were done with unexposed fish (control) and with high-PFOA exposed fish (2 mg/l). Subsequent effects of PFOA exposure were assessed through a multidisciplinary battery of analyses:

Analytical chemistry - PFOA accumulation in carp tissues was quantified by high performance liquid chromatography. Solely in organs of fish exposed to 2 mg/l, PFOA concentrations were above the limit of detection with highest levels in blood and liver.

Fish biometry - Carp condition factor, hepato-somatic index and gonado-somatic index didn't differ significantly among fish of the three groups.

Histopathology - No signs of histopathological changes occurred in liver of PFOA-exposed fish. Gonads of carp exposed to 200 ng/l PFOA were normal whilst those of carp exposed to 2 mg/l PFOA exhibited spermatogenesis perturbation and oocytes degeneration.

Digital image technique - Texture analysis of liver section pictures effectively discriminated among carp of the three experimental groups and detected morphological differences not discernible with the traditional histology based on human sight.

Molecular biology - In carp exposed to both PFOA concentrations, the expression levels of glutathione S-transferase genes in the liver and aromatase gene in the gonads were dysregulated (upregulated or downregulated).

The results indicate that each method used and level of biological organization studied show a different sensitivity and confirm the need to integrate many endpoints and techniques to predict accurately the ecotoxicity profile of a chemical. Further analyses, currently in progress will expand our knowledge on risk due to PFOA exposure.

TOX006

CHANGES IN ANTIOXIDANT ACTIVITY AND IN ESSENTIAL OIL COMPOSITION IN FEIJOA SELLOWIANA BERG. GROWN IN THE POLLUTED AREA OF 'ITALIAN TRIANGLE OF DEATH'

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The district of Acerra is one of the vertexes of the so called ''Triangle of Death''. This city is an important agricultural centres, but this part of Campania region has been used for illegal waste dumping (Senior & Mazza 2004). Data from the Cancer Registry of the local health authorities in the study area are alarming (Senior & Mazza 2004). Only a few studies have addressed the effect of air pollutants on essential oil components, and the results are sometimes contradictory and differ according to the polluting agent (Judzentiene et al., 2017).
The aim of ours study was to assess the effects of pollution on essential oil compotition and antioxidant activity in Feijoa sellowiana Berg., an edible fruit plant cultivated in Acerra.
20 plants of F sellowiana obtained in vitro by micropropagation from the same organism, were planted in field in Acerra district in a polluted site (5 plants) and in a non-polluted site (5 plants) (data ARPAC) In addition, 10 plants were planted in greenhouse with soil from unpolluted (5 plants) and polluted (5 plants) sites. After 10 years, in fruits from all the samples the antioxidant activity (chemiluminescence test) and essential oil composition (GC/MS) were tested. Both greenhouse and field grown plants from pollutes condition, showed a significant increase of antioxidant activity and a changing in essential oil composition. Sixty compounds of the oils, were identified. Finally, The acetonic extracts of F. sellowiana from all the sites were purified to obtain flavone, the compound responsible for antitumoral and antioxidant activity. The amount of the flavone was higher in the polluted conditions site than the unpolluted ones.

TOX007

IMPROVING THE SOILPLUSVEG MODEL TO PREDICT DISCHARGE, DYNAMICS OF MOVEMENT IN SOIL, AND RHIZOREMEDIATION POTENTIAL OF PCBS

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Among the national priority polluted sites, the SIN Brescia Caffaro is located in a mid size city Brescia, (200,000 inhabitants) in northern Italy. The site derived from the activity of the former Caffaro s.p.a., a chemical factory among the largest former polychlorinated biphenyls (PCBs) producer in Europe, which produced such chemicals for more than 50 years up to mid 80'. About 100 Ha of agricultural areas were contaminated by a mix of Persistent Organic Pollutants (POPs, mostly PCBs, dioxins, furans) and heavy metals (Hg, As) in variable concentrations, often exceeding the safety values. Contamination mostly resulted because of runoff irrigation with contaminated waters. PCBs were measured in three different agricultural areas and in three different points per area, in vertical cores up to 1 m depth. The resulting samples were representative of 0-10, 10-20, 20-30, 30-40, 40-60, 60-80, 80-100 cm. The results of concentration measurements with depth (for about 80 PCB congeners) confirmed a general tendency of PCBs to be confined to the upper 40-60 cm (depending on the congener). For example, in field A, PCB 28 ranged from 150 to 250 µg/kg in the top 30 cm to about 0.6 µg/kg at 1 m depth; PCB 209 (peculiar of Caffaro production) ranged from 15000 to 13000 µg/kg in the top 30 cm, descending to about 13 µg/kg at 1 m depth. These concentrations of PCBs were then compared to those obtained by a modified version of the the SoilPlusVeg model (a multilayered dynamic multimedia fugacity model) and used to predict discharge amounts and conditions regulating vertical movement. The objective was to reconstruct soil concentration profile during the historical contamination to predict discharged amount, potential for additional vertical movement, and conditions regulating chemical bioavailability for future PCB rhizoremediation.

TOX008

ENVIRONMENTAL RISK ASSESSMENT OF SODIUM LAURETH SULPHATE (SLES) CONTAINED IN CONDITIONING AGENTS USED IN MECHANIZED TUNNELLING.

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Anionic surfactants (ANS) are a heterogeneous group of amphipathic compounds characterized by linear aliphatic chains (from C8 to C18) with a polar group (sulphate or sulfonate) neutralized with a counter ion. Given the variability of their molecular composition, ANS are considered mixtures. Among ANS, the sodium laureth sulphate (SLES) is the main component of commonly used foaming agents necessary to facilitate the excavation procedures in mechanized tunnelling. However, its use raises concern for the environment considering the presence of SLES residual concentration in soil debris. In addition, the absence of a soil threshold limit for SLES in the EU legislation does not facilitate the re-use of soil debris as by products (e.g. land covering). Consequently, a huge amount of such detritus can only be discharged as a waste with economic costs. In absence of a threshold limit, the environmental risk assessment (ERA) of foaming agents containing SLES can be a possible alternative to evaluate potential negative impact on ecosystems. However, the ERA can be limited by scarce knowledge data on the real ecological effects of SLES in foaming agent treated-soils and the site-specific characteristics (e.g. soil texture, microbial activity) which can lead to different levels of exposure. This study is part of a wider project aiming to develop a suitable methodology to identify environmental acceptable levels of SLES residues in soil debris produced during the tunnelling operations in Italy. Particularly, we report the results of ERA procedures performed using SLES residues from foaming agent-treated soils from tunnelling excavation sites. The risk has been characterized based on the exposure/toxicity ratios, where the exposure levels were predicted through predictive models or measured in micro/mesoscom studies. The ecotoxicity of SLES for terrestrial organisms (earthworms and plants) were experimentally determined in this study, whereas toxicity data for the aquatic organisms were gathered from literature.

TOX009

SPATIAL AND TEMPORAL DISTRIBUTION OF CURRENT USE PESTICIDES IN ALPINE GLACIERS

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The Alps, characterized by high level of precipitations and proximity to the emission sources, can be very susceptible to the accumulation of contaminants. Indeed, there is evidence that current-use pesticides (CUPs) through medium range atmospheric transport can reach the Alps glaciers and accumulate in snow/ice pack. Consequently, peaks of contamination could occur during melting season.

In this context, meltwater samples were collected during summer 2016 from Lys, Morteratsch, Forni, Presena, Tuckett and Giogo Alto Glaciers and analyzed to determine the CUPs occurrence.

Among them, the insecticide chlorpyrifos (CPF) and the herbicide terbuthylazine (TBZ) were frequently detected. CPF was found in all the glaciers with highly variable concentrations ranging from 1,9 ng/L (Lys Glacier in September) to 70.27 ng/L (Forni Glacier in July). Regarding TBZ, both the highest concentration of 2.96 ng/L in July and the lowest value of 0.51 ng/L in September were found in Presena samples.

Both CPF and TBZ showed geographical differences in concentrations that can be ascribed to the different land use of the Po River Plain and related conjunctly to the physical chemical properties of the compounds and the climatic and geomorphologic characteristics of these Alpine areas.

Seasonal differences were also detected for TBZ and its metabolite desethyl-terbuthylazine. The parental compound (TBZ) was mainly present at the beginning of the melting season while the metabolite was detected in the late summer samples.

An ice core was drilled at Lys Glacier on Monte Rosa during summer 2003. The major contaminant in all years were CPF (from 1 to 32 ng/L) and TBZ (from 1 to 2 ng/L), which show a positive correlation with the historical regional use.

This evidence suggests that the regional atmospheric transport of CUPs should be taken into consideration in order to protect the water quality of this pristine environment.

TOX010

PRIORITY AND EMERGENT CONTAMINANTS IN MUNICIPAL WASTEWATERS: LEVELS AND REMOVAL IN CONVENTIONAL WTPS

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Priority and emergent pollutants (EPs) include a wide range of elements (chiefly heavy metals) and organic molecules (residues and degradation products from pharmaceutical compounds, pesticides, surfactants, hormones, flame retardants, plasticizeres, personal care products, etc…). For many of them the toxicity is well known, but still no limit exists for the discharge, even if, in some cases, water quality standards have been enforced at national and international level.

The presence and amount of EPs in watewater depends on various sources, some of which are specific while others are common to different families of compounds.

Among the main sources are excretion and disposal for pharmaceutical compounds, direct discharge, use and disposal for industrial products and pesticides, generation by combustion and soil deposition and run-off for PAH, etc.

Conventional wastewater treatment plants (WWTPs) are designed to remove organic matter (COD and BOD5), nutrients and potentially hazardous bacteria, but their efficiency in removing EPs is highly variable and mostly unreliable. It depends on the specific physical and chemical properties of the pollutant rather than onm the category they belong, on the process sequence in the WWTP and on a series of operation parameters of the WWTPs whose role is still not well known.

In general, conventional WWTPs without tertiary treatments are not able to ensure a sharp and, especially, a reliable and constant removal of EPs. Due to the differences among EPs and process efficiencies, and to the concurrent presence of many of them, reliable performances can just be obtained by combining more than one tertiary treatment.

Considering the costs related to the upgrade of conventional WWTPs for EP removal, interventions on the drainage systems and sewer overflows should also be considered and the true need for advanced treatments should be evaluated with respect to the flow and conditions of the receiving waters.

TR001

OCCURRENCE OF THE POTENTIAL ICHTHYOTOXIC PRYMNESIUM CF PARVUM (PRYMNESIOPHYCEAE) IN THE BARATZ LAKE (NORTH WESTERN SARDINIA): IMPACTS AND PERSPECTIVES.

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Prymnesium Massart are single-celled and biflagellated microalgae provided of a short haptonema. The genus includes ichthyotoxic species causing fish kills in natural environments and affecting aquatic biodiversity, ecosystem functioning and services. P. parvum Carter is by far the most common and cosmopolitan among the Prymnesium species. Being eurytherm and euryhaline, it is observed in marine, brackish and freshwater ecosystems. The species produces several exotoxins, but the exact mechanism of toxicity on fish is still debated.

The presence of P. cf parvum in the Baratz Lake has been signaled since the end of the 70s and its role in fish-kill events has been suspected since then. This work analyzes the historical and recent available data on P. cf parvum blooms, investigating the relationships of the species with selected environmental variables. The aim is to contribute in the understanding if the species has a role in the poor fish presence in the lake, influencing its ecosystem functioning and services. After the first detections, the species was observed between 1994 and 1997 both in association and not with fish-kill events. Instead, the species was not reported in six samplings between June 2011 to May 2012 and from April 2016 to October 2017. From November 2017 to March 2018 a long-lasting bloom was detected and it was concomitant with a widespread death of fish. The species was detected steadily along the time series, showing a more wide temporal distribution in the nineties compared to the more recent years. Anyway, the maxima of cell density (1-2 x 108 cells L-1) were always detected from winter to early spring. The presence of the species was not clearly related to concrete environmental conditions, confirming the complexity of the interaction of P. cf parvum with abiotic and biotic variables, making difficult to identify appropriate management strategies.

TR002

INTERACTION BETWEEN NITROGEN POLLUTION AND FOOD WEB ARCHITECTURE IN THREE COASTAL LAKE IN CENTRAL ITALY.

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Transitional water ecosystems constitute extremely complex and productive environments, a preferred route of migrating birds and optimal nursery locations for many fish species. In these interesting environments, descriptors of trophic relationships between species in a web have been suggested as potential integrative and sensitive endpoints for anthropogenic pressure. Indeed, nutrient concentrations can also influence the feeding behavior of aquatic animals. For fish in particular, human activities such as aquaculture, recreational fishing, hydraulic management and mowing of aquatic vegetation represent potential threats to the maintenance of minimum vital populations. To better understand the effects of environmental disturbance on the fish fauna structure, we analyzed the changes of food web architecture in three neighboring transitional water habitats located in a restricted area of the Thyrrenian coastal area of Central Italy (Lake Caprolace, Lake Fogliano and Lake Sabaudia), which are affected by different inputs of nitrates from agricultural, farming and urban activities. Fish, macrozoobenthos, aquatic macrophytes and attached macroalgae, leaf detritus were sampled at five sites in each habitat and stable isotope analysis (C and N) was carried out in order to describe trophic pathways in the food web. δ15N values of Fish increased from Caprolace to Sabaudia according to the increasing nitrate concentration derived from organic sources. Highest organic pollution in lake Sabaudia was associated with lower fish species richness, changes in species composition, and a collapse of their trophic niche due to huge food availability with respect to the other two lakes. These results suggest that nitrogen pollution can be responsible of evident changes in the architecture of biodiversity, determining a low functional diversity in the trophic structures, with strong implication for biodiversity management and conservation.

TR003
AQUACULTURE PRODUCTION AND FISHERIES IN COASTAL LAGOONS: THE CHALLENGING BALANCE

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Coastal lagoons provide a wide range of ecosystem services. Their role as nursery areas and their high productivity sustain fishery and aquaculture production, economic activities of relevance in coastal areas. Traditionally, lagoon fisheries have exploited the migration movements of several species of commercial interest entering or leaving the lagoons in specific times during their biological cycle (i.e. "lavorieri" in Sardinia); in modern times, aquaculture activities are increasingly exploiting their natural productivity and accessibility. The sustainability of fisheries and aquaculture depends on the preservation of the ecosystem services provided by lagoons; consequently, research, development, and management of these activities should take into account not only productionand other socio-economic activities, but also and centrally the ecologic scope. This multidisciplinary approach is the core of the research strategy at the International Marine Centre. The strategy will be illustrated with two examples, two cluster projects funded by Regione Sardegna through Sardegna Ricerche with the participation of 14 aquaculture and fishermen cooperatives. OSTRINNOVA is an ongoing project on Crassostrea gigas production; its key points are 1) the suitability of the lagoons by means of database analysis, 2) their potential productivity based on environmental parameters and mathematical models, and 3) the assessment of the impact of the aquaculture activity on the lagoon system. TECNOMUGILAG is a recently started project on Mugil cephalus restocking; its key points are 1) the production of juveniles from wild adults captured in Sardinian lagoons, 2) the design of restocking adapted to the lagoon's characteristics, and 3) the monitoring of restocking success. The final aim is to provide knowledge and tools to the stakeholders and decision makers for the development of management plans that preserve lagoon ecosystems, in order to allow the sustainable exploitation of their services by aquaculture, fisheries, and other human activities.

TR004

EXTREME EVENTS DUE TO CLIMATE CHANGE IMPAIR THE BIODIVERSITY PROVISION OF ECOSYSTEM SERVICES IN SHALLOW LAGOON HABITATS

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Suspension-feeding bivalves are valued providers of services to shallow-water ecosystems unless extreme events (EVs) don't impair their functioning with possible cascade effects on the local biodiversity bringing the system to collapse to another state. EVs such as heat waves and hypoxia, as those recorded in 2017 by the long-term recording thermo- and oxygen-logger network in the Stagnone di Marsala lagoon system (maintained by Ecology Lab at UNIPA), induce functional trait's displacement with consequent possible mass mortalities (biomass removal) and alteration of the biogeochemical functions of water clarification. To disentangle how the removal of a foundation species from a community leads to habitat deterioration and unpredictable cascade events, we selected a pond where we recorded a series of 49 thermal spikes (up to 35°C) of water's mass in less than two months which were juxtaposed with hypoxia events (less than 2 mg l-1). Such multiple EVs caused mass mortality of the foundation species living in the pond (the non-indigenous bivalve Brachidontes pharaonis). The collapse of bivalve's filtering service made waters highly unstable, with large oscillations of most trophic variables such as suspended and sedimentary organic matter and primary production (e.g. chlorophyll-a [CHL-a]). Thus, through a before-after design, we quantified the effects of EVs in diverting the habitat state thanks to the foundation species removal. We measured the loss of trophic control due to the displacement of filtering function (e.g. CHL-a before 1.05 ± 0.48 vs 6.6 ± 4.7 µg l-1 after) and the collapse of associated biodiversity (e.g. species richness before 4.63 ± 1.64 vs 0.51 ± 0.11 after). Such kind of studies are crucial when assessing the effects of EVs on ecosystem services provision, even though, a number of questions remains open as those on how to manage EV effects on vulnerable ecosystems in a proactive and adaptive context.

TR005

NOT JUST A SANDY BEACH. THE MULTI-SERVICE VALUE OF MEDITERRANEAN COASTAL DUNES

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Coastal dunes are transitional systems which host a remarkable ecological diversity and are at the same time among the most fragile and threatened ecosystems worldwide. These systems comprise approximately three-quarters of the world's shorelines and offer manifold ecosystem services, including material and intangible benefits, whose relevance for human society has been often overlooked. In order to plan for a sustainable use of these threatened ecosystems, proper indicators to quantify ecological services and functions over time should be provided. We summarize the main results and considerations obtained by our lab during the last decade. The research briefly describes coastal dune ecosystem biodiversity, coastal zonation and functionality, coastal dune mapping and landscape analysis. In addition, it provides an insight on the most recent work efforts devoted to identify indicators of integrity and to quantify ecosystems services. Our research, developed in the coasts of central Italy, includes the Italian LTER site of dune ecosystems, offering sound bases also for multi-temporal ecological analysis.

Based on coastal dune biodiversity assessment and mapping we proposed and tested an indicator of coastal landscape functionality that takes into account the importance of the contiguity among different dune ecosystems in assuring the integrity of coastal zonation. We implemented such approach for a long term analysis identifying the coastal tracts in need of specific conservation actions, due to coastal dune integrity decrease..

Then, we explored the role of coastal dunes on regulation and cultural functions in a multi-service perspective. We focused on ecosystems of conservation concern (according to Habitats Directive) occurring in the N2000 network dunes along the Adriatic coast. We assessed regulating (Climate regulation, Protection from wind and aerosol, Erosion regulation) and cultural (Recreation & Tourism) services and we explored the trade-offs between them. According to our results, an effective dune management aimed at preserving coastal ecosystem services potential shall favor the conservation of the complete natural dune zonation.

TR006

A COMPARATIVE STUDY OF THE MOLLUSC COMMUNITIES OF A MEDITERRANEAN SALTWORK (Marsala, western Sicily).

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Saltworks are peculiar artificial ecosystems and holds great interest for basic research. In fact the cooling vat (the first pond of the evaporating series) is a good example of a relatively closed area and can be considered an excellent in the field open-air laboratory, namely a mesocosm reproducing a simplified model of the natural condition of hyperaline lagoons.

The aim of the present work was to analyse the structure, composition and distribution of molluscan assemblages and to identify the faunistic relationships between the cooling vat and the neighbouring basin of Stagnone di Marsala, beside considering exchanges between saltwork, Stagnone di Marsala and sea, on soft-bottom, covered by Cymodocea nodosa. In structural terms, two molluscan communities can be identified. As regard the saltwork, the community was always characterized by halolimnobic and euryaline species such as Ventrosia ventrosa, Loripes lacteus, Abra segmentum and Pirenella conica. while the community inhabiting Stagnone was composed mainly of marine taxa; here a good exchange with the sea is confirmed by the high values for species richness and diversity gives rise mainly to the presence of marine taxa: e. g Jujubinus striatus, Dikoleps nitens, Rissoa paradoxa, R. similis, Columbella rustica etc.

The saltwork molluscan assemblage doesn't seem to be similar to that of the Stagnone. The low specific richness, the high abundance and the low evenness, showed a pioneer stage of colonization, being poor in species and dominated by taxa with high abundance and low evenness.

TR007

RECRUITMENT MODELS FOR ASCENDING JUVENILE EELS (ANGUILLA ANGUILLA) IN A CENTRAL-EASTERN SARDINIAN ESTUARY: RELATIONSHIPS WITH TEMPORAL AND ENVIRONMENTAL FACTORS.

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European eel (Anguilla anguilla) is a catadromous typical species of coastal, estuarine, and river habitats. Juvenile eels recruitment suffered a significant decrease since 1980s. According to the International Council for the Exploration of the Sea (ICES) the eel stock is outside safe biological limits. Council Regulation (EC 1100/2007) establish measures for the recovery of European eel stock, transposed into Sardinian Eel Management Plan including monitoring activities.

To better understand stock dynamics on local scale, we assessed the interactions between glass eels and elvers recruitment abundance (juvenile eels), temporal (season, moon phase), local (river mouth) and environmental factors (temperature, salinity, dissolved oxygen, tidal coefficient). Data were collected for new moon weeks during 2017-2018 samplings on Pramaera estuary (Sardinia, Italy – 1558770E; 4425164N), near the sea communicating area. Results gained by modelling suggest temporal and environmental migration patterns for recruits. Relationships between environmental parameters and ascending eels abundance were anyway nonlinear and multivariate. Generalized Additive Models (GAMs) revealed that glass eels abundance was associated with environmental variables (water temperature 11-15 and 25°C, and growing tidal coefficient), temporal (winter and spring seasons, falling moon) and local factors (river mouth open) for 66.1% of total explained deviance. The best elvers GAM explained 74.8% of total deviance, showing a clear increasing of abundance during the spring season. Water temperature (>20°C) and dissolved oxygen (>5 mg/l) influenced elvers captures, while other variables and local factors didn't seem to be significantly connected. Presented models describe interannually fluctuations in ascending eels recruitment for this pilot site. Further investigations are needed to extend demographic analyses to other sites to compare and provide useful tool for defining eel management plan as requested by EC Regulation.

TR008

CARBON STOCK CAPACITY OF P. OCEANICA MAT IN A HIGHLY DEGRADED COASTAL BAY

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Seagrass meadows are important coastal ecosystems with a relevant role in climate change mitigation due to their capacity to sequester and stock large amounts of carbon (blue carbon) in the sediments for a long period. However, these ecosystems are under threat worldwide and their decline may reduce significantly their blue carbon stock.

In the Mediterranean Sea, the endemic seagrass P. oceanica is one of the most important species and is capable to form a biogenic reef known as "mat", a complex network of living and dead seagrass tissues buried within the sediment. Moreover, due to the anoxic conditions of sediment and the refractory feature of the detritus trapped, the mat and the carbon buried are stored over millennia. Despite the importance of P. oceanica in carbon sequestration, there are still many knowledge gaps on the role of mats as carbon sink especially after its death.

Augusta Bay (Sicily) is a semi-enclosed basin hosting the largest petrochemical complex in Europe and the most important chlor-alkali plant in Italy.

Since the 1950s, this bay has been characterized by environmental degradation and pollution as consequences of industrial discharges, uncontrolled sewage discharges and dredging. As a result, the entire seabed of the southern part of the basin, called Priolo Bay, is marked by an irregular distribution of P. oceanica dead mat.

In this study, we compared the capacity of dead mats to store carbon with that of living meadows and bare sediments. Cores were collected, and subdivided into 1 cm layers, which were dated (^{210}Pb) and analysed for Corg and Cinorg to calculate C stocks. Results provided evidence for the role of dead mats as traps of carbon and carbon sinks.

ORAL

P_ALIEN001

CO-OCCURRENCE OF BRYOPHYTES AND VASCULAR PLANT SPECIES CAN BE DISRUPTED BY INVASIVE ALIEN SPECIES?

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Many studies suggest the role of community diversity in resistance to IAS invasion; in this framework, the relationship between non-native vascular species and Bryophytes is poorly explored. We investigated if and how the presence of invasive alien plant species affect the diversity of vascular and bryophytes communities on coastal dunes. Data on the presence and abundance of bryophytes, vascular plant species and IAS in 100 60x60cm quadrats in a small Sardinian coastal dune characterized by a high human pressure, were explored for the occurrence of congruence diversity patterns (both in richness and composition) between taxa and, if this is the case, how the presence of vascular alien species affect these relationships. We analysed the data using species composition and abundance but also in terms of functional traits. Within bryophytes, Tortella flavovirens is the most common species confirming itself as a pioneer taxa, while among IAS Carpobrotus sp. is the most abundant. In our data the relationship between IAS vs bryophyte and vascular plants richness is weak and not significant. The richness of bryophyte species is negatively influenced by the presence of alien species. When present alien species, vascular species' richness show a slight increase, probably due to the presence of greater water availability and soil. Co-occurrence showed a good correspondence between taxa, suggesting a comparable mechanism of filtering for bryophytes and vascular plants. Future results might give insights and explain the role of functional traits in shaping native plant comunities in response of IAS invasions in Mediterranean coastal dunes.

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P_ALIEN002

MODELING ACACIA SALIGNA INVASION IN MEDITERRANEAN COASTAL DUNES. AN INTEGRATIVE ANALYSIS USING ILTER INFRASTRUCTURE DATA

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Invasive alien species pose a major threat to biodiversity and ecosystem services worldwide. Even if preventing biological invasions should be the most cost-effective way to minimize the impact of Invasive Alien Species (IAS) on biodiversity, new efforts are necessary to identify the early signs and to assess invasion risk. In this context, the implementation of invasive Species Distribution Models (iSDMs) could represent a sound instrument that merit of further research.

Acacia saligna, is an Australian vascular plant introduced in Europe during the last half century, it represents one of the most dangerous Invasive Alien Species in the Mediterranean basin and its spread is particularly worrisome in Italy and Europe.

With this work, we propose an iSDM-based methodology to: a) explore the role of multiple drivers in the invasion process, and b) assess the risk posed by A. saligna in coastal dune ecosystems. The research was carried out on the Adriatic coast of central Italy (Molise region) including two sites of the international LTER network and three Sites of Conservation Interest.

We examined the statistical relationship between Propagule pressure, Abiotic and Biotic variables (here after PAB) and A. saligna occurrence by using a Generalized Linear Model (GLM) with a binomial distribution of errors.

We effectively modeled the occurrence of A. saligna and we identified the specific role of the PAB variables in determining the alien species presence. The invasion by A. saligna varies across the coastal landscape and preferentially occurs close to the coastal pine forests, and close to existing stands, on road borders and at intermediate distances from the coastline namely in the first fixed dunes facing the sea.

According to the predicted occurrence, we identified coastal tracts with different invasibility values supporting site-specific management strategies. Our results encourage the use of iSDMs as a means of evaluating the risk posed by IAS, and, at the same time, represent an attempt to fill the gap between theory and practice in conservation decision-making.

P_ALIEN003

SMALL-SCALE CRAYFISH DISTRIBUTION MODELLING OF THE INVASIVE CRAYFISH PROCAMBARUS CLARKII IN THE MOLENTARGIUS-SALINE REGIONAL NATURAL PARK (SARDINIA, ITALY) IN RESPONSE TO ENVIRONMENTAL VARIABLES.

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The crayfish, Procambarus clarkii, is among the worst invasive species capable of disperse overland, aiding the invasion of new environments. Because management options are limited once crayfish become established, there is a critical need to identify the suitable habitats for this invasive species. In this study, we forecast the potential distribution of crayfish based on environmental predictors in the Molentargius-Saline Regional Natural Park (Sardinia, Italy). Current known distribution was used to build correlative species distribution models (SDMs) and forecast distribution in the entire area. We considered, during the spring season, 5 quantitative environmental descriptors at the local scale (Depth, Water Temperature, Salinity, pH and Dissolved Oxygen). Single station data were used to generate synoptic distribution of environmental factors through the inverse distance weighted deterministic interpolation (IDW). The SDMs obtained through 2 different algorithms showed very good performance: GBM (General Boosted Models, ROC=0.847) and RF (Random Forest, ROC=0.996). For GBM the predicted distribution correlated most significantly with environmental variables (Salinity, Dissolved Oxygen and pH), while for RF all variables are homogeneously significant. Identified best models, performed by the Ensemble Modeling technique, showed that most of the areas outside the currently known distribution may offer potential habitats for P. clarkii. Greater probability to find the species presence were computed in correspondence of the Drainage Channel and ESF6B basin of the EcoSistema Filtro. However, for the Bellarosa Minore basin the forecast spread of the species is evident in all the tanks with large dense patches. Presented results deepen the knowledge about distribution patterns of P. clarkii in the Regional Natural Park. Moreover, the ongoing study gives a basic background for the future development of management strategies. This study was supported by the Fondazione di Sardegna for the project Impact of Invasive Alien Species on Sardinian ecosystems and by the Fondazione con il Sud for the project Nr. 2015-AMB-0065.

P_ALIEN004

SPREAD OF A PARASITE INFECTION: PINNA NOBILIS MASS MORTALITY IN TAVOLARA PUNTA CODA CAVALLO MARINE PROTECTED AREA

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Mass mortality events represent demographic catastrophes whose magnitudes are changing among animal taxa, with increases for birds, marine invertebrates, and fishes. A mass mortality of the endemic bivalve Pinna nobilis is occurring in the Mediterranean since 2016 (southern and central Spain).

Visual assessment in Tavolara Punta Coda Cavallo MPA (North-East Sardinia) was done during July 2018 to estimate Pinna nobilis healthy (high reactive valves), sick (slow reactive valves), upright dead (recent mortality) and laying dead (recent past mortality) individuals. Counts were made in 12 cells (100m×100m). In each cell, 3 transects (100m×6m) were done and data collected were overlapped to those gained in the exact same cells during 2016.

Results have identified 57.3% healthy, 17.6% sick, 9.9% recently died and 15.2% dead individuals, highlighting that mortality is going on in the MPA. The comparison with the previous data-set evidenced that live individuals have remarkably decreased from 496 (November 2016) to 281 (July 2018), and at the former survey dead individuals were so exiguous that were negligible. Overall, the total number of individuals (dead pooled with live) were quite different (496 in 2016 and 375 in 2018), suggesting that dislocation of sick and dead individuals during storms has already been occurred.

Video recordings have been done of Pinna nobilis closing movement through time to identify reliable sickness predictors of mortality with estimates of the time needed to die. This data will contribute evaluating the extent and the dynamics of the mortality at the MPA, and will help estimating whether this mortality in the Mediterranean will end up with the extinction of the species or local extinctions, with the selection of resistant genotypes.

P_ALIEN005

ALEX INDEX TO EVALUATE ALIEN MACROALGAE INVASIONS: THE CASE STUDY OF VILLASIMIUS-CAPO CRABONARA MARINE PROTECTED AREA

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The European legislations emphasise the priority to monitor abundance and the state of non indigenous species (NIS) and environmental impact of invasive NIS, in order to avoid that biological invasions alter the Good Environmental Status of coastal ecosystems. In this contest, a modified version of the ALien Biotic IndEX (ALEX) has been recently proposed to evaluate biological invasions in macroalgal assemblages. ALEX was tested along gradients of invasion in sessile assemblages of Mediterranean hard bottom habitats. For five invasive macroalgae a variable number of case studies per each of four habitats were examined from the available data sets. Results showed that the application of ALEX to sessile assemblages of hard bottoms allows to qualify the level of invasion along the considered gradients. Thus, ALEX was applied in a Marine Protected Area where a recreational-fishing port is present testing the following hypotheses: ALEX increases with the distance from the port, it changes between the two directions off the port and it changes among three different habitats. A total of four introduced species were found, the Chlorophyta Caulerpa cylindracea and the Rhodophyta Apoglossum gregarium, Acrothamnion preissii and Womersleyella setacea. Although all study sites were in high quality status, ALEX detected different values among habitats and conditions suggesting a local dynamics of NIS spread and different resistance to invasion of the habitats. Results support the suitability of ALEX to detect spatial and habitat differences within a MPA where some NIS of macroalgae are at early stages of spread. ALEX index results can encouraged its employment in coastal benthic monitoring plans where NIS spread is to be assessed and a quality status has to be quantified.

P_ALIEN006

FIRST DATA ON THE APPEARANCE OF CALLINECTES SAPIDUS (RATHBUN, 1896) IN SARDINIA (WESTERN MEDITERRANEAN)

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The Atlantic blue crab Callinectes sapidus (Crustacea, Decapoda), native of the eastern American coast (from Nova Scotia to Argentina), is one of the five alien portunid species introduced in the Italian seas and one of the most invasive species in the Mediterranean Sea. Its wide ecological tolerance and opportunistic predatory behavior, together with the passive transport via ship ballast water, have allowed this species to colonize shallow coastal waters and estuaries of Europe since 1900. This work reports the first data on the occurrence of C. sapidus in Sardinia (Italy, western Mediterranean) and gives additional information on its spreading in the western Mediterranean.

The presence of the species was detected by professional and recreational fishermen, which caught a total of nineteen specimens between April 2017 and June 2018. Seventeen specimens (eight females and nine males) were found in six lagoons along the western (Calich, Is Benas, Cabras, S'Ena Arrubia, Marceddì) and southern (Su Stangioni) Sardinian coast. Two males were reported from Tirso river (western area) and in nearby freshwater ponds. Two individuals from S'Ena Arrubia and Cabras lagoons were measured, weighed and directly identified. Other specimens were identified based on appropriate photographs.

All the blue crabs were ascribed to the genus Callinectes based on the lack of spines in the inner margin of the carpus of cheliped, and to the species C. sapidus observing two (instead of four) interorbital triangular teeth in the frontal margin of the carapace.

Further studies will aim to individuate established populations of C. sapidus in Sardinia to investigate possible impacts on affected ecosystems and fishing activities, and to find proper management measures, involving professional and amateur/recreational fishermen.

P_ALIEN007
NON-INDIGENOUS SPECIES AND MARINE PROTECTED AREAS

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The introduction of non-indigenous species (NIS) has been pointed out as a major threat to biodiversity. NIS may in time become invasive (i.e. invasive alien species "IAS") and may cause biodiversity loss and ecosystem service changes. In the Mediterranean Sea, due to multiple human-borne stressors, the number of recorded NIS has currently reached a number around 1000 NIS. Sicily and its surrounding islands, also including a high number of Marine Protected Area (MPAs), as a consequence of their geographic position and the intense maritime traffic volumes, including fisheries and recreational fleets that foster the introduction of marine alien species, is a region particularly vulnerable and prone to NIS invasions. Since frontiers do not exist in the sea, biological invasions may severely affect MPAs, whose major aim is biodiversity conservation, because they are also located in proximity to ports and marinas or are frequently used by small recreational or fishing boats as well as tourists. Assessing effects that IAS have on MPAs is crucial for planning suitable management activities which also require sound knowledge of the pathways of introduction, the impact and current distribution of IAS. Therefore, the distribution, pathways and spread dynamics of invasive taxa recorded till now in Sicilian MPAs, based on relevant publications, grey literature, unpublished data and in situ observations, is presented here and discussed.

Altogether, 18 alien and 3 cryptogenic species have been recorded from Sicilian MPAs. Unexpectedly, even though in the southern coast of Sicily the maritime traffic is more intense, the MPAs located in the north-western coast of Sicily (Egadi Islands MPA with 19 species and Ustica Island with 7 species) are the most affected by this phenomenon. The creation of permanent observatories and alarm systems might be an effective tool in the management of present and future introductions of NIS in MPAs.

P_ALIEN008

REDUCING THE SPREAD OF INVASIVE FISH SPECIES THROUGH A CANAL CONNECTING TWO LAKES: ASSESSMENT OF EFFICACY AND PRACTICALITY OF DIFFERENT GEARS.

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One of the challenging objectives of the project IdroLIFE LIFE15 NAT/IT/000823 is to reduce the spread invasive alien fish species from Lake Maggiore to SPA IT1140013 Lago di Mergozzo and Montorfano.
We present here the results after two months of activity in the canal connecting the two lakes. We tested different type of traps. Small quadrangular traps (mouth 40 cm, length of the unique chamber of 1 meter, front wings 1 m long and 40 cm high), medium sized circular traps (circular mouth and body chambers with a diameter of 60 cm, wings with a length of 8 meter and 60 cm of heigth), large circular traps (circular mouth and chambers of 90 cm diameter, wings with a length of 10 m and a heigth of 90 cm), and very large traps with quadrangular mouth and chambers of 120 cm of side, front wings 10 meter long and 1.2m high). Traps were controlled two-three times per week and fish were removed every time. Native species were released, whilst non native species were retained. The catfish Ameiurus melas was the most abundant allochtonous fish species caught both by number and biomass, followed by the pumpkinseed Lepomis gibbosus and the wels catfish Silurus glanis. Pike Esox cisalpinus, rudd Scardinius erythrophthalmus and tench Tinca tinca were instead the most common native fish species caught.
The number of fish caught per unit of time and trap area changes markedly among the different gears and the effort required to handle the traps shows remarkable differences. Our preliminary results suggest that the traps with a circular mouth and long wings seem to be the most suitable gears in terms of efficacy and practicality.

P_ALIEN009

PREDICTING HOW AN INTERTIDAL PREDATOR CRAB CAN CONSTRAST THE INVASION OF A BIVALVE: EVIDENCE IN A CONTEXT OF THE OPTIMAL FORAGING THEORY

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Ecological invasions are of pressing concern for the stability of ecological communities and biodiversity loss. To understand whether local predation can be able to contrast the invasions of highly aggressive non-indigenous species (NIS) may be useful to design conservation and management plans such as, for instance, regulation of local predator's harvesting. Predator-prey interaction is an important ecological function that can clarify whether local predators can primarily rely on NIS, and if we use principles of the Optimal Foraging Theory (OFT) we will be able to predict winners and losers of the arms-race between local predators and NIS. OFT says that predators should rely on preys that optimize the net energy intake per time unit spent in foraging activities. In the real world, predators include a wide variety of preys in the their diets but only some of them are optimal in terms of profitability. Here, using the Holling (1959) functional response (FR) framework, we tested whether the intertidal marine predator warty crab, Eriphia verrucosa could be able to exert biotic resistance against a NIS prey, the bivalve Brachidontes pharaonis. Thus, we measured the FR, a selection index, the rate of energy gain in terms calories and we performed a cost/benefit analysis for five preys, including our NIS. Results showed that crabs preferred more NIS than indigenous species which had each different levels of profitability. The cost/benefit analysis showed that, according to the OFT, our predator tried to maximize its net energy gain rate which was realized primarily with NIS. Our predator had a Holling FR Type II - when measured on NIS - and this means that our predator may be able to destabilize the invasion process generating useful information to design harvesting strategies of these crabs which is usually used for the human consumption.

P_ALIEN010

INVASIVE AND POTENTIAL INVASIVE ALIEN SPECIES IN THE FRAMEWORK OF THE ALIEM PROJECT

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The Mediterranean project on invasive alien species "ALIEM" (PO Marittimo, Action pour Limiter les risques de diffusion des espèces Introduites Envahissantes en Méditerranée), started in 2017 and will be concluded by 2020. The project is taking place in the Italian regions of Liguria, Sardinia and Tuscany, in the French island of Corsica and in the French region of PACA. The project aims to establish a common platform for data sharing and communication and to promote good practices to mitigate the risk of invasive alien species. A selected set of key invasive species is under investigation; in particular Vespa velutina, V. crabro and Rhynchophorus ferrugineus among alien insects, Acacia spp., Senecio spp. and Pennisetum spp. among plants. All these species or genera, with the exception of V. velutina, are ready present in Sardinia. For example, many species of Acacia (e.g., A. saligna, A. dealbata, A. mearnsii) have been introduced in the past as ornamental or as forestry species and are now naturalized and invasive in many habitats in Sardinia. We present here the first results on the presence and distribution in Sardinia of these key invasive species and propose some general guidelines for mitigating their negative impacts and the risks of further introductions.

P_ALIEN011

INVESTIGATING MULTIFACETED IMPACTS OF INVASIVE ALIEN SPECIES ON SARDINIAN ECOSYSTEMS: FROM ECOLOGY TO NEUROSCIENCE

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The invasion capacity of allochthonous species depends primarily upon their bio-ecological traits, but also upon the vulnerability of the recipient ecosystems, which in turn depends on the attributes of local biodiversity and the integrity of ecosystem functions. Sardinia, as an Island, is putatively highly vulnerable to the effects of biological invasions. Accordingly, in the last 20 years, several ecosystems of Sardinia have faced a progressive increase in the number of IAS. The project "Impact of Invasive Alien Species on Sardinian ecosystems", by means of a multidisciplinary approach is tackling two main objectives: 1) the study of presence, distribution and life traits of a selection of allochthonous species (with focus on fish, marine algae and invertebrates, and terrestrial plants) that have invaded Sardinian ecosystems; 2) the analysis of their impacts on biodiversity and ecosystem functioning of the invaded ecosystems, along with fish neurological effects of biomolecules associated with invasive algae. We will illustrate the current results obtained dealing with the consequences of invasive plants on the local biodiversity, the biogeochemical modifications induced by an invasive marine alga (Caulerpa cylindracea) and its attempted eradication, the effects of an invasive shrimp (Procambarus clarkii) on the sedimentary biogeochemistry of a protected wetland (Stagno di Molentargius, Cagliari).

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P_BEF001

VARIABILITY OF PARACENTROTUS LIVIDUS GONAD DEVELOPMENT IN THE SINIS MARINE PROTECTED AREA (WESTERN SARDINIA, ITALY)

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The sea urchin Paracentrotus lividus is a resource heavily exploited along Mediterranean coasts for its high commercial value. Population dynamics of P. lividus is influenced by biological and ecological processes, such as reproductive capacity, larval dispersal and recruitment. Understanding the variability of these processes is crucial to identify proper conservation and management strategies for this resource.

This study aims to detect the variability of gonad development of P. lividus in the Marine Protected Area Penisola del Sinis - Isola di Mal di Ventre through Gonadosomatic Index (GSI) and histological analysis. Furthermore, the occurrence of spawning events and their magnitude were detected with a view to the subsequent evaluation of larval supply and recruitment process.

Sampling was conducted monthly in three sites, one of which outside the MPA; two sampling stations were selected at each site. GSI, as an indicator of gonad development, was calculated for each specimen as the ratio of gonad weight to body weight . The spawning magnitude was defined as the ratio of the mean individual gamete output and the mean monthly pre-spawning GSI. The histological analysis was carried out to evaluate the gametogenic condition of gonads. Gonad development was classified in six stages for both sexes: recovery, growing, premature, mature, partly spawned, spent.

Spawning events were detected from March to April inside the MPA and until May outside. The spawning magnitude varied between 52% and 60%, respectively outside and inside the MPA. A marked variability was detected in the stages of gonad maturation: mature stage was found during winter months in all three sites, until May only outside the MPA.

Such a variability should be considered for further demographic studies (e.g. on larval supply, recruitment process, adult abundance) and suggests the use of a differentiated approach to manage sea urchin populations even on a local scale.

P_BEF002

DISTRIBUTIONANDABUNDANCEOFPARACENTROTUSLIVIDUSLARVAE AND SETTLERS IN THE SINIS MARINE PROTECTED AREA (WESTERN SARDINIA, ITALY)

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The evaluation of ecological processes regulating sea urchin population dynamics became a crucial point for planning sustainable harvesting in the Mediterranean Sea. Recruitment process is the bottle-neck of sea urchin populations and understanding differences in abundance of the early demographic stages help to predict the stock availability along the harvesting areas. In this study, we examined the pelagic abundance of larvae and the abundance of settlers of the sea urchin species Paracentrotus lividus along the Sinis Peninsula (Sardinia, Western Mediterranean Sea).

The study area was divided in five sectors characterized by different geomorphological and hydrodynamic conditions. This stretch of coast includes different levels of harvesting pressure: a low and medium level in the Marine Protected Area (Peninsula del Sinis - Isola di Mal di Ventre) and a high-pressure zone of harvesting to the north of it. From April to June, after the observed period of spawning in this region, larvae supply were sampled twice a month along the sectors. From May to July, in thirty-two stations, sea urchin settlers were trapped in collectors placed on the bottom and replaced every two weeks.

Plancton sample analysis shows the presence of larvae in April and their higher density in May but they were no found in June. Whereas, since the planktonic life-stage ranges between 20 and 40 days, settlers were found in collector sample directly from May.

Next analysis will shed light on the spatial variability of the recruitment along this stretch of coast. If variability will be detected, our findings will be an effective baseline/starting point for the management of each sector affected by their own demographic influence, harvesting pressure and ecological drivers.

P_BEF003

TEMPERATURE INFLUENCE ON THE HERBIVORY RATE OF THE GREEN AND THE PENCIL SEA URCHIN IN THE GALAPAGOS ISLANDS

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It is known that heating can lead to predictable changes in foodweb dynamics, productivity and community structure. Metabolic theory suggests that an increase in temperature follows an increase in the metabolism and grazing rate of herbivores with a substitution of algal biomass. Because of the increasingly high emissions of greenhouse gases into the atmosphere, the temperature of the oceans is increasing considerably. There is a growing scientific literature regarding the increase of the grazing rate as the temperature increases, although the thermal performance curves of many herbivores are unknown. We experimentally tested the hypothesis that plant–herbivore interaction strength increases with temperature. We have measured how the effect of temperature influences the grazing of two common sea herbivores of the Galapagos Archipelago, the green urchin Lythechinus semituberculatus and the pencil urchin Eucidaris galapaguensis. The objectives were assessing the dependence on temperature (from 14° to 32°C) of their grazing, if the grazing rate varies between the two species, and if the ranking between the species is homogeneous across the temperature range. This will allow estimating which species will be dominant in 2100, under future temperatures projected by IPCC RCP 8.5.

The results indicate different species performance along the temperature range investigated. Particularly, a bimodal pattern of grazing effect was evidenced for both species where both species have shown an increased grazing activity at about 16° and 28°C. L. semituberculatus activity was higher than that of E. galapaguensis, although only at the cold mode it was significantly higher. In addition, both species were found not survived at the highest temperatures (30° and 32°C), suggesting a late-century scenario dominated by macroalgae systems and thus an absence of the two key herbivores.

P_BEF004

COULD OCEAN ACIDIFICATION INCREASE PREDATION RISK OF THE FUNCTIONAL KEY-SPECIES PARACENTROTUS LIVIDUS IN THE MEDITERRANEAN SEA?

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Oceans are becoming more acidic. The current rate in acidity change is about 50 times faster than any known historical change, making it difficult for invertebrates to build shells and skeletons. This threat for marine invertebrates may affect ecological interactions between species like prey-predator dynamics, and in last instance, when key-funtional species are involved could have a dramatic impact on benthic marine communities. The goal of the present work is to estimate the effect of ocean acidification on the vulnerability of the sea urchin Paracentrosus lividus to predators as functional key species of Mediterranean coastal ecosystems.

The study was divided into two phases: a laboratory one where the animals were exposed to two different conditions, and a field one (to follow) where the sea urchins will be tested for predation rates. An equal number of wild sea urchins of vulnerable-size were collected and exposed to natural pH condition (8.09±0.02; pCO2 level 390 µatm), and to low pH condition (7.78±0.02; pCO2 level 1000 µatm), as reported in IPCC future projections

Several structural parameters were evaluated as an indication of their defense ability towards fish predators. Specifically: spine length, size diameter, exoskeleton thickness, exoskeleton breakpoint, and attachment to the substrate were evaluated for both set of sea urchins exposed to the two different pH. Predation pressure will be estimated in a Marine Protected Area where the treated sea urchins will be returned. These areas are well known to be rich in fish species natural predators of P. lividus.

We expect a deterioration of the structural parameters which in turn will increase their vulnerability towards predators. Potentially the increase of the structural weakness may increase the threshold of the safety size with important repercussion on the top-down mechanism controlling compositions of Mediterranean benthic community.

Preliminary results will be discussed

POSTER

P_BEF005

ENGINEERING EFFECT OF PINNA NOBILIS (LINNAEUS 1758) SHELLS ON BENTHIC COMMUNITIES: A CASE-STUDY FROM TWO AREAS OF SARDINIA

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The fan mussel Pinna nobilis Linnaeus, 1758 is one of the largest bivalves in the world and endemic in the Mediterranean Sea. The species occurs in soft-sediment habitats and in seagrass meadows of Posidonia oceanica and Cymodocea nodosa. P. nobilis is considered a good example of an ecosystem engineer offering an adequate substratum to many benthic invertebrate species also providing information about the overall conditions of the surrounding habitat. In order to better understand the ecological role of the species in structuring and enriching biodiversity, this study is aimed to test the null-hypothesis that the composition of epibiontic communities does not change across areas and across locations within different areas.

The study was conducted in the Gulf of Oristano (W Sardinia) and Calasetta (SW Sardinia). Five specimens from three locations within each area (n= 30) were considered for epibionts coverage (cm2), calculated using the TpsDig2 from pictures of the valves. Differences among locations in each area were explored using PERMANOVA on Bray Curtis similarity matrixes. The taxa mostly contributing to the observed differences were identified by SIMPER analysis.

The valves of P. nobilis were almost entirely covered by epibionts. Significant differences of epibiontic colonization on valves were observed either between areas or among locations in each areas. Most of the observed variations were explained by the factor "area" due to the relative abundance of dark filamentous algae in the Gulf of Oristano and green filamentous algae in Calasetta.

The results obtained herein argue in favour of the important engineering role of P. nobilis in the estuarine and coastal habitats. Indeed in some areas the species represents the exclusive "vertical" hard substrata for the colonization of epibionts, also providing a refuge from predation, increasing species richness and thus biodiversity.

P_BEF006

VISUAL IMAGING OF DEEP BENTHIC HABITATS IN THE ROSS SEA REGION MARINE PROTECTED AREA, ANTARCTICA

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The Ross Sea Region Marine Protected Area (RSRMPA) has been legally established in December 2017 and covers a surface of ca. 1.55 million km2, encompassing a vast area (1.12 million km2) of full protection (General Protection Zone, GPZ). Because of intrinsic difficulties, not much visual information is available about resident benthic communities in the RSRMPA, especially those that are out of reach by Scuba diving. Through time, only very fragmentary information has been provided by cameras and in later times by Remotely Operated Vehicles (ROV) and assimilated devices. In this scenario, two dives have been conducted at Terra Nova Bay during the 2013-2014 austral summer in the proximity of the Italian Mario Zucchelli Station using a modified Pollux III ROV. One station imaged Adelie Cove down to 120 m, while the second one explored the Terra Nova Bay 'Canyon' in a depth range of 220-298 m. The latter dive documented the existence of significant sessile and vagile mega- and macrobenthos, with a predominance sponges, cnidarians and echinoderms, with a considerable presence of erect bryozoan colonies. Images have been geo- referenced in the perspective of habitat mapping requirements. Another contribution to the visual exploration of RSRMPA deep communities was provided austral summer 2016-2017 through a single CTD cast with a HD Action Cam mounted on the frame. In this occasion we obtained a glimpse of benthic life at 550 m on the margin of Cape Hallett, showing the relevance of the acorn barnacle Bathylasma corolliforme, especially the accumulation of its skeletal remains. All these visual observations pertain to the GPZ of the Marine Protected Area. Research funded by the Italian Antarctic Research Program (PNRA)

P_BEF007

ECOSYSTEM BASED-MARITIME SPATIAL PLANNING IN PRACTICE: THE TUSCANY ARCHIPELAGO CASE STUDY

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Ecosystem Based-Marine/Maritime Spatial Planning (EB-MSP) is a process that adopt Ecosystem Based Management (EBM) as an instrument of sustainable economic growth that incorporates environmental issues and concerns. EB-MSP aims at favouring economic development that copes with the marine environment and its resources conservation. Such holistic and integrated approach reflects on the allocation of maritime uses in space and time, by incorporating socio-economic and ecological goals, in line with both Blue Growth and Marine Strategy Framework Directive (MSFD) objectives. In this study, we applied EB-MSP in the Tuscany Archipelago, by including 5 out of the 7 islands of the Archipelago as well as the Tuscan coastal waters that are in front and surround them. This area presents high density of maritime uses in place and growing demand for new uses, together with high valued marine habitats and components that give justice to the inclusion of such marine area within the National Park of Tuscan Archipelago and the Pelagos Sanctuary. We proposed and tested an EB-MSP process to orient future management plans in preserving the marine environment while favouring economic development in the area. We developed desk-based studies, as well as we integrated local stakeholders' contributions through a participatory process, to co-produce the knowledge framework of the area, and to identify synergies and conflicts between marine environment and local concerns. We mapped maritime uses and environmental features to analyse both positive and negative interactions to orient future needs of environmental conservation and protection. We highlighted the key role of EB-MSP to underpin the maintenance of marine biodiversity and habitats, thus ensuring both socio-economic and environmental objectives.

P_BEF008

FOOTPRINTS OF CORAL SYMBIOTIC HYDROZOANS HIGHLIGHT THE DIVERSITY OF THE ZANCLEA-SCLERACTINIANS ASSOCIATION

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Hydrozoans of the genus Zanclea have been acknowledged only recently as a fundamental component of the highly diverse fauna associated with reef-building scleractinian corals. Although widely distributed in coral reefs, the biodiversity of these diminutive hydrozoans remains enigmatic due to the paucity of available morphological characters, incomplete morphological characterizations and the possible existence of cryptic species. Recently, molecular techniques have revealed the existence of multiple hidden genetic lineages but phylogenetic data are not yet corroborated by significant morphological results. In this work, we further explore the morpho-diversity of three lineages, namely Zanclea associated with the coral genera Goniastrea, Porites and Pavona. Aside from providing a complete classical characterization of either the polyp and medusa stage of each clade, we searched for new potential taxonomic indicators either on symbiotic hydroids and on host corals. On the hydroids, statistical analyses on almost 7,000 nematocyst capsules revealed a significant difference in terms of nematocyst size among the three Zanclea clades investigated. On each host coral genus, we identified peculiar skeletal modifications related to the presence of Zanclea symbionts and we assessed their fingerprint as diagnostic attribute in the characterization of the Zanclea-scleractinians symbioses.

P_BEF009

HOW LEAF STRUCTURE MATCHES PHOTOSYNTHESIS IN DIFFERENT PLANT SPECIES OF MEDITERRANEAN MAQUIS ECOSYSTEMS

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In Mediterranean regions plants are often exposed to several environmental factors that limit their growth and productivity. The high air temperatures and the low soil water supply due to the summer drought are known as the primary constraints in affecting plant photosynthetic performance. In this study, we have compared the functional leaf traits and the photosynthetic performance of sclerophyllous and semi-deciduous species widely spread in the Mediterranean maquis of southern Italy.

The results show that the evergreen sclerophyllous species (e.g. Pistacia lentiscus L. Phillyrea angustifolia L., Quercus ilex L.) and semideciduous species (e.g. Cistus incanus L., Cistus salvifolius L.) modulated the photosynthetic activity differently during the summer season and showed leaf structural properties linked to intrinsic plant capability to overcome the stress.

More specifically, the evergreen sclerophyllous species showed higher photosynthetic rates (AN) and water use efficiency (WUE) compared to semi-deciduous species and have leaves characterised by higher mass per unit leaf area (LMA) and tissue density (LTD) as well as lower relative water content (RWC) and thickness (L) compared to semi-deciduous species, which exhibited the lowest carbon/nitrogen ratio.

The difference in functional leaf traits among species significantly affected the photosynthetic behaviour in terms of light absorption and plant carbon balance: the sclerophyllous evergreens utilize the absorbed light more in photochemical processes, as indicated by higher rate of quantum yield of PSII electron transport (FPSII) and electron transport rate (ETR); the semideciduous species prevent the photoinhibitory damage risks dissipating the excess of light energy by non-radiative dissipation process as shown by higher values of non-photochemical quenching (NPQ). The different photosynthetic regulation accomplished by changes in leaf structure guarantees the adaptive success of these species in their environment.

P_BEF010

SILICA DYNAMICS IN A SUBALPINE LAKE: FROM EXTERNAL LOADS TO IN LAKE PROCESSES

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Silica (Si) is an essential nutrient and the molar ratio of Si relative to N and P is relevant in the eutrophication process of aquatic ecosystems because it determines species composition. Lakes and reservoirs are biogeochemical reactors that recycle, store, remobilize and transform material. However, related to the well-studied nitr ogen and phosphorous, only few works have examined factors controlling Si loads, retention and stoichiometry in lakes.

In the frame of the project funded by the CARIPLO Foundation (ISEO: Improving the lake Status from Eutrophy towards Oligotrophy - Fondazione Cariplo 2015 - 0241) we analyzed Si, N and P loads and recycling in Lake Iseo. More specifically the purpose of this work was threefold; 1) to evaluate the role of the lake in regulating Si availability along the hydrographic network, 2) to understand how the lake influence N:P:Si ratios in river waters and 3) to analyze the spatial and temporal variability of benthic metabolism and Si fluxes in the littoral zone colonized by different primary producers communities.

Quantification of incoming (2536 ton TSi y-1) and outcoming Si loads (622 ton TSi y-1) suggests that Lake Iseo is a net Si sink and retains 78% of total load. Intact core incubations of different substrates collected from the littoral zone during the summer vegetative period indicate that the littoral zone mainly recycles DSi to the water column, but the intensity of Si regeneration differs among investigated habitats. Bare sediment colonized by benthic microalgae and rooted macrophytes show the highest release (121 µmol m-2 h-1) while rocky shores colonized by epilithon have the capacity to store Si during the all period (-29 µmol m-2 h-1).

P_BEF011

SPLITTING THE HAIRS: UNRAVELLING SEASONAL VARIATIONS IN DIET OF APENNINE BROWN BEAR (*URSUS ARCTOS MARSICANUS*) THROUGH STABLE ISOTOPE ANALYSIS OF HAIR SECTIONS

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Applying Stable Isotope Analysis (SIA) on non-invasively collected animal tissues allows detailed understanding of the trophic ecology of endangered and elusive species. We applied this technique to the isolated and critically endangered population of Apennine brown bear (Ursus arctos marsicanus) living in the National Park of Abruzzo, Lazio and Molise and adjacent areas. By accounting for the assimilated bear diet, our aim was to complement previous understanding of the food habits of this bear population, based on traditional scat analyses, in order to assist conservation management of the population and its habitat.
We analysed Carbon and Nitrogen stable isotopes of bear hair sections and potential food resources in order to: i) assess temporal variation of bear isotopic signals at a monthly resolution; ii) evaluate the assimilated diet at seasonal scale for two consecutive years; iii) investigate the extent of bear dependence from anthropogenic food sources, such as crops or livestock, which could result in human-bear conflict. Hair samples from genetically identified bears were collected using hair traps, while food resources were sampled at bear foraging sites.
In total, we analysed 35 hair tufts belonging to 27 different bears and assessed assimilated diet patterns using Bayesian stable isotope mixing models. Most of the studied bears showed wide Carbon and Nitrogen ranges and significant interindividual differences in seasonal isotopic patterns confirming their generalist feeding behaviour. The preferred resources are vegetable matter (herbs, fleshy fruits and masts), although a high consumption of ants was also observed during early summer. Furthermore, SIA suggested neither C4 plants (corn) nor vegetable crops represent staple and recurrent foods for Apennine brown bears.

P_BEF012

THE NEED FOR KNOWLEDGE BASELINE TO BETTER UNDERSTAND THE IMPACT OF EXTREM EVENTS

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The role of a single foundation species in controlling population and community dynamics and modulating and stabilizing ecosystem processes is widely recognized. Therefore, the absence of accurate knowledge baseline on the biodiversity and functioning associated to these species lead inaccurate reading of the effects of extreme events (EVs) whose frequency and duration are rapidly increased in the last decade. Here, we tested the effects of mussels, as foundation species, in shaping local taxonomic and functional diversity (e.g. structure, richness and diversity of the macrobenthic associated assemblages and their trophic behaviour). The facilitation effects of mussels was tested under an increasing gradient of density for two selected model species, the non-indigenous Brachidontes pharaonis and the indigenous Mytilaster minimus (mussels/m2) from lagoon to marine coastal systems. We tested the physical structuring role by reading patterns of organic matter quantities and composition in the associated sediments. By measuring died mussels shell fragments and detrital components, we also highlighted the "trapping function" of the foundation model species. The provided outcomes represent a crucial and effective quantitative knowledge baseline useful to inform future more adaptive management and conservation measures to be applied especially in similar ecosystems which are threaten and more vulnerable to EVs. Specifically, foundation species showed a recognized role in facilitating (facilitation effect) biodiversity and, moreover, the species-related tipping points per gradient of density have been successfully reported. Collected data on mussels' biomass will be useful to quantify future biodiversity loss associated to biomass removal due to EVs.

P_BEF013

SPATIAL VARIABILITY OF MACROBENTHIC COMMUNITIES IN HEADWATER STREAMS AND RIVERS OF NORTHERN ITALY

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River ecology conceptualized different theories to describe the responses of benthic riverine communities to environmental variability. The River Continuum Concept (RCC) suggested that river communities are adapted to optimize their energy balances according to physical gradients from headwater to mouth. On other hand, the Riverine Ecosystem Synthesis (RES) introduced the relevance of lateral dimension and local ecological patterns across various temporal and smaller spatial scales.

This work analysed the macrobenthic communities sampled in 61 sites from 16 rivers of Northern Italy in order to investigate which theory (RCC or RES) better describes their variability. A total of 12 physical, chemical and ecological parameters were considered to describe both longitudinal and lateral dimensions, as well as local variability. Multivariate analysis was performed to test the effects of different environmental parameters.

The observed macrobenthic communities were composed by a total of 69 families. The results showed that both longitudinal and lateral dimensions are needed to describe the variability of macrobenthic communities. Granulometry was the most important parameter for benthic communities in headwaters. The findings demonstrated that the combined effects of different variables play an important role and both RCC and RES models should be considered when modelling headwater living communities.

P_BEF014

AFFORESTATION OF OVEREXPLOITED AGRICULTURAL SOILS: PRELIMINARY RESULTS ON SOIL QUALITY AFTER 18 YEARS FROM PLANTATION

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The issue of soil exhaustion or soil sickness, referring to the progressive loss of soil quality and decrease in fertility, has increased considerably in the last decades. Recent models predicted that around 200,000 km2 of degraded agricultural land in Europe will be abandoned between 2000 and 2040. Accordingly, this research aims at identifying an adequate forest management that might recover low fertility soils through an increase of soil organic matter (SOM) and soil quality, improving the ecosystem services of those areas. Thus, a former agricultural site was identified in Brusciana (FI) where, for the past 18 years, various forest associations for wood production have been established, namely white poplar and common walnut (K), which were also planted intercropped with other species such as hazelnut (C), Italian alder (A), and autumn olive (E). These forest stands were compared also to an adjacent agricultural field (X). Preliminary analyses on the topsoil (0-10 cm) showed a general low concentration of SOM (10-70 mg/g), although lowest values were found in X and highest in A, while the others were intermediate. The same trend was followed by soil urease enzyme, while β-glucosidase was lower in the agricultural field in comparison to the other stands, where no significance difference were reported Regarding the acid phosphomonoesterase, significant differences were found between A and X, while the remaining stands showed similar values. We have computed the AI3 index as a reference for soil quality, which showed a better values in A compared to X, indicating that soil quality increased up to 4 times compared to the beginning of the experiment, while the other values were comparable. In conclusion, our preliminary results showed that afforestation of tired agricultural soils improved soil organic matter and soil quality, in particular in the stands where Italian alder were planted.

P_BEF015

CARBON STOCK CHANGES FOR ITALIAN BEECH FORESTS UNDER A CHANGING CLIMATE

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In Italy, beech forests are the most important ecosystem for their carbon stock, but they are also threatened by climate change. In fact, one study showed a considerable reduction of beech extent between 64.5% and 98.8% in different IPCC scenarios along with a reduction in C stock. In further detail, the C stock in the first 5 cm of soil was influenced by temperature seasonality and elevation. On this basis, we carried out an elevation transept in 10 beech forests in Italy, sampling 3 stands at an increasing distance of 200 m from each other. In each of these 30 stands we collected litter and topsoil. A preliminary analysis of the relationship between the organic carbon and temperature seasonality and elevation as predictors showed a much stronger effect of the former, together with spatial autocorrelation. As a consequence, we added uncorrelated bioclimatic variables used as predictors in GLS modelling. Our models have been projected on current, potential and future (2070 RCP6) beech extent. Considering the sum of leaf litter and topsoil, our results showed that, on the one hand, taking into account a stock in the potential conditions of 410 Tg, there can be a change of the organic C stock to 225 Tg in 2070, while under the current extent of beech the estimate is 121 Tg. On the other hand, the concentration of organic C is expected to increase from 80 Mg/ha under current and potential conditions up to 122 Mg/ha for 2070. This increase will be much more evident in the southern Apennines (up to 4 times) than in the Alps (almost no change). These results can be explained by temperature seasonality changes, which is expected to increase from 6.2 to 6.9 ° C for 2070 in beech's area of occurrence.

P_BEF016
WILL THE RESORTS SAVE THE CORAL REEF?

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Coral reefs support immense biodiversity and provide important ecosystem services to many millions of people, they are degrading rapidly in response to numerous anthropogenic drivers of which the most important is caused by the increase in temperature.
The main aim of joint research team is to understand how to reduce the water temperature from 32° C at 28° C, a temperature suitable for their survival. If we consider the Maldives as an example, we know that in the hottest moments the thermal profile of water moves from 32° C on the surface to about 28° C, at a depth of about 15 meters, suitable for survival of corals. We asked ourselves how to force a water recirculation, from the bottom to the top, able to bring to the surface a temperature compatible with the life of the corals. It is known that water circulation, from bottom to top, has already been used in different situations. For instance, eutrophication of large lakes or pollution of ports have been solved by recirculating water through the use of hydraulic systems.
Our innovative solution of ecological engineering goes through the design of an ad hoc hydraulic system to preserve hotspot of coral reef biodiversity around resort islands. Maldives are composed by 1200 and about 120 of them are used as luxury resorts each with its own reef. Hydraulic engineering systems could be positioned nearby the resorts in such a way as to generate a flow of current towards the reef able to mix the water and bring it to values compatible with the survival of the corals. Since the resorts are spread over some 800km, each point could become a biodiversity hotspot that facilitates coral re-growth once temperatures have decreased everywhere.

P_BEF017

THE SCIENTIFIC RESEARCH ON ECOSYSTEM SERVICES: A BIBLIOMETRIC ANALYSIS

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The scientific research on ecosystem services has grown substantially over the past ten years, making more evident the vital role played by natural ecosystems in support of human economy and well-being. Several studies showed that biodiversity represents a fundamental part of the Earth's life support system. Indeed, biodiversity considerably affects ecosystem functioning while contributing to the provision of different types of ecosystem services. The increasing ecological awareness of scientists, citizens, and policy makers on the importance of natural capital stocks and ecosystem services flows boosted nature conservation strategies and the development of more environmental friendly production processes. In this study, we explored the global scientific literature on ecosystem services over the last thirty years. The software VOSviewer was used to create maps based on network data of scientific publications, scientific journals, researchers, research organizations, and countries. Specific keywords were finally used to explore the co-occurrence of different terms connected to the research on ecosystem services. This approach allowed the identification of the main areas characterizing the scientific literature and research on ecosystem services.

P_BEF018

IDROLIFE LIFE15 NAT/IT/000823. CONSERVATION AND MANAGEMENT OF FRESHWATER FAUNA OF EU INTEREST WITHIN THE ECOLOGICAL CORRIDORS OF VERBANO CUSIO OSSOLA

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The LIFE Nature project IdroLIFE started in November 2016. CNR-ISE is the coordinating beneficiary and associated beneficiaries are the Province of Verbano Cusio Ossola, the Val Grande National Park and GRAIA srl. Fondazione Cariplo and 30 private hydropower companies partecipate to IdroLIFE as cofinanciers.
IdroLIFE aims to:
a) Improve the conservation status of Rutilus pigus, Chondrostoma soetta, Cottus gobio, Leuciscus souffia, Salmo marmoratus, and crayfish Austropotamobius pallipes in Natura 2000 sites of Verbano Cusio Ossola Province.
b) Reduce and control the spread of alien invasive species in the project sites.
c) Promote and stimulate the awareness for aquatic biodiversity conservation among citizens;
By:
a) the renovation of a public fish hatchery at the CNR-ISE headquarter in Verbania dedicated to conservation activities in Natura 2000 sites.
b) the re-establishment of the connectivity along the water corridor of Toce River SPA IT1140017, which is one of the last river in the Po River basin holding a residual Salmo marmoratus population.
c) the re-establishment of the connectivity along the water corridor of San Bernardino river, which is the main water connection from SIC IT1140011 Val Grande to Lake Maggiore and Po River Basin
d) the repopulation of Rutilus pigus and Chondrostoma soetta in SPA Lago di Mergozzo and Montorfano, Cottus gobio, Leuciscus souffia and crayfish Austropotamobius pallipes in SIC Val Grande and Salmo marmoratus in Toce River
e) Active control and reduction of the density of invasive alien fish and crayfish species in project sites.
f) Development and adoption of a conservation plan at provincial scale including measure for alien species control.
g) Involve in the project development and disseminate project principle, aims and results among a large audience of stakeholders

P_BEF019

PAH DEGRADATION CAPABILITY OF FOREST SOIL MICROBIAL COMMUNITY

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Polycyclic aromatic hydrocarbons (PAHs), mainly produced by uncompleted combustion, can accumulate and be retained in soils. Since PAHs have potentially toxic and carcinogenic effects, they represent a risk for human beings and ecosystems. Microbial degradation is the main responsible for PAH removal from soil. The objective of this research was to study the soil microbial activities and to reveal the microbial key-players involved in PAH degradation. Therefore, we applied a metaproteomics approach to link functional and taxonomic information of the soil microbial communities.

Three different forest soils were chosen: holm-oak (H), beech (B) and black pine (P). In the laboratory, each soil was separately spiked with benzo[a]pyrene (95 mg/kg), pyrene and phenanthrene (125 mg/kg, each) and incubated in mesocosms, in controlled conditions, along 108 days, during which PAH quantification, hydrolytic, laccase and peroxidase activities and metaproteomics analyses were performed.

At the end of the incubation, we observed in all forest soils a strong decrease in phenanthrene and pyrene content: phenanthrene reached a degradation percentage of 99, 95 and 58%, in H, B and P respectively; pyrene a degradation percentage of 97, 96 and 85%, in H, B and P respectively. Benzo[a]pyrene at the end of incubation showed a decrease of 1% in H, 5% in both B and P. Enzyme activity dynamics differed among soil forest systems, although similar trends were observed for the three mesocosms spiked with each PAH, in each soil type.

Protein-based taxonomy was evaluated to analyze the microbial community composition, identifying some strains as key players in PAH degradation.

P_DEA001

THE "BIODIVERSITY" OF COMMUNICATION AND PUBLIC ENGAGEMENT IN ECOLOGY: ACTIVITIES AND REFLECTIONS FROM THE LTER-ITALY NETWORK

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Socio-ecological research is conducted in national Long Term Ecosystem Research (LTER) networks worldwide, aiming at collecting and synthesizing both environmental and socio-economic data and to involve a broader stakeholder-community. The LTER networks therefore represent a suitable context where new and different forms of communication and of public participation and engagement could be experimented and where reflections about the way scientists communicate ecology can arose.

LTER-Italy realized, since 2015, the informal science communication initiative "Cammini LTER", a series of trails connecting two or more LTER sites, where researches walked and cycled together with citizens, aiming at providing the public with the opportunity to get familiar with Italian ecosystems, from the sea to alpine tundra. During Cammini, LTER researchers experimented different forms of dialogue and of knowledge exchange with citizens, using a diversity of tools and language.

Here we present the most relevant examples of this "biodiversity" of communication and public engagement, analysing the key players, the context, the main results and criticisms. Alongside the classic forms of communication, aiming at informing the public about the LTER activities, others - more participative - were explored and developed: Citizen Science and Bioblitz, where knowledge and experiences are shared, the "Sea Futuring Tours", partecipatory labs where communication became a chance of comparison among expert and non-expert perspectives and also the communication through social networks used in a non-conventional way.

P_DEA002

INVASIVE SPECIES: CHALLENGES AND OPPORTUNITIES FOR ENVIRONMENTAL EDUCATION

Padoa-Schioppa E.

Invasive species pose a major challenge for environmental education. On the one hand, they are an objective environmental problem, which often requires radical management interventions. On the other hand, those interventions can be judged negatively by society. Here, in this context, I will show the steps of a work carried out in the course of the primary education sciences of Milan-Bicocca:

1) knowledge of the problem (analysis and study of the invasion potential of extra-European tortoises);

2) analysis of the risk existing in its territory and reflection on the options available;

3) critical reflection on the concept of balance, naturalness and human role in ecosystems.

The results confirmed the fundamental importance of a good communication plan for the eradication campaigns. They also highlight how to deal with and spread knowledge of the problems related to invasive species can contribute to increasing attention to environmental issues and encouraging the adoption of more correct behaviors

P_DEA003

STARTING FROM SCHOOLS: THE FIRST STEP OF THE BOTTOM-UP PROCESS TO INFORM THE SCIENCE-POLICY INTERFACE

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The need to translate the scientific ecological information to inform the public societal actions in a context of sustainability is pressing and one among the most sensitive and crucial aspect in the creation of an effective science-policy interface process. Primary and secondary schools represent one of the main steps of the informing process when engaging with public opinion. This allows to feed - from the bottom - the decision-making process about the most emerging ecological issues such as the rebounds of biodiversity loss on our societies due to Non-Indigenous Species (NIS) in local sea- and landscapes. Stimulating the interest of students can facilitate an increasing awareness around the implications of biodiversity loss. Here, we present the 'Un Sacco di Palermo' modular pedagogical kit which was Promoted by Manifesta 12 Palermo Educational Department and developed by Valentina Mandalari together with scientists, local activists and artists to describe the the transformation of the city, the distribution and the ecological role of NIS in Palermo urban and coastal ecosystems. The often not-accessible scientific evidence were translated into easy-to-read information with the main idea to support teachers and educators in introducing the violent urban expansion called 'Il Sacco di Palermo' and its impact since 1950s on urban ecosystems' dynamics. The kit addresses environmental, urban and societal consequences of the city's unregulated development. Based on scientific evidence it contains a set of activities encouraging students to investigate the multiple aspects of the city's urban transformation through collective, class-based games, neighbourhood field trips, individual research, and cross-institutional collaborations. The pedagogical kit of Manifesta 12 was specifically designed for students and tailored to show the relationship between the "Sacco", NIS ecological effects and biodiversity loss in the hope to increase student's perception and facilitate their internalization of ecological awareness.

P_DEA004

DO THEY UNDERSTAND, MISUNDERSTAND OR NOT UNDERSTAND? THE "INVASIVE ALIEN FLORA PATH" CHALLENGE IN LIFE-ASAP PROJECT

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LIFE ASAP (Alien Species Awareness Program, LIFE15 GIE / IT / 001039) is a training, information and communication project aimed at promoting activities to prevent new introductions and reducing the voluntary and/or accidental dissemination of invasive alien species (IAS). Within this project the "Invasive Alien Flora Path", set in the Botanical Garden of Cagliari, is an educational trail created to see and learn about alien plants introduced in Italy for ornamental or food purposes.

To evaluate and monitor path's communicative effectiveness and the level of visitor knowledge and perception on IAS related issues before and after the guided tour of the path, we designed four questionnaires, addressing different age groups. Considering the stages of cognitive development of children from three to seven years, we designed a questionnaire with images and drawings only for the nursery school and for the first two years of primary school: we aim to detect the ability of children to observe and recognize the IAS they met during the guided tour. With the help of the teachers and the use of a stamp, children will fill it out them with fun. Children of 3rd, 4th and 5th classes of primary school are able to assimilate and memorize concepts: true or false answers, accompanied by drawings and cartoons to facilitate their comprehension will be used to understand both the degree of knowledge acquired and to test the efficiency of the teaching techniques adopted during the guided tour. For students in secondary schools of I and II degree and adults, two multiple choice questionnaires will be administered, before and after the guided tours, in order to identify their a priori knowledge and the new information acquired. Increasing awareness and the dissemination of good practices can effectively change the behaviours of many sectors of the society and help combatting IAS.

P_DEA005

LAND AND SEA JOINT – THE EDUCATIONAL PROJECT TERRAMARE

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Today, the global financial and economical crisis has made evident the inner relationship between environmental degradation and social needs. Throughout the Mediterranean Sea the consequences of the new shift in the geopolitical order and the cultural conflicts confronting is a first result of disadvantages and environmental crisis with a continuum growth of environmental disorder and difficulties on manage territories. In this contest, the foundation "Fondazione con il Sud" promotes project for Sustainable Development and Environmental Education to empower citizen to live sustainably in an environmentally conscious manner and to promote cultural integration.

The "Terramare" project is proposed as a model of integrated protection and management of coastal protected areas, based on the close interconnection between the terrestrial nature reserve and the marine protected area. Contextualized in the Pelagie islands, the project plans to tackle some critical issues of the two protected areas and the territory by proposing to the local community an active role in the protection and management of natural capital and identifying new ways of enjoying and living protected areas based on sustainable tourism and the strengthening of the local identity.

P_IDRO001

STEPPING STONES OR SHELTER AREAS? THE ROLE OF ROCK GLACIERS IN CONTEXT OF ALPINE DEGLACIATION

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Deglaciation is causing significant consequences on the hydrology of the Alpine watersheds and their lowland areas, which will be characterized by an increasing variability and hydrological stochasticity due to the loss of glaciers and the reduction of snow cover. On the other hand, given the greater climatic resilience of permafrost, this component of the cryosphere will play an increasingly important role in the hydroecology of high altitude basins. Rock glaciers are the most evident form of alpine permafrost and are the source of streams whose baseflow derives from the melting of interstitial ice. While streams fed by glacial melt (kryal), snow-melt and precipitation (rhithral) and groundwater (krenal) have been extensively investigated, little is known about the ecology of rock-glacier fed streams, despite their peculiar hydromorphological, physical and chemical characteristics . We investigated a high altitude Alpine basin in the South Tyrolean Alps (Solda Valley, Ortles -Cevadale Massif) to illustrate the ecological peculiarities of the streams fed by rock glacier in comparison with high altitude streams of different origins: glacial, spring and mixed. We sampled streams of different origin but with comparable geology and altitude within two sub-basins, for a total of 13 stations sampled in the three key moments of the summer season: peak of snow melting, ablation and recession. Preliminary community analysis of invertebrates, albeit with low taxonomic detail (genus / family), shows how the rock glacier streams, which share the same altitude of glacial-fed streams, are similar in composition, abundance and diversity to the streams of the valley floor. Therefore, a fundamental question arises, inherent the biogeographic role of rock glaciers in the context of deglaciation: are rock-glacier fed streams stepping stones used by invertebrates to colonize high altitude areas, or rather hotspots of diversity in which cold-stenotherm taxa will they shelter after glaciers will melt and disappear?

P_IDRO002

RESPONSE OF BENTHIC INVERTEBRATE BIOMASS TO SMALL- AND LARGE-SCALE FACTORS IN ALPINE RIVERS

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Benthic invertebrates are a key component of the biodiversity of rivers as they colonize all the aquatic habitats associated to the riverine ecosystem. Moreover, acting as intermediate consumers, macroinvertebrates play a fundamental role in the energetic dynamics of rivers. For example, herbivorous and predaceous taxa exert an important top-down control on the primary producers and the populations of benthic organisms respectively, while shredders invertebrates are involved in the organic matter processing. At the same time, macroinvertebrates are the preferred food items for the higher trophic levels, including both aquatic and terrestrial species. As a consequence, the biomass of benthic invertebrates can be considered as a helpful indicator of the ecosystem functioning and integrity, and several authors recommend its adoption for river biomonitoring. However, this variable is still scarcely included in field studies and discrepancies on the results exist in literature because of the stream-specific differences. Here we present preliminary results on the relationship between the benthic invertebrate biomass and several environmental factors, including hydraulic conditions, basin-related characteristics, water chemistry and metrics of biological integrity. Data were collected during a large-scale survey (PRIN "No Acqua" project) encompassing 15 Alpine streams (Piemonte, Italy); this experimental design allowed us to evaluate the variability in biomass under natural conditions, avoiding the influence of river-specific conditions. Our results show that the biomass of macroinvertebrates in Alpine streams is strongly influenced by a combination of small- and large-scale factors, like the availability of organic matter, the composition of the invertebrate communities and the concentration of nutrient. As the project is still on going these preliminary findings will represent an important baseline for testing the effects of hydro-morphological impacts on benthic invertebrate biomass.

P_IDRO003

RECURRENT DROUGHTS REDUCE ECOLOGICAL NICHES OF SCRAPERS IN INTERMITTENT ALPINE STREAMS

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Several mountain streams are currently changing from perennial to intermittent systems due to increasing water abstraction combined with global climate change effects with expected detrimental consequences on biodiversity and functionality. In particular, droughts are expected to strongly affect autochthonous energy inputs, such as periphyton, with cascading effects on benthic invertebrates feeding on it. We here examined whether the ecological niche of scraper macroinvertebrates experiencing recurrent summer droughts show alterations compared to perennial stretches in 13 mountain streams in SW Italian Alps. For each stream, benthic communities were sampled after complete flow resuming in April 2017 in a control section, with permanent flow, and in a disturbed section, which has been experiencing summer drought since 2011. In each section, we collected Surber samples in three different microhabitats and we coupled biological sampling with measurements of multiple environmental parameters, namely flow velocity, water depth, substrate composition and chlorophyll a concentration of diatoms, cyanobacteria and green algae. We calculated niche width of each recorded taxon with the Outlying Mean Index (OMI) analysis based on microscale environmental parameters and we tested for differences in terms of niche width for each taxon by means of Wilcoxon test. Our results showed a significant reduction of niche width for most taxa in intermittent stretches compared to perennial ones, suggesting a reduction of available microhabitats. This is particularly evident for rheophilic taxa, such as Heptageniidae and Blephariceridae, whereas tolerant taxa, like Baetis, are favoured in intermittent sites probably because of lower competition with other groups. Such results underlay how benthic communities in intermittent sections of previously perennial alpine streams are currently under pressure and further investigations in mountain areas are required in the next future to better unravel these processes.

P_IDRO004

ECOLOGICAL CHARACTERISTICS OF THE WATERS IN THE VALLE OF GORINO BEFORE AND AFTER REALIZATION OF THE HYDRAULIC STRUCTURE IN THE LOCALITY TRAGHETTO

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Eutrophication is a phenomenon of pollution that involves aquatic environments and begins with an enrichment of nutrients, which favors an increase in primary productivity and an accumulation of organic substance unsustainable for the ecosystem.
The decomposition processes of the accumulated organic matter determine, in a time dependent on the type of accumulated plants and the physical conditions at the boundary, an excessive consumption of oxygen which leads to the establishment of hypoxia and anoxia.
Monitoring within the project LIFE AGREE - coAstal laGoon long teRm management - LIFE13 NAT/IT/000115, carried out before and after the construction of the hydraulic structure in the locality Traghetto, described the ecological characteristics of the waters of the Valle of Gorino.
Sampling was carried out in 9 stations, 8 of which are inside the Valle of Gorino and a station located on the river Po.
The entry of nitrates from the Po during the autumn and winter period influences the entire Valle of Gorino regardless of the position of the stations and the entry route of fresh water.
In spring and summer this effect is not evident but subsists and probably exerts a conditioning of the trophic state of the pelvis and its evolution towards dystrophy.
The construction of the hydraulic structure in the locality Traghetto is strategic for the fine regulation of salinity in the Valle Seganda area.
This product must be the subject of careful management that allows the regulation of salinity gradients in the entire Valle of Gorino.

P_IDRO005

CHANGES IN ISOTOPIC SIGNATURES OF EPILITHON IN LAKE BRACCIANO DURING THE DROUGHT CRISIS

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Lake Bracciano (Central Italy) is the main freshwater reservoir for the city of Rome. Despite its ecological and economic importance, the drought, that characterized the last two years (2016-2017), and the direct withdrawals produced a remarkable decrease of the lake depth (maximum decrease: -187 cm). Moreover, the 2017-2018 autumnal, wintry and vernal rainfalls only allowed a partial recover of the water level and this condition poses a threat for the ecosystem structure and functioning. The epilithic nitrogen isotopic ($\delta^{15}N$) signature is a powerful tool for the environmental monitoring of nutrient inputs in freshwater ecosystems, able to discriminate the origins (organic vs inorganic) of nitrogen discharges and describe their spatial and seasonal dynamics. We hypothesized that the depth decrease, with consequent increase of the beaches, could promote a higher touristic pressure, in comparison to our previous study, and therefore an increase of organic nitrogen inputs in the littoral zone. When we compared the space-time distributions of the epilithic $\delta^{15}Ns$ of 2015-2016 and 2017-2018, the resulting change detection analyses show complete divergence patterns between same seasons in different years. In particular, the complete disappearance of "high organic" nitrogen signatures in Summer 2017, the contraction of the "moderate organic" class and the remarkable increases of "inorganic" nitrogen signature spatial distributions from Spring 2017 to Winter 2017-2018. In fact, in Summer 2017, the touristic pressure decreased. On the other hand, most of the "inorganic" signatures were unlikely related to the agricultural activities and probably reflect the effect of the epilithic N2-fixation ($-3‰ \leq \delta^{15}N \leq +3‰$) as a result of the increased distance between riparian vegetation and aquatic ecosystems, with consequent decrease of allochthonous organic matter contribution and the onset of N limitation.

P_IDRO006

CENSUS AND HYDROPERIOD OF COASTAL TEMPORARY PONDS IN LATIUM (CENTRAL ITALY)

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Temporary ponds have been neglected habitat for a long time, although they include some habitats to be preserved and inserted within the Habitat Directive, recognized as biodiversity hotspots and ecological corridors for many native and alien organisms. Understanding their occurrence on the territory and lifetime is mandatory to engage correct management practices. So, the main aim of the present study is threefold: 1) to georeference all small wetlands, with particular attention to temporary ponds, within the coastal area of Latium, central Italy (as defined by the Millennium Ecosystem Assessment) by exploiting the temporal geographic information system of Google Earth as well; 2) to evaluate their hydroperiod after the analysis with ArcGis, with whom Georeferenced the ponds up the Basemap of Latium; 3) to calculate their water surface size variability within a year, with same method on ArcGIS, after the georeferencing. Specifically, we monitored 137 ponds, 72 permanent and 65 temporary ponds, the latter always with a surface less than 3 ha. We observed that the investigated temporary ponds have a large variability in the hydroperiod duration, depending on the rain period beginning and intensity, and the substrate structure and geological properties. Indeed, the permeability and the slope of the substrate determines the water amount. These hydroperiod changes have significant effects on temporary waters, and may alter the biotic interaction patterns. Climate change, proximity of urban areas, intensification of agricultural activities, expansion of tourism and their scattered and isolated distribution (habitat fragmentation), make temporary ponds very vulnerable habitats. So, contributing to manage and preserve these habitats means to evaluate the conservation status, and the first step is to improve the knowledge on their distribution within the national territory.

P_IDRO007

RIVER-GROUNDWATER MIXING: HOW IRRIGATION AND N EXCESS DRIVE N DYNAMICS IN PO PLAIN WATERSHEDS

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From global to local scales, N budgets performed to investigate and manage anthropogenic pressures generally hypothesize but do not quantify N accumulation in soils and groundwater. This is a key issue for river basins like the Po River and its sub-basins (Northern Italy), which drain a heavily fertilized and irrigated agricultural land and are characterized by springs. We hypothesize widespread river- nitrate-polluted groundwater interactions during irrigation periods. Large fractions of river discharge are diverted to irrigate permeable soils by flooding, a practice that enhances nitrate transfer from soils to groundwater and from groundwater to rivers via springs and river-groudwater interaction. As a result, nitrate display sharp increase in stretches without point N inputs and crossing areas with springs. Aim of the work, part of the INTEGRON project supported by Fondazione Cariplo, is to integrate N budget at watershed scale with the role of groundwater as N source, quantifying N-rich groundwater input to rivers. Soil N budgets were calculated for Oglio, Adda and Ticino watersheds and were integrated with experimental N mass budgets. During 2017 we performed reach-scale N balances by seasonal samplings of river water in segments crossing the springs area. For all basins a soil N surplus and water contamination risk emerged, as N inputs (mostly livestock manure and synthetic fertilizers) largely exceeded outputs (mostly crop uptake). Reach-scale N and conservative parameters balances suggested diffuse contamination of nitrate-rich groundwater into the river. Similar outcomes were found for the Oglio River using a water quality model (QUAL2Kw). The combination of basin level budgets, experimental balances and QUAL2Kw modelling represents an effective tool for the evaluation of diffuse N pollution and for optimal water quality management.

P_IDRO008

SATELLITE DATA FOR IMPROVED WATER QUALITY PRODUCTS IN MULARGIA RESERVOIRS

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Earth observation (EO) imagery gathered from Landsat-8 and Sentinel-2 are operationally used with H2020 SPACE-O project (Space Assisted Water Quality Forecasting Platform for Optimized Decision Making in Water Supply Services) to observe a set of key variables for water quality monitoring in Mulargia reservoir. This serves as drinking water source for the towns of Cagliari and hinterland, and 20 different villages place in the surrounding area (700.000 inhabitants).

The products, based on the physics-based Modular Inversion and Processing System image-processing-chain, provide time-series data of the water quality parameters from 2013 to 2017. The water quality obtained was Chlorophyll-a (chl-a), Secchi Disk Depth, Turbidity and some ecological and warning indexes (Trophic Status Index, HAB Probability). Moreover, the TIR Sensor on board of Landsat-8 data was used to investigate the lake surface temperature and evaporation rate. The validation of the products show a good agreement between EO vs in situ data (turbidity R2 = 0.82; chl-a R2 = 0.72), in particular the trend of the results during the years shows the same tendency. For Lake Mulargia, 138 clouds free images produce many information about the water quality: the average chl-a was 10.8 mg m-3, and average turbidity was 5.9 NTU. Our results show that in spring and autumn period the quality of the water is worse. Especially, in concomitance with low water levels and intense precipitation that foster a high run-off of particulate matter from the basin. Furthermore, the results verified a patchy distribution of red cyanobacteria in April and October 2015 with a coverage of 2.6 and 1.4 hectares, respectively. All the products obtained are used in the SPACE-O modules to support the implementation of the Mulargia monitoring as well as for the water forecasting for local populations.

P_IDRO009

FLY FISHING CATCH AND RELEASE AREAS AS TOOLS TO COMBINE ENVIRONMENTAL CONSERVATION AND ECONOMIC PROMOTION IN ALPINE VALLEYS

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In the Alps, rivers represent one of the most important yet vulnerable environments, due to the increasing pressure of global (i.e., climate change) and local (i.e., water withdrawal, hydropower, morphological alteration) impacts. Conservation demands often collide with economic pressures, especially in the most marginal and poor valleys. To combine environmental protection with socio-economic promotion we propose to increase the diffusion of 'no-kill' fly fishing areas. In recent years, the number of fly fishing anglers increased: these people not only invest time and resources in their passion but also are particularly demanding from an environmental point of view. In this context, numerous Alpine rivers could constitute an important tourist attraction, with the destination of some reaches to fly fishing catch and release areas. This happens regularly in other neighbouring countries (namely Austria, Slovenia, France), generating a touristic and economic input that could be not negligible especially in some of our 'marginal' Alpine valleys. Fly fishing catch and release areas have a low ecological impact and these structures can constitute an important element in the river protection, because in these areas limits on human activities can be imposed and only specimens from native strains (e.g.: Mediterranean Brown Trout) can be introduced. Moreover, such practice allows to protect breeding individuals and then to conserve well structured salmonid populations. These stream reaches can also constitute an important cultural and scientific catalyst, promoting the knowledge of stream ecology and conservation. This contribution presents the experience of the new (2018) no-kill reserve of the river Pellice, hypothesizing the realization of a similar project in Valle Po (Piemonte). Within the Miur ITALIAN MOUNTAIN LAB project, we support the dissemination of these practices, which can be an important element not only for conservation but also for the increase of a low impact, 'learning' tourism.

P_LIFE001

BIOMONITOR: AN R PACKAGE FOR CALCULATING BIOMONITORING INDICES OF RUNNING WATERS

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Biomonitoring is crucial to assess and preserve the quality status of running waters. Following the implementation of Water Framework Directive, a multitude of indices has been developed targeting at the effects of stressors on aquatic communities. However, the application of those indices is generally confined within the country in which they are developed, making the sharing of methods among researchers difficult. Our work aims to cover this gap by developing a package called biomonitoR for the free statistical software R. Currently, biomonitoR allows the calculation of numerous ecological indices for macroinvertebrate and macrophytes communities. When importing data, biomonitoR compares the user database with a reference database, obtained www.freshwaterecology.info, to assure taxonomic consistency. Due to the its flexible structure, biomonitoR can also accommodate custom reference database provided by the user, thus widening the use of the package to other biotic communities. The indices developed until now encompass different features of biotic communities such as diversity and evenness (e.g. Shannon-Wiener, Simpson, Margalef, Menhinick, Pielou), sensitivity to stressors (e.g. Average Score per Taxon for macroinvertebrates) and functional indices based on fuzzy-coded biological and ecological traits (e.g. Community Weighted Mean, Community Specialization). biomonitoR is still in development but is already downloadable (https://github.com/alexology/biomonitoR/) and testable. This project it is based upon work from COST Action CA15113 (SMIRES, Science and Management of Intermittent Rivers and Ephemeral Streams, www.smires.eu), supported by COST (European Cooperation in Science and Technology). Different stakeholders (e.g. researchers, private consultants, water resource managers) may directly benefit from this new tool which strongly facilitates the estimation of a wide range of ecological indices for biological communities.

POSTER

P_LIFE002

USE OF A CONSUMER-GRADE DRONE FOR HIGH-RESOLUTION CORAL REEF HABITATS MAPPING OF THE SOUTHERN PART FAAFU ATOLL, REPUBLIC OF THE MALDIVES

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Maldives are a unique marine biodiversity hotspot. This unicity makes Maldivian coral reef environments extremely fragile to global climate change effects (acidifications, the rise of surface temperature and sea level rise) and anthropogenic impacts. Use of satellite remote sensing data can be extremely useful in monitoring and assessment of those impacts. However, a major problem with this kind of application is the spatial resolution that can be too coarse for detailed studies. The newly affordable consumer-grade drone can fill this gap for mapping coral reefs at a scale between a scuba or snorkelling surveys and satellite images derived maps.

In our study, we collected high-resolution images using a commercial drone (DJI Phantom 4) along different sectors of coral reefs surrounding inhabited, uninhabited islands of the Southern Faafu Atoll. The acquired data were processed in order to map the extension and the composition of shallow lagoon habitats, from the beach to the reef crest. In addition, high-resolution images (1,5 cm/pixel) were collected in situ, at selected locations, in order to realize a 3D model of shallow reef communities using Structure from Motion algorithms. These 3D optical models will be used as the first step of a 3 years monitoring campaign addressed to observe the 3D structural complexity changes of the reef after the 2016 bleaching event. The whole study will focus on the integration of multi-scale maps to investigate, on a multi-temporal scale, ecological and geomorphological shifts in the study area and to figure out relationships with human activities (agriculture, land reclamation, new infrastructure) and pressures related to global climate changes.

P_LIFE003
YES!BAT SUSTAINABLE RICE FIELS: SAY YES! TO BATS

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In 2015, the leaders of 193 countries adopted the United Nations 2030 Agenda for World Sustainable Development. This agreement commits nations to foster and finance actions to achieve 17 sustainable goals, among which are The achievement of a sustainable production (Sustainable Development Goal SDG12) and The protection of life on lands (SDG15). Under these SDGs, the project YES!BAT Sustainable rice fields say YES! to bats promotes an integrated pest management strategy in rice fields that takes advantage of the ecosystem services provided by bats. Indeed, bats are outstanding predators of nocturnal insects, among which there are several pests for agriculture. The project is based on the deployment of bat boxes in rice fields that encourage bats in areas, such as rice fields, where there are few roosting sites, therefore fostering their beneficial pest control service (a single bat can consume up to 1/3 its body weight in insects per night). These artificial roosts will provide shelters that are completely lacking in the intensive agricultural landscape of rice fields. Colonisation success is evaluated by monthly checking of boxes and by acoustic surveys, to gather information on the presence of other bat species foraging in the study area which are not found in the bat boxes. These shelters will also allow the rapid and easy collection of guano that will be analysed through morphologic and metagenomic techniques to gather information on the diet of bats. A particular focus will be dedicated to the detection of alien insect pest species. At the end of the pilot activities, a best practice document will be developed to illustrate targeted habitat management techniques for improvements to those habitat components (e.g. conservation of relict forests, plantation of woody borders, hedgerows and trees, wetland management) that will guarantee the establishment of bat populations in the long term.

P_PAES001

INTEGRATING BIODIVERSITY AND MOBILITY ANALYSES OF A METROPOLITAN ECOSYSTEM: THE CASE STUDY OF MILAN

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The ever-changing urban environment of a metropolis is almost exclusively shaped by the needs and the habits of humans. Rapid but long-term land-use changes coupled with the high intricate patterns of population mobility occurring even on very short (i.e. hourly) temporal scales lead to a quite diversified time-varying urban ecosystem. Such an urban ecosystem can interestingly be explored with tools that ecologists typically adopt to analyze biodiversity in a natural environment.

In this study, we considered the city of Milan (Italy) and we integrated beta-diversity indicators, used to compare the land-use mix in the different neighborhoods of the metropolis (Municipi), with human mobility patterns that allowed a better understanding of the intra-metropolitan connections through time. Data on land uses at high spatial resolution for the year 2015 were obtained from the DUSAF database of the Lombardy Region, while human mobility patterns were reconstructed from mobile phone traces available from the largest open multi-source dataset of call detail records (CDRs) released from the '2014 Telecom Italia Big Data Challenge'.

Results consist in Urban Diversity Maps which revealed the existence of complex spatio- temporal patterns overlapping the somehow expected concentric zone structure of the city, due to its historical structure and development. Specifically, it was possible to identify which areas are more similar/dissimilar in terms of land-use composition and which other are linked by human mobility. These outcomes could be important for policy makers and could allow them to improve strategic development plans accounting for the needs of a changing city.

P_PAES002

MANAGING MARGINAL AGRICULTURAL LANDS TO ENHANCE THE PROVISION OF BIOENERGY AND ECOSYSTEM SERVICES AT LANDSCAPE LEVEL IN AGROECOSYSTEMS

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Over the last years, there has been a growing interest in bioenergy production. Their exploitation concurs in reaching EU targets of 20% of total energy production from renewable sources. On the other hand, bioenergy production is known to induce changes in landscape patterns and trade-offs with other ecosystem services (ESs). Trade-offs between the exploitation of BBES and other ESs are not currently taken into account in either feedstock analysis or certification schemes. Sustainability requirements and social acceptance for the use of BBES are needed. In this framework, the use of marginal lands for the exploitation of BBES can be an effective tool to reduce the impacts on landscape and ESs, as well as trade-offs with food production.
The scope of this study is i) to identify marginal agricultural lands through remote sensing data, and ii) to analyse the spatial distribution of such areas in relation to other ecosystem services provided at landscape level, in order to suggest appropriate land use strategies aimed at enhancing the provision of a set of ecosystem services in agroecosystems while reducing trade-offs among them.
The method is applied for the Province of Rovigo, located in the Veneto region (Northern Italy). Using a GIS-based environmental modelling, after the identification of marginal agricultural lands through remote sensing data, meaning croplands not involved or poorly involved in food production, their spatial distribution is analysed in relation to spatial-explicit ecosystem services assessment, as well as additional spatial and biophysical data driving the provision of certain services. Results are discussed in relation to potential land use strategies aimed at enhancing the provision of a set of ecosystem services in marginal agricultural lands identified without affecting other services provided at landscape level.

P_PAES003
MARINE LANDSCAPE AND A NEVER SEEN HUMAN FOOTPRINT

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Like the terrestrial counterpart, the marine landscape, is characterized by a mosaic of resource and environmental patches generated by biotic and abiotic pressures. Even if patchiness and heterogeneity are well known in marine landscapes at changing spatial-temporal scales, oceans still remain the least observed areas of our planet. To support a more effective Marine Spatial Planning (MSP) and Ecosystem-Based Management (EBM), scientists have pointed out the need to fill gaps in Ocean Observation Data (OOD). This becomes more cogent for several user-groups, as the merchant shipping (cargo or passengers vessels), often poorly represented in MSP due to a lack of fine-scale spatially explicit data to support the decision-making processes. Here, we used the Strait of Sicily as a case study area to show the effectiveness of Automatic Identification System (AIS) data in addressing gaps in OOD for shipping in a cross-border context (Sicily-Malta). We demonstrate how fine-scale spatial intensity and occupancy data-layers derived from AIS can be used to generate maps of vessel pressure and provide an indication of patterns of impact on the marine environment. We screened and analysed the vessel traffic (e.g. passenger vessels, offshore service vessels, bulk carrier and cargo, fishing vessels) annually operating in the study area potentially detecting conflicts among ocean user-groups. The shallow coastal waters and habitats off the continental shelf, and some defined slopes' areas, experienced a more persistent pressure associated with fishing activities being source of potential conflict among users (e.g. shipping, conservation areas and petrochemical sectors). By dominating ocean use, shipping should be included when informing decision-making processes to allow reducing conflicts among user groups, increasing compliance and preventing environmental impacts. AIS data can represent a comprehensive tool to fill gaps in OOD and to visualise patterns of vessel behaviour and potential threats better supporting a cross-border MSP.

P_PAES004
VULNERABLE MARINE ECOSYSTEMS: A MARINE LANDSCAPE COMPONENT

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The concept of a marine landscape classification was developed to enable actions to be taken to benefit nature conservation specifically in circumstances where marine biological data are limited. Since 2008 the United Nations General Assembly (UNGA) called all the States and Regional Fisheries Management Organizations or Arrangements (RFMO/As) to pay attention to the sustainability of deep sea fisheries. The UNGA resolution, followed by the FAO Deep-Sea Fisheries Guidelines, has turned the spotlight on Vulnerable Marine Ecosystems (VME), the areas of seabed considered vulnerable to impacts from high seas fishing activities. The need to provide an internationally agreed-upon set of criteria for identifying a VME and detailed management actions suggestion emerged and, over the last decade, VME species have been identified, described and reported (as from FAO, ICES and several RFMO databases and tools). Here we propose a systematic review and evidence-based synthesis exercise to summarize the available knowledge baseline on VME. We highlighted knowledge gaps and gluts among scientific and grey literature with the final aim to suggest, promote and support a more comprehensive and uniform reading of issues related to VME. Over ten years, new or potential VME have being identified, reported and protected from commercial vessels activities, existing closures have been taken and reviewed periodically, new management measures taken where circumstances have changed. Some VME species are more studied than others. Our global analysis coupled with an inventory of VME and fisheries measures adopted to prevent significant adverse impacts of bottom fisheries, should inform the spatial management strategies to be applied in the next future adding a useful harmonized, integrated and updated data-source in the context of marine landscape classification of vulnerable marine ecosystems.

P_PAES005

BIOPHILIC DESIGN: HOW TO ENHANCE PHYSICAL AND PSYCHOLOGICAL HEALTH AND WELLBEING IN OUR BUILT ENVIRONMENTS.

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Biophilic Design is an applied science that takes into account the most recent findings on the relationship between Man and Nature to render artificial spaces more coherent with innate human biophilia. It is well known that the application of biophilic design reduces stress, stimulates creativity and clear thinking, improves physical and psychological well-being and accelerates healing. Considering the relentless process of global urbanization, these effects of biophilic design will become increasingly important in the design of our urban spaces, architectural solutions and interior design. The aim of the present study is to develop a conceptual framework for biophilic design, reducing the gap between scientific research and its translation into functional applications.

P_TOX001

CHLORINATION OF TRAMADOL, CHARACTERIZATION OF ITS DERIVATIVES AND THEIR POTENTIAL TOXICITIES

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The presence of uncontrolled quantities of some drugs in waters could be of great interest especially for the evaluation of the environmental risk considering that often, it is based on the calculation of the Predicted Environmental Concentrations (PEC) obtained from consumption data. Chlorination is by far the most used process at low costs in the disinfection step in wastewater treatment plants (WWTPs). Chlorine is often added to wastewater as a sodium hypochlorite solution and the mixture HOCl/OCl^-, known as free available chlorine (FAC), is a powerful non-specific oxidant, capable of inducing transformation of different micro-pollutants. Products obtained are usually chlorinated and/or oxidized, and could be more toxic than parent compounds. In this work, the chlorination experiments were performed on Tramadol (TRA) that is a synthetic, centrally acting analgesic agent used for the relief of moderate to severe acute and chronic pain, and shows a potency ranging between weak opioids and morphine. TRA is used in both human and veterinary medicine. In 2004, a high concentration of TRA (up to 97 μg L^{-1} and 6 μg L^{-1}) was reported in secondary effluent and surface water in Germany, underlining the environmental occurrence of this compound. The experiments were performed mimicking conditions of a typical wastewater treatment process. Specifically, the reaction products have been extracted from the aqueous phase with ethyl acetate and the organic phase has been purified by chromatographic techniques Thin Layer Chromatography (TLC), Column Chromatography (CC), High Performance Liquid Chromatography (HPLC). A number of parent drugs were isolated and fully characterized by 1D/2D NMR and Mass Spectrometry analyses. The toxicities of TRA and its transformation products will be evaluate on aquatic organisms.

POSTER

P_TOX002

DIEL MODULATION OF THE HSP70 AND HSP60 IN THREE SCLERACTINIAN CORAL SPECIES LIVING IN A MALDIVIAN SHALLOW REEF

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In scleractinian corals different processes, behaviours and physiological regulations are associated with the daily variation of temperature and light, which in shallow reefs can vary widely and regularly reach extreme levels. However, the modulation of the cellular defense mechanisms in response to natural environmental fluctuations remains still little known. In this study, the expression of cellular stress mechanisms such as the Heat shock proteins Hsp70 and Hsp60 was analyzed in coral colonies adapted to live in a shallow lagoon, during three consecutive days characterized by the same temperature/light trend. In particular, three different coral species with a different susceptibility to stresses have been compared. Each species showed a significant diel modulation of both Hsps, which also displayed a coordinated expression. However, the diel modulations of both Hsps were species-specific and only that of the branching Acropora tenuis appeared correlated with the temperature. All the species displayed high Hsp levels at 13.00 and 16.00, probably as protection from heat shocks and oxidative damages produced by the elevated values of temperature and luminance. Taken together, the results may provide useful information about the cellular mechanisms involved in the corals adaptation to extreme conditions.

P_TOX003
USING MUSSELS TO ASSESS MARINE COASTAL ENVIRONMENTAL RISKS

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Using living organisms as early warning systems may be important in monitoring the environmental health. To date, current evidence suggests that integrating diverse warning systems at different biological levels may not only increase the probability of detecting threats but also mitigate their impact. Here, we propose the use of both molecular and morphological descriptors at different biological levels in sessile bivalves (a suitable biological model in monitoring programs) to collect information on the ecosystem health of coastal marine habitats. Specifically, we used both protein post translational modifications in two different tissues (i.e., muscle adductor and digestive gland) and body shape features (i.e., valve geometric morphometric descriptors) in the sessile bivalve Mytilus galloprovincialis. Mussels were released within small inox steel cages in undisturbed and disturbed sites, in two different periods: 1) Autumn for 60 days; 2) Spring for 48 days. The covariation of nitration and morphometric descriptors highlighted how different biological levels may act as early warning systems for the same stressors, depending on their intensity and seasonal occurrence. Although promising findings have been shown, future studies may be implemented on biomarkers to exploit some population features, with the aim to propose an actual monitoring program that predictively would provide possible scenarios on the species fitness and ecosystem changes. Thus, the use of quality biotic elements may provide an objective environmental monitoring method and facilitate the development of sanitary, economic, and social strategies related to sustainable exploitation.

P_TOX004

CHEMICAL INVESTIGATION OF THE INVASIVE ALGA CAULERPA TAXIFOLIA VAR. DISTICHOPHYLLA FROM SICILIAN COASTS

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Biological invasions by non-indigenous species have been widely recognized among the most important threats to the integrity of Mediterranean ecosystems, often resulting in huge economic and societal impacts. The success of non-indigenous macrophytes in the new range may be due to a variety of factors such as their vegetative reproductive strategy and synthesis of toxic compounds. These toxic compounds may influence native consumers by reducing their performance with negative implications for their overall grazing activity and, ultimately, for their ability to control the spread of the invasive algae in the new area. In particular, the invasive algae Caulerpa taxifolia (Vahl) C. Agardh (Ct) and Caulerpa cylindracea (Sonder) (Cc) are known to contain two main bioactive metabolites, the toxic sequiterpene caulerpenyne (CYN) and the bisindolic pigment caulerpin (CAU), potentially acting as chemical stressors for several Mediterranean species. Novel and urgent questions have also been raised by the spread of Caulerpa taxifolia (Vahl) C. Agardh var. distichophylla (Sonder) Verlaque, Huisman e Procaccini along Italian and Turkish coasts. Although the levels of CYN in Ctvd collected in the Eastern Mediterranean were determined to be much lower than those determined for Ct in the Western Mediterranean, the possible presence of CAU in Ctvd still has to be ascertained. The present work confirms and quantify the presence of CYN in Ctvd from Sicilian coasts by means of liquid chromatography/mass spectrometry (LC-MS), while the same procedure did not allow detection of CAU in the algal extracts, thus supporting substantial differences in the chemical composition of the two C. taxifolia alien strains, and implying "different ecological effects on the resident biota".

P_TOX006

CHANGES IN ANTIOXIDANT ACTIVITY AND IN ESSENTIAL BIL COMPOSITION IN FEIJOA SELLOWIANA BERG. GROWN IN THE POLLUTED AREA OF 'ITALIAN TRIANGLE OF DEATH'

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The district of Acerra is one of the vertexes of the so called ''Triangle of Death''. This city is an important agricultural centres, but this part of Campania region has been used for illegal waste dumping (Senior & Mazza 2004). Data from the Cancer Registry of the local health authorities in the study area are alarming (Senior & Mazza 2004). Only a few studies have addressed the effect of air pollutants on essential oil components, and the results are sometimes contradictory and differ according to the polluting agent (Judzentiene et al., 2017).

The aim of ours study was to assess the effects of pollution on essential oil compotition and antioxidant activity in Feijoa sellowiana Berg., an edible fruit plant cultivated in Acerra.

20 plants of F sellowiana obtained in vitro by micropropagation from the same organism, were planted in field in Acerra district in a polluted site (5 plants) and in a non-polluted site (5 plants) (data ARPAC) In addition, 10 plants were planted in greenhouse with soil from unpolluted (5 plants) and polluted (5 plants) sites. After 10 years, in fruits from all the samples the antioxidant activity (chemiluminescence test) and essential oil composition (GC/MS) were tested. Both greenhouse and field grown plants from pollutes condition, showed a significant increase of antioxidant activity and a changing in essential oil composition. Sixty compounds of the oils, were identified. Finally, The acetonic extracts of F. sellowiana from all the sites were purified to obtain flavone, the compound responsible for antitumoral and antioxidant activity. The amount of the flavone was higher in the polluted conditions site than the unpolluted ones.

P_TOX007

EFFECT OF SALICYLIC ACID AND MELATONINE IN ESSENTIAL OIL COMPOSITION IN MENTHA PIPERITA L. AND MENTHA ARVENSIS L. UNDER HEAT STRESS

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The essential oil composition in Mentha piperita L. (variety: mitcham) and Mentha arvensis L. (variety: japanese) can be affected by genetic background and environmental conditions. Salicylic acid (SA) and melatonin play an effective role in the plant physiological processes. The aim of this study was to evaluate changes in the chemical profile of essential oil in M. piperita and M. arvensis using salicylic acid and melatonin under heat stress conditions. Heat stress limits biomass and/or metabolite production in medicinal plants. For this purpose, we treated these two species using two different heat stress conditions (heat stress T2 and extreme heat stress T3) in growth chambers comparing with normal condition T1. To compensate for the effect of heat stress we treated the plants by salicylic acid (4 mM) and melatonine (30 µM) for 24 hours before the harvest. As expected, using the condition T2 the quantity of oil increased but in extreme heat stress T3 the quantity of oil decreased. The quality of oil (Menthol percent) decrease in both of them dramatically. In M. arvensis the treatment with salicylic acid and melatonine together compensate heat and increase the menthol. In M. piperita the treatment with salicylic acid and melatonine (separate and together) increase the menthol in normal condition T1. In extreme heat the salicylic acid increase the menthol percent. Salicylic acid and melatonine also improve the quality of other monoterpenes in menthol pathway.

P_TOX08

EFFECTS OF EMERGENT CONTAMINANTS ON MACROINVERTEBRATES AND ECOLOGICAL INTEGRITY OF AN ALPINE STREAM

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Long-term ecological studies have highlighted changes in the invertebrate community structure and functional diversity in glacier-fed streams due to glacier retreat, with loss of the most cold-stenothermal invertebrates, mainly Diptera Chironomidae. Climate change is not the only threat for the alpine fauna, but exposure to chemical contamination by pollutants carried to the glaciers by atmospheric transport and released in the ice-melt waters is growing. Among these, pesticides and "emerging contaminants" (CECs) (e.g., PPCPs= pharmaceuticals and personal care products). In Alpine environments, even if the measured concentrations of the detected contaminants may be much lower than those causing acute effects, prolonged exposure to mixture of CECs may damage macroinvertebrate communities, with cascade effects on the river food webs. CECs are emitted also by Wastewater Treatment Plants (WTPs), representing an emerging environmental problem in Alpine rivers strongly affected by tourism, where pollution level peaks during holidays.

The ecotoxicological and genotoxic effects of four pollutants (ibuprofen-IBU, furosemide-FUR, trimethoprim-TMP and triclocarban-TCC) were tested seasonally in seven insect species: Diamesa cinerella, Pseudodiamesa branickii, Baetis alpinus, Perlodes intricatus, Dictyogenus alpinus, Rhyachophila occidentalis, Rhyachophila tristis. A negative effect of the sewage was highlighted on alpha-diversity. Furthermore, populations living downstream of the sewage, in winter, resulted generally more resistant to the pollutant most concentrated in the environment (IBU), as expected. Genotoxicity tests (Comet assay) highlighted a WTP effect under natural conditions and a genotoxic effect for most of the tested compounds. The general stress conditions highlighet by taxonomical composition and ecotoxicological and genotixicty tests were not detected by the standard methods used to assess the ecological status of rivers in Italy i.e STAR-ICMi and EBI indices. These results suggest a reduced performance of such indices in detect pollution by CECs, when present with concentrations far below those required to cause acute effects.

P_TR001

A "CENTRE OF GRAVITY APPROACH" TO ASSESS OF THE ENTRANCE OF EGGS, LARVAE AND JUVENILES OF MARINE MIGRANT FISHES IN THE VENICE LAGOON

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The sea-lagoon connectivity is a key element in the life cycle of many species of marine fish, especially for those belonging to the guild of juvenile marine migrants (JMM) which use transitional water ecosystems as nursery grounds. The entrance of JMM fish inside transitional water ecosystems is generally linked to tidal flow, chemical-physical conditions of the water and hydraulic circulation. The aim of this study is to analyse the entrance of JMM in the three sub-basins of the Venice lagoon. Ichthyoplankton (bongo nets, 22 stations, 8 surveys, December to April) and fish juveniles (seine net, 16 stations, 6 surveys, February to April) were sampled in 2016 and 2017 along a sea-lagoon gradient in each lagoon sub-basin. The "centre of gravity" of the distribution of eggs, larvae and juveniles was calculated by weighting the position of the sampling sites along the gradient by the fish density, to analyse the progressive entrance of individuals inside the lagoon. Except for few occasions, eggs seemed to be always concentrated in marine stations while larvae distribution gravitated nearer to the sea inlets, indicating a progressive shift of marine migrant concentration inside the lagoon. Strong differences between sub-basins were observed for juvenile forms: only in the north sub-basin individuals seemed located in the inner part of the sea-lagoon gradient already during the first sampling campaign, indicating that in this sub-basin they can move from the sea to the lagoon edge since the first arrive in the lagoon. If carried on, this sampling activity will provide a useful baseline to assess the different sea-lagoon connectivity of the three sub-basins, also highlighting the possible impacts on fish fauna arising from the morphological and hydrodynamic changes due to the construction and operation of mobile barriers for the protection of Venice from high tides.

P_TR002

OCCURRENCE OF THE NON-INDIGENOUS SPECIES DYSPANOPEUS SAYI (CRUSTACEA: BRACHYURA) IN A MEDITERRANEAN COASTAL LAGOON (S. GILLA, SOUTHERN SARDINIA)

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Introduction of non-indigenous species (NIS) represents a worldwide threat to the integrity of the native communities, altering the natural distribution of the biota and impacting biodiversity. The Mediterranean Sea has been exceptionally susceptible to biological invasions and it is considered the world's most invaded sea, hosting currently more than 700 NIS.

Among the Mediterranean NIS, the mud crab Dyspanopeus sayi (Smith, 1869), native to the Western Atlantic, was recorded only in recent years. The first record was from the Venice lagoon in 1991, where nowadays, it is the most common crab species. Most probably, it was introduced by shipping, as larvae in water ballast or accidentally through exchanges of aquaculture products. Since then, the species has spread into other areas, colonising different locations across the whole Mediterranean Sea.

We report here the first record of this species in a Sardinia lagoon (Santa Gilla lagoon, Southern Sardinia), obtained from samples collected during the investigation of the macrozoobenthic communities. Six stations were screened during four surveys, and three male specimens of the NI crab were found in the central area of the lagoon. The few records suggest that the introduction of the species could have been a recent event. However, as the sampling method used was not appropriate to collect vagile species like crabs, we cannot infer on the abundance of the species in this lagoon.

This finding, however, deserves particular attention since, within its native range, it is a common predator of shallow water bivalves. Moreover, in the Adriatic Sea, D. sayi has exterminated different prey mollusc species in a very small locally restricted area. We pinpoint here that, since the Santa Gilla lagoon is an important site for shellfish farming and aquaculture of commercial value bivalves species, an accurate search for abundance and potential impact of D. sayi on this lagoon is needed.

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P_TR003

ASSESSMENT OF THE ENVIRONMENTAL CONDITION OF LESINA E VARANO LAGOONS (CENTRAL ADRIATIC SEA, APULIA-ITALY) USING THE ABC METHOD (ABUNDANCE-BIOMASS-COMPARISON)

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The present paper was aimed to analyze the environmental condition of Lesina e Varano lagoons (Central Adriatic Sea, Apulia-Italy) along environmental disturbance gradients using the ABC method (Abundance-Biomass-Comparison) proposed by Warwick, 1986, that provides the integration of numerical abundance and biomass data of the macrozoobenthic of soft bottom. The macrozoobenthic populations of soft bottom are particularly important for their ability to respond significantly to environmental changes of both natural and anthropogenic origin. For the survey we used the benthic macrofauna data collected in the Lesina and Varano lagoons from 2000 to 2016 in the context of several research projects. The sampling was performed with box-corer of volume 15x15x18 cm3 equal to 4.05 l. The samples were screened with a 1 mm mesh sieve and identified, where possible, up to the species level. The abundance (ind/m²), the wet biomass (gr/m²) and the multivariate statistical analysis were calculated. As for Lesina the average abundance ranged from a minimum of 636±903 ind/m² to a maximum of 6096±5611 ind/m², as for Varano from 106±204 ind/m² to 18215±21919 ind/m². The average wet biomass ranged from a minimum of 116±141 gr/m² to a maximum of 456±315 gr/m² as for Lesina, while regarding Varano from a minimum of 31±62 gr/m² to a maximum of 1630±1129 gr/m². The Gargano lagoons follow typical patterns of the Mediterranean lagoons, with environmental and anthropic disturbance gradients, that make them moderately stressed ecosystems (W≈0).

P_TR004
EVOLUTION OF THE LESINA LAGOON IN RELATION TO ANTHROPOGENIC IMPACT AND CLIMATE CHANGES

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The lagoonal system of Lesina is the result of a continuous evolution due to the reciprocal balance between eustatism, coastal paleomorphology, sediment supply, tidal effects and modification of the hydrographic basin. The genesis of the Lesina lagoon is linked to the coastal dynamics that led to a progressive development of the tombolo inside a shallow water sea bay. The lagoon was born behind the dunes that developed over a sandy coastal land. Subsequently, the area of the lagoon system decreased and the shape underwent continuous changes due to the constant filling of sediments. Biological communities of the lagoon are made up of organisms able to adapt to large variations in salinity and temperature, but that modify their assemblages in relation to the geomorphological, environmental, hydrological and climatic conditions. In the last century, during the industrial age, the lagoon and adjacent areas have become important for huge amounts of human activities that have compromised the ecosystem's health. At the beginning of the twentieth century, the lagoon and the surrounding areas were quite exclusively frequented by fishermen and shepherds. Thereafter adjustment works were carried out to benefit from the natural functions of the lagoon. Firstly, the sea-lagoon exchanges were improved and the adjacent wetlands were recovered for agricultural activities. Successively a huge number of human activities developed in the area, quickly transforming the landscape and adapting the functions of the lagoon to their needs. In the present work the human actions and the natural events that have influenced the current condition of the lagoon are historically described, as well as the relationships with the climate change. Moreover, the historical analysis of chemical, physical and biological data is used for a tentative description of the current biological communities in relation to the direct and indirect anthropogenic impact.

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