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Facoltà di Economia "G. Fuà", Caserma Villarey

Libro degli Abstract



Patrocinato da:

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Tutela del Territorio e del Mare



Dipartimento di Scienze della
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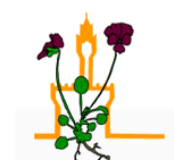


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TEST OF STROBILATION INDUCERS IN *AURELIA* SPP.: TOWARD A VALIDATED PROTOCOL



RELAZIONI A INVITO

Development of innovative tools for understanding marine biodiversity and assessing good environmental status, within the Marine Strategy Framework Directive

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The Marine Strategy Framework Directive (MSFD) seeks to protect, preserve and restore the quality of the marine environment across Europe, achieving Good Environmental Status (GEnS) by 2020. This concept is a challenging issue and provides multiple opportunities for European marine research, in order to support the ecosystem-based approach to environmental management. Biodiversity is one of the key factors which support ecosystem resilience and the sustainable provisioning of services, which in turn contribute to the performance of economic systems and human well-being. Many indicators of biodiversity exist, most are mutually complementary, and representing different aspects of the multidimensional concept of biodiversity. However, to be informative at a societal level, biodiversity indicators need to be combined within integrated monitoring, modeling and decision-making frameworks. Indicators of biodiversity should be used to translate biodiversity loss and degradation directly into policy responses. For a better understanding of these concepts, the EU project DEVOTES (DEvelopment Of innovative Tools for understanding marine biodiversity and assessing good Environmental Status), is investigating, testing and validating indicators, using modelling tools for the assessment, developing new monitoring tools and establishing an integrated way of assessing GEnS of biodiversity and related descriptors (i.e. food-webs and seafloor integrity).

From populations to ecosystems: Towards a unifying ecological theory

Michel Loreau

The vigorous growth of ecology has been accompanied by its gradual fission into several distinct subdisciplines. In particular, community ecology and ecosystem ecology provide two distinct perspectives on complex ecological systems that have complementary strengths and weaknesses. A new ecological synthesis is needed today both to ensure scientific progress and to develop appropriate responses to the global ecological crisis we are entering. Although different unifying approaches have been proposed recently, I champion a theoretical approach that seeks to merge the principles and perspectives of different disciplines. The new research field on the relationships between biodiversity and ecosystem functioning, stability and services is an example of this approach that has contributed to resolving important scientific controversies, making ecology more responsive to societal needs, and transforming ecological theory itself into a more integrative, quantitative and predictive theory.



COMUNICAZIONI ORALI



S8. Biodiversità e funzionamento ecosistemico: un tributo a Carlo Heip [S1.1-S1.16]

S1.1 Scioglimento di neve e ghiaccio: effetti sul macrobenthos in torrenti alpini d'alta quota

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I torrenti alpini rispondono velocemente ai cambiamenti della temperatura. Essendo alimentati da ghiacciai, scioglimento delle nevi o falde freatiche possono registrare diverse fluttuazioni dei parametri abiotici. Si prevede che il cambiamento climatico altererà in modo significativo il regime idrico, le dinamiche temporali nonché il mosaico di condizioni chimo-fisiche: queste variazioni condizioneranno anche il biota fluviale. Nell'ambito di questo studio sono state campionate le comunità di macroinvertebrati sia lungo un torrente perenne di origine glaciale (Rio Saldura, Val Venosta), sia in 13 dei suoi tributari. Le stazioni di campionamento, dislocate tra 2500 e 1600 m s.l.m., sono state visitate durante tre periodi: prima dello scioglimento di neve e ghiaccio (tarda primavera), durante lo scioglimento (estate) e dopo lo scioglimento (autunno). I 13 sottobacini differiscono per grado di copertura glaciale. Lo scopo principale era quello di mettere a confronto le comunità macrobentoniche e le condizioni abiotiche caratterizzate dallo scioglimento delle neve ghiaccio con diversa intensità e durata. I risultati hanno evidenziato comunità più abbondanti e diversificate nei torrenti senza copertura glaciale nel loro bacino, mentre solo pochi taxa specializzati riescono a colonizzare i torrenti che vengono influenzati in modo cospicuo dallo scioglimento di neve e ghiaccio. Cambiamenti climatici e scioglimento dei ghiacciai cambieranno il regime dei torrenti d'alta quota e anche il loro biota.

S1.2 Variazione stagionale di input energetici e comunità macrobentoniche in un fiume alpino

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I fiumi alpini differiscono per molti aspetti dagli altri sistemi lotici, specialmente a causa delle peculiari caratteristiche dei bacini idrografici di alta montagna. In questo studio abbiamo esaminato la variazione stagionale delle principali variabili ambientali, degli input energetici autoctoni (clorofilla bentonica) ed alloctoni (particellato organico grossolano di origine terrestre, CPOM) e delle composizione strutturale e funzionale delle comunità macrobentoniche in un fiume alpino non glaciale, il Po a Pian della Regina (Crissolo, CN). Le concentrazioni di clorofilla e la quantità di CPOM mostrano un *trend* stagionale differente rispetto a quanto accade a quote inferiori, con variazioni legate alle particolari condizioni climatiche ed idrologiche alpine che si riflettono sulle comunità di macroinvertebrati bentonici (nel lavoro viene anche presentato un approfondimento legato ai cicli vitali di tre specie tipicamente alpine). L'accumulo e lo scioglimento di enormi masse nevose, con la conseguente variazione di portata primaverile e con la raccolta di grandi quantità di particellato organico dal bacino, costituiscono probabilmente una delle principali determinanti ambientali. Lo studio evidenzia, inoltre, come l'input energetico alloctono, sinora considerato poco importante in ambienti siti al di sopra della linea degli alberi, costituisca al contrario una risorsa di primaria importanza per le comunità macrobentoniche alpine.



S1.3 How to select indicator plant species for taxonomic and functional biodiversity in the systems affected by humans.

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Indicator species of biodiversity are essential in biodiversity monitoring programs, in particular to assess effects of land management on ecosystem processes and services. Here we present a novel approach to select indicator species predictive for high values of taxonomic (TD) and functional (FD) diversity. We used vineyards as model system along environmental and management gradients in Southern Switzerland. We selected 48 vineyards and we sampled ground-cover vegetation in June and August. We consider ten widely-used functional traits and we selected six indices of taxonomic and functional diversity. We applied a two-steps' analysis: (1) using Threshold Indicator Taxa ANalysis (TITAN) based on the six biodiversity indices, we defined three groups of sampling plots with low, medium and high biodiversity values; (2) using the Indicator species analysis (IndVal), we then selected indicator species significantly associated with the medium and high biodiversity values. We identified 52 indicators species of different aspect of biodiversity out of 259 vascular plant species sampled during the study: 24 species (46%) were exclusively indicators of FD indices, whereas only 10 (19%) were associated to taxonomic ones; 18 species (35%) were indicator of both FD and TD indices. We highlighted that indicator species selected from distinct aspects of biodiversity show high degree of complementarity to explain ecological processes in system. Our results emphasize the need for considering functional aspects of biodiversity in diversity-conservation strategies when the objectives are to preserve both diversity of taxa as well as ecosystem functioning.

S1.4 Functional diversity changes detected by plant indicators and soil parameters in forest ecosystems after tree cutting

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Forest biomass removal represents one of the more common forms of human disturbance influencing biodiversity, vegetation structure and floristic composition of the plant communities in an ecosystem. Aim of this paper is to detect the effects of the forest management on the functional diversity in deciduous oak forest in Central Italy subjected to different tree cutting management. The study was realized through a multi-set of indicators: i) well known models of plant indicators- Ellenberg, Hemeroby and Grime- ii) new Index of Floristic Coherence (FCI) derived from the phytosociological survey, and soil/humus measured parameters (pH, water content, organic carbon %). Spearman - Rank Correlation Test was performed to verify the correlations among the plant indicators and soil parameters and to verify their efficacy in detecting the state of forest stands after tree cutting. Afterwards, one-way analysis of variance was utilized to determine differences among the different rotation age stands. Temperature indicator discriminated the oldest age stands from the recent ones, while nitrogen availability indicator distinguished the intermediate age stands. This study allowed to detect, through a multidimensionality approach, changes in diversity after tree cutting disturbance.



S1.5 The soundscape analysis of a Mediterranean maqui: sonic environment and structure of vegetation

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Herein we present one of the first attempts to couple the complexity of vegetation and topographic features with the sonic environment that we use as a proxy to understand the distribution of species and individuals in their habitat. To achieve this, the sonic features of a bird community were studied during the spring and early summer of 2011 in a Mediterranean maqui located on the western slope of a remote hanging valley that is dominated by *Erica arborea*, *Quercus ilex* and *Arbutus unedo*. Species composition, height, vertical foliage profile, canopy density and dispersion of vegetation were utilized as probable proxies for the sonic patterns. The acoustic activity of birds was collected through the use of a regular matrix of 4 x 5 recorders, spaced 25m apart, which were placed following the topographic isoclines. The sonic complexity of the soundscape was evaluated using the Acoustic Complexity Index (ACI), which is a recently developed metric. The results show that, even in the case of sampling sites that are very close together, sonic patterns vary enormously across the season, highlighting the great variability of the soundscape and the adequacy of the sampling scale of 25m adopted in this habitat. The topographic features do not seem to be connected to the sonic environment. The PCA applied to the vegetation parameters revealed two principal distinguishing factors, which we were able to define as “vegetation density and structure” and “species segregation.” The main sonic complexity was found where the vegetation was taller and denser, especially where *E. arborea* was the dominant species. Although this proves that acoustic dynamics can be linked to vegetation structure, even on a small scale, a consistent element of sonic variability cannot be explained by vegetation patterns alone, and a soundtope hypothesis must be invoked.

S1.6 Ecosystem vulnerability to disturbance propagation as revealed by food web structure: the role of species richness

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The multitude of stressors impacting biological communities, and their possible combined effects, claim to the development of an holistic approach to ecosystems conservation and management. Disturbances can spread within communities through top-down and bottom-up pathways, depending on stressor' origin and community structure. In order to investigate the relationship between species richness, food web structure and food web vulnerability to the propagation of disturbances, we reconstructed 8 detritus-based food webs belonging to different kinds of habitat, both aquatic and terrestrial, basing on C and N stable isotope analysis. We quantified the probability that a disturbance spreading from any given node (i.e. Taxon) will hit the rest of the community, as the proportion of nodes of the whole community forming part of the food web belonging to any given basal, intermediate or top node. Food webs differed in their vulnerability to disturbance propagation, which decreased with food web size, posing species richness as a key factor buffering communities from disturbance spread. Disturbances arising from basal nodes generally propagated more than those arising from top and intermediate nodes, and with few nodes being critical to propagation detected in each food web. This suggest that food web-related ecosystem vulnerability to disturbances should be taken into account when developing conservation strategies and when assigning ecosystem-based management priorities.

S1.7 Organic pools, benthic metabolism and nitrogen fluxes along an inland-marine transect

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In the Po River Basin, agriculture and animal farming determine an excess of N which is transferred along the inland waterways to the sea. To analyze the processes affecting N loads in the path between the freshwater and marine extremes, across salinity, eutrophication and organic load gradients, we analyzed the benthic metabolism, the quantity and composition of sedimentary organic matter (OM) and the meio- and macrofauna communities at 7 sites across a transect from the inner Po River to the Goro lagoon and the adjacent coastal marine area. All variables displayed significant spatio-temporal variations, with riverine sites characterized by wider seasonal variations than the lagoon and marine counterparts. In summer the sedimentary proteins turnover in the freshwater sites was about 7-folds faster than in all other sites, whereas in winter the lagoon sediments were the most reactive. The variability in OM degradation rates in the river-to-sea transition in winter was mirrored by the patterns of meiofaunal α - and β -diversity. Denitrification rates and efficiency were higher at freshwater sites, and decreased along the salinity gradient. Freshwater sediments were a net inorganic N sink, whereas brackish and marine sediments were a N source, with macrofauna explaining most of the small-scale variability of processes. Our results indicate that freshwater sediments act as summer “bioreactors” whose activity is modulated by the lability of organic and inorganic N compounds.

S1.8 Relationships between macrobenthos and the microbial loop: effects on sedimentary N loads

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The effects of suspension-feeder bivalves on sedimentary organic matter pools and meiofauna in lagoon systems has been evaluated by testing, in microcosm, two different hypotheses: 1) elevated densities of bivalves modify benthic metabolism; 2) pelagic-benthic coupling processes mediated by biodeposition alter the quantity and turnover of sedimentary organic matter and meiofaunal biomass. Microcosms with bare sediments (S), clams (SV), macroalgae (*Ulva* spp., SU) and with both clams and macroalgae (SUV) have been fed with lagoon phytoplankton for ten days. During the experiment all microcosms were preeminently heterotrophic. Respiration rates and meiofaunal biomass were measure before and after the incubation period. The benthic respiratory rates varied significantly between sediments lacking vs. those enriched with clams (1000 and 3000 $\mu\text{mol O}_2 \text{ m}^{-2} \text{ h}^{-1}$, respectively), which suggests a strong effect of bivalves on benthic metabolism. Regeneration rates of ammonia (700 $\mu\text{mol m}^{-2} \text{ h}^{-1}$) and reactive P (30 $\mu\text{mol P m}^{-2} \text{ h}^{-1}$) in sediments enriched with bivalves are 7 and 6 folds higher than those in bare sediments ($\sim 100 \mu\text{mol NH}_4^+ \text{ m}^{-2} \text{ h}^{-1}$ and $\sim 5 \mu\text{mol PO}_4^{3-} \text{ m}^{-2} \text{ h}^{-1}$). When compared to bare bottoms, sediments enriched with *Ulva* and clams are characterised by reduced sedimentary protein pools, associated with higher protein degradation rates. Meiofaunal biomass decreases in all microcosms, but less evidently in sediments enriched with both macroalgae and clams. Altogether the results of this short-term experiment suggest that in lagoon sediments hosting large auto- and heterotrophic the transfer of N pools towards higher trophic levels is pre-eminently mediated by the benthic microbial loop.



S1.9 Effects of intertidal grazer diversity on epilithic biofilm: ecological consequences of species loss under possible species extinction scenarios

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Biodiversity and ecosystem functioning experiments in rocky intertidal habitats have focused mostly on macroalgal productivity, whereas epilithic microphytobenthos (EMPB) remained largely unstudied. We performed a field experiment, using cage enclosures, to test the effects of species richness, identity and density of gastropod grazers on the photosynthetic efficiency and biomass of intertidal EMPB on an exposed rocky shore in the north-west Mediterranean. The diversity and composition of intertidal grazers affected photosynthetic efficiency but not photosynthetic biomass of EMPB. However, the impact of grazers on EMPB photosynthetic efficiency declined with decreasing biomass of EMPB following the natural trend observed during the study period. This result suggests that the effect of grazers on biofilm photosynthetic activity also depends on EMPB biomass. We found a non-linear relationship between species richness and photosynthetic efficiency, which reflects a negative but idiosyncratic effect of herbivore richness on this response variable. Moreover the impact of grazers on the photosynthetic efficiency of EMPB also depends on the species composition of the herbivore guild. Thus, loss of species led to non-predictable changes on EMPB photosynthetic efficiency, which depended on the number and identity of species loss. This work highlights that biodiversity effects can vary over time, especially in highly dynamic communities such as EMPB in rocky intertidal habitat.

S1.10 Chasing fish and catching data: using spearfishing videos to assess the structure of fish assemblages on shallow rocky reefs

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Spearfishing and freediving (diving without a breathing apparatus) are growing recreational activities throughout the Mediterranean. Recording the fishing action by means of underwater HD micro-cameras has become common practice among recreational spearfishermen. During a fishing session, a spearfisherman adopting the technique of “aspetto” (diving to the bottom and wait for the fish to approach) generates a series of video recordings of the fish assemblage in the vicinity of the seafloor. This study explored the potential of recreational spearfishing footage for assessing the structure of fish assemblages on shallow rocky reefs. Fish species richness and abundance (nMax) and biological attributes of the sea-bottom were extracted from videos either recorded on purpose or provided by local recreational spearfishermen. The information obtained through spearfishing videos analysis was comparable to that generated by common underwater visual census (UVC) techniques. The willingness of spearfishermen to provide video recordings and information on environmental conditions recorded during the fishing session suggests that a citizen science programme launched on a national or basin-wide scale may allow the acquisition of a large amount of data. These would enable quantifying variation in the structure of fish assemblages beyond the spatial and temporal scales that can be tackled by traditional UVC operated by scientific divers.



S1.11 Marine reserve effect on persistence and fishery yield of abalone

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Abalones (*Haliotis* spp.) are long-lived, slow-growing marine mollusks whose natural populations have undergone dramatic declines all over the world, mainly due to overfishing, ocean warming, and the spread of disease. Here, we investigate whether Marine Reserves (MRs) can be part of the optimal management of abalone fisheries, i.e. assess whether a suitable network of MRs can protect populations from overexploitation and, at the same time, sustain fishery output. To do so, we developed a management model explicitly accounting for the main demographic features in abalone life cycle, such as the high plasticity in growth, size-dependent natural mortality, fecundity, sexual maturation and larval dispersal. Our analysis suggested that a MR network protecting ~30% of the fishing ground might have a positive effect on abalone population persistence. The model suggests that the risk of population collapse could be drastically reduced in the presence of MRs. In addition, high long-term fishery yields can be maintained in the presence of MRs, provided that their size is scaled to the species' dispersal distance. Importantly, our analysis indicate that MRs are a viable precautionary approach to fishery management, as the long-term population abundance and fishery yields are less sensitive to errors in the estimation and/or in the enforcement of the optimal harvesting rate than in the case of traditional management.

S1.12 Assessment of the diversity and biomass of coralligenous cryptic sponges

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Coralligenous habitat results from a multi-stratified accumulation of encrusting algae and animal builders in dynamic equilibrium due to simultaneous actions of disruptive agents; the result is a spatially complex structure full of crevices and holes. Consequently, the coralligenous may host a rich and diversified fauna more than any other Mediterranean community. Nevertheless no data are available about its cryptic fauna that could play an important contribute to the exchange of material and energy between water column and sessile fauna, acting as reserve pool and refuge, as reported for the coral reefs. Here we quantify, in terms of diversity and biomass, the cryptic sponge community present inside and outside the coralligenous framework of Portofino Promontory (Ligurian Sea) at different depths. We report a total of 61 sponge species; the average number of sponge taxa presents outside the coralligenous accretions is lower than the number of taxa identified inside. Moreover the analysis puts in evidence the highest values of the sponge biomass inside the coralligenous blocks compared with the sponge biomass hosted outside. This work underlines that, at least for sponges, the cryptofauna component can exceed the total epifauna of coralligenous concretions. Under this point of view it is clear that the functional role of the coralligenous habitat need to be studied in more detail and its adequate conservations urgently required.



S1.13 Microbial and macrofaunal communities associated with sedimentary environments of the Condor Seamount (Azores, NE Atlantic)

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Seamounts are ubiquitous topographic features of the world's oceans. Despite in recent years increasing knowledge has been accumulated on seamounts ecology, their sedimentary environments and associated communities and the relationships between biodiversity and ecosystem functioning remains almost unexplored. The Condor Seamount (Azores, NE Atlantic Ocean) has been the focus of the first seamount research observatory. Quantity and composition of sediment organic matter, prokaryotic abundance and diversity (using molecular fingerprinting and 16S rDNA tag pyrosequencing), prokaryotic C production and degradation were investigated in different areas (summit, flanks and bases) of the Condor Seamount and in an external site. Macrofauna abundance and diversity was investigated on the summit, the southern flank and in the external site. Distribution and quality of sediment organic matter reflected the general circulation pattern over the Condor. Our results suggests the influence of hydrodynamic conditions and organic matter quality in shaping the relationships between microbial diversity and ecosystem functioning. Although limited to three sites, data on macrofauna do not necessarily support the paradigm that seamounts are more biodiverse than the surrounding seafloor. However, the abundance and taxonomical distinctiveness of Condor's macrofaunal assemblages suggest that seamounts habitats may play a key role by increasing the β -diversity and thus the overall regional biodiversity.

S1.14 Assessing for the reliability of longitudinal and bathymetric patterns in the distribution and diversity of two deep sea benthic components: meiofauna vs macrofauna along the Mediterranean sea

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The comprehension of spatial patterns in the distribution of deep-sea benthic fauna and species diversity, as well as factors controlling them, constitute two main ecological challenges especially when concerning the deep-sea. In the present study we used an integrated investigation of both meio- and macrofauna communities to assess longitudinal and bathymetric patterns of these two important deep-sea benthic components inhabiting the deep Mediterranean sea. Results presented here suggested that whilst the macrobenthic standing stock and diversity appeared to follow a longitudinal gradient decreasing eastward, the meiobenthic component didn't show a clear longitudinal trend. The PERMANOVA tests showed how water depth was responsible just for a low percentage of the meio- and macrofaunal descriptors variability. Interestingly, the two benthic component showed major changes in the functional diversity (trophic diversity) at different longitudes rather than along different depths. Food availability (sedimentary organic matter content and microbial communities), characterizing each one of the investigated slope area along a west-east axe, appeared to influence the macrobenthic standing stock and biodiversity patterns; grain size contributed mostly to regulate the meiofauna diversity.



S1.15 Unveiling the hidden biodiversity: colonization of meiofauna in deep-sea hydrothermal vents

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Extreme natural environments such as Hydrothermal Vents (HV) offer unique opportunities to investigate the adaptation of organisms to severe abiotic conditions and the effects of these conditions on biodiversity. While mega- and macrofauna in HV have been intensively studied since their discovery, meiofauna, in spite of its ecological relevance, have only recently been included in HV ecological studies. The picture emerging from the few meiofaunal investigations points to a vent meiofauna which is low in abundance and diversity. In addition, the meiofauna inhabiting deep-sea HV shows low correspondence to neighbouring deep-sea sites and reveals a high endemism. What is less known are the colonization mechanisms and interconnectivity of HV meiofauna. The objective of this study is to understand the interconnectivity and colonization processes of meiofauna in HV sites. The experiments implied the deployment of 3 different substrata in four areas characterized by contrasted levels of hydrothermal activity. The first experiment set up was deployed during the MoMARETO cruise in 2006 and recovered in 2008 (after 2 years). The second was deployed during the first MoMARSAT cruise in 2010 and recovered in 2011 (after 1 year). Results will be discussed in order to understand the potential influence of fluid flow on newly arriving meiofauna and its potential preference in colonizing different organic and inorganic substrata.

S1.16 Partitioning of production and respiration among benthic groups in the deep Mediterranean basin

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The comprehension of the spatial patterns of benthic biomass is essential to understand the process of global carbon cycling in the deep-sea ecosystems. The decline of benthic biomass with the increasing of depth is well documented for meiofauna, macrofauna and megafauna while our knowledge on bacterial and prokaryotic biomass along the bathymetric gradients are limited to few investigations that highlight contrasting results. Data on viral biomass are completely lacking although the key role of this component in the functioning of deep-sea sediments. Up today only few investigations have been carried out to estimate the carbon production and respiration rates of different components of the benthic fauna to investigate the C cycling in deep-sea ecosystems. To cover this gap in the deep Mediterranean Sea, in the framework of the RITMARE project, we focus our investigation on the dynamic of benthic components from viruses to megafauna. Thanks to its importance for the global biodiversity (hosting more than 7.5% of global biodiversity) and its environmental and trophic characteristics (a well-known longitudinal gradient for food sources), the Mediterranean basin can be considered a good model to explore the variability of the total benthic biomass, secondary production and respiration rates along spatial and trophic gradients. The aim of this investigation is to explore the role of each benthic component on the production and respiration rates in deep Mediterranean Sea.



S9. Ecologia dei parassiti e delle malattie infettive [S2.1-S2.10]

S2.1 Does space matter in cholera spreading?

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Cholera outbreaks in various regions of the world can exhibit very different dynamics ranging from endemic cycles where an annual recurrence of the disease is observed, to epidemic dynamics where long periods with no cases are followed by sudden, large outbreaks. The recent dramatic cholera epidemic in Haiti has revamped the interest of the scientific community and the health-care specialists on the latter, which usually exact a higher toll because of the unpreparedness of the health facilities to face such emergencies. Epidemic dynamics are characterized by an invasion of the disease into the susceptible population and, in turn, by an invasion into disease-free regions. Here we provide empirical and theoretical evidence of the crucial role of space in epidemic dynamics and we outline a general framework for the description of spatial processes in disease spreading. The model accounts for the dynamics of susceptible and infected individuals within different human communities, and for the redistribution among them of *Vibrio cholerae*, the causative agent of the disease. Spreading mechanisms include the diffusion of pathogens in the aquatic environment and their dissemination due to the movement of human carriers. Accounting for these processes is crucial to develop mathematical models that can reliably provide key insights into the course of an ongoing epidemic, potentially aiding real-time emergency management in allocating resources and evaluating the impact of interventions.

S2.2 Spatially explicit modelling of cholera epidemics

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Epidemiological models can provide crucial understanding about the dynamics of infectious diseases. Possible applications range from real-time forecasting and allocation of health care resources to testing alternative intervention mechanisms such as vaccines, antibiotics or the improvement of sanitary conditions. We apply a spatially explicit model to the cholera epidemic that struck Haiti in October 2010 and is still ongoing. The dynamics of susceptibles as well as symptomatic and asymptomatic infected are modelled at the scale of local human communities. Dissemination of *Vibrio cholerae* through hydrological transport and human mobility along the road network is explicitly taken into account, as well as the effect of rainfall as a driver of increasing disease incidence. The model is calibrated using a dataset of reported cholera cases in each Haitian department. We further model the long term impact of several types of interventions on the disease dynamics by varying parameters appropriately. Key epidemiological mechanisms and parameters which affect the efficiency of treatments such as antibiotics are identified. Our results lead to conclusions about the influence of different intervention strategies on the overall epidemiological dynamics.



S2.3 *Vibrio cholerae* in the waters of rural Bangladesh: from site-specific detection to population biology

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Presence of *Vibrio cholerae* serogroups O1 and O139 in the waters of the rural area of Matlab, Bangladesh was investigated by quantitative measurements carried out using a portable flow cytometer. Water samples were collected from different water bodies that constitute the hydrologic system of the region, a well-known endemic area for cholera. Water was retrieved from 66 locations, including ponds, river waters, and irrigation canals during an inter-epidemic time period. Samples were treated with O1- and O139-specific antibody, which allowed precise concentration measurements based on flow cytometry. Concurrently, a longer campaign was carried on, in which the water level in one of the ponds was monitored between May 2011 and December 2012. Together with water volume, other relevant hydro-climatological variables were measured. Moreover, samples of the water were withdrawn biweekly from the pond and they were analyzed for phytoplankton and *V. cholerae* concentrations, as vibrio populations have been reported to survive in the environment in conjunction with other microorganisms. The dynamics of the water volume in the reservoir are then reconstructed as a balance of input (from rainfall and drainage) and output (evaporation) terms. Finally, a process-based model of the ecology of the bacterium is proposed, in conjunction with the dynamics of phytoplankton and of the nutrient content of the water, which fluctuates according to the balance equation previously identified.

S2.4 Environmental and landscape factors associated with West Nile vector population dynamics in North-western Italy

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The transmission risk of West Nile virus (WNV) is strongly related to the abundance of mosquito vectors. *Culex* spp. mosquitoes are considered the main enzootic vectors of WNV in Europe. We analysed an 11-year time series (from 2001 to 2011) of adult *Culex pipiens* mosquitoes, sampled in Piedmont region (North-western Italy), to determine the principal drivers of mosquito population dynamics. Linear mixed models were implemented to examine the relationship between *Cx. pipiens* population dynamics and environmental and landscape predictors. As environmental explanatory variables we used Land Surface Temperature, Normalized Difference Water Index (NDWI) and Precipitation (total amount and the number of days). In addition, we used some landscape variables that account for the proximity of mosquito traps to urban sites and rice fields. *Cx. pipiens* abundance is positively influenced by the number of days with precipitations during spring. Furthermore, several days of precipitations in spring postpones the onset of mosquito activity while lots of rainy days in summer extend the duration of *Cx. pipiens* activity. Higher temperatures during spring months anticipate the emergence of mosquitoes, while in warmer summer we observed longer *Cx. pipiens* breeding season but with overall lower total abundance of mosquitoes. Finally, higher values of NDWI in spring anticipate the emergence of mosquitoes and extend the *Cx. pipiens* breeding season.



S2.5 Understanding the environmental drivers of West Nile Virus (WNV) emergence in Europe

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WNV is a mosquito-borne pathogen with continuous geographic expansion in Eurasia. Its ecology in Europe is still poorly understood due to the high viral diversity and the complexity of its cycle. Several vertebrate and mosquito species are involved in WNV dynamic, although a limited set are playing a major role. Moreover, the interplay among the many biotic and abiotic factors driving WNV amplification is complex. To shed light on the dense relationships among WNV emergence and environmental drivers is therefore essential. The aim of this study was to analyze the relationships among WNV human cases in Europe (2010-2012; ECDC) and a series of climatic and environmental parameters characterizing the areas with WNV cases. The modeling procedure has been carried out using GLMs, WNV incidence as response variable and a complete set of climatic and environmental predictors. Best models were identified using AIC model selection. Preliminary results showed that WNV incidence is positively influenced by summer temperature anomalies while spring precipitation anomalies have negative effects. Besides, the most important environmental predictors include the presence of populated forest, irrigated croplands and mosaic grasslands. Several other parameters are currently under examination. In conclusion, results showed how using a multi-set of predictors within a robust modeling framework could provide a better perception on the parameters creating the favorable condition for WNV spill over.

S2.6 Preventing diseases outbreaks in a network of cattle farms: the case of bovine tuberculosis in Emilia Romagna

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The ecological approach to the analysis of disease dynamics has become relevant in the last three decades since the seminal work by Anderson and May in 1979. Thanks to the ability of parasites to move through the ecological continuum formed by wildlife, livestock and humans, the protection of any of these compartments from disease outbreaks has significant implications also for the health and well-being of the other two. In this work we investigated pathogen dynamics in a network of cattle farms following the introduction of an infected animal in a disease-free region. As a reference example we focused on bovine tuberculosis (bTB) in Emilia Romagna, Italy. This region is currently bTB-free and the surveillance is based on three strategies: on-farm systematic testing, testing of moved cattle and inspection at the slaughterhouse. The goal of this study was to assess the effectiveness of current and alternative surveillance systems in detecting the infection in livestock. To do so, we built a simulation model describing both within-farm and between-farm bTB dynamics. The former was described by a Susceptible-Exposed-Infected model, while the latter by a network model where nodes represent farms and links cattle trade between farms. Preliminary results suggest that there are pros and cons for each surveillance strategy. Tests on traded cattle and slaughterhouse inspection perform better than routine testing in detecting major outbreaks while the latter is better than the former for minor ones.



S2.7 Network heterogeneity and dynamical complexity in seasonal infectious diseases

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It is well known that the topology of the network of contacts among individuals can sharply influence the emergence and the persistence of infectious diseases. Much less is known about how this network influences the dynamical properties of epidemics, especially in the important case of seasonal diseases. Here we study periodically forced SIR and SIRS contact processes in complex networks (of Erdős-Rényi and scale-free type) that are subject to vital dynamics of the hosts. Accounting for host demography in these systems is far from trivial and causes the scale-free networks to lose their key property: a fat-tailed degree distribution. We first introduce a broad class of models that integrate birth and death of individuals with the simplest mechanisms of infection and recovery, thus generating age structured systems of hosts that interact in a complex manner. Then, in the non-seasonal case, we study how the proportion of infectives scales with the number of contacts among individuals. Rather surprisingly, we discover that the result of hubs being at highest risk of infection is not as general as originally expected. Via bifurcation analysis, we finally discuss how the strength of seasonality conjoins with network heterogeneity in giving rise to chaotic temporal patterns. Interestingly, we find that dynamical complexity is maximal (i.e. chaotic) at intermediate value of heterogeneity.

S2.8 Optical remote sensing in an eco-epidemiological study: The challenge of Lake Kivu, DRC

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We construct a remotely-sensed database of Chlorophyll-a concentrations as a proxy for plankton biomass in Lake Kivu for the purpose of furthering the eco-epidemiological study of cholera in the Kivu provinces of the Democratic Republic of Congo. After processing the MODIS-Aqua data, we use a fractional factorial design of experiments to identify the primary factors influencing the quality of the remotely-sensed database. Factors include the choice of atmospheric correction model and bio-optical algorithm, data exclusion criteria based on the application of data quality flags, and the presence or absence of temporal interpolation of the data. The experimental response is measured as the coefficient of correlation r between the remotely-sensed Chl-a data and the ground-truth (*in situ* Chl-a data). Then, we use the optimized Chl-a database to assess the relationship between Chl-a, other environmental variables, and cholera incidence, using incidence data from the lakeside towns of Goma and Bukavu as well as the combined North and South Kivu provinces. This analysis of environmental influences on cholera incidence is an important preliminary step in the development of an endemic cholera model for this region.



S2.9 Modelling the impact of multi-host helminth parasites on hosts' population dynamics

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This work is inspired by multi-annual observations of helminth infection levels and population densities of rock partridge (*Alectoris graeca saxatilis*) that is an endangered species in the Dolomitic Alps (northern Italy). Field data show that the nematode parasite *Ascaridia compar* infect both rock partridge and black grouse (*Tetrao tetrix*), and also suggest a competitive interaction between the two galliform species that share a common spatial domain in the Alps. We hypothesized two possible interaction mechanisms: direct competition and parasite-mediated competition, also called apparent competition, and we used mathematical models as a proof-of-principle verification of these hypotheses. Outputs from the direct competition model are in contrast with field observations, while outputs of the parasite-mediated competition model qualitatively fit the observed pattern suggesting that the sharing of parasite free-living stages between the two species can trigger the competition playing an important role in the decline of rock partridge in Trentino region. The model has been extended to a spatial model that allows for a partial habitat overlap, showing the role of diffusion in shaping either exclusion or spatial segregation of the competitor less tolerant of infestation.

S2.10 Holobiont alterations. A first tool to manage climate change effect on coralligenous communities

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To investigate the role of anthropogenic impact in the occurrence of mass mortality events of the purple gorgonian *P. clavata* in the Mediterranean Sea we conducted a comparative study of bacterial communities associated with this coral collected at different geographic locations and depth, showing contrasting levels of anthropogenic disturbance and health status. Our rationale considers that alteration of the coral holobiont may be investigated as a proxy of coral health status and sensitivity to nonresident pathogens. Using massive parallel 16SrDNA gene pyrosequencing we showed that the bacterial community associated with healthy *P. clavata* in pristine locations was dominated by a single genus *Endozoicomonas* spp. *P. clavata* samples collected in human impacted areas and during disease events had higher bacterial diversity and abundance of disease-related bacteria, such as vibrios, than samples collected in pristine locations whilst showed a reduced dominance of *Endozoicomonas* spp. In contrast, bacterial symbionts exhibited remarkable stability in *P. clavata* collected both at euphotic and mesophotic depths in pristine locations suggesting that fluctuations in environmental parameters such as temperature have limited effect in structuring the bacterial holobiont. Overall our data suggest that anthropogenic influence may play a significant role in determining the coral health status by affecting the composition of the associated microbial community.



S10. Ecotossicologia, alterazione e restauro ambientale [S3.1-S3.18]

S3.1 Microplastics and trophic transfer of polycyclic aromatic hydrocarbons (PAHs) to marine organisms

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Microplastics represent an important environmental concern due to their great abundance in the oceans, the entanglement of large vertebrates and physical damages caused once ingested. Their capability to adsorb different classes of pollutants has been recently suggested, but the possibility that microplastics represent a biologically relevant source of chemical exposure for aquatic organisms is still relatively unexplored. In this study, the efficiency of adsorbing pyrene was assessed under laboratory conditions for two different polymers, polyethylene (PE) and polystyrene (PS); obtained results were compared with chemical characterization of microplastics collected from some local beaches. The trophic transfer of pyrene from microplastics was evaluated in experiments with two classical bioindicators, the mussel *Mytilus galloprovincialis*, and the fish *Mugil cephalus*. Results on chemical levels of pyrene were integrated with histological analyses to detect the presence and tissue localization of microplastics, and with a battery of biomarkers, including cytochrome P450, peroxisomal proliferation, oxidative stress, lipid peroxidation, lysosomal stability, and DNA integrity. This study provided the first evidence that microplastics can adsorb PAHs, emphasizing an elevated bioavailability of these chemicals after the ingestion, and the sensitivity of several cellular responses to the presence of either contaminated or virgin plastics.

S3.2 Use of the Arctic scallop, *Chlamys islandica*, as bioindicators: latitudinal and chemical effects on the antioxidant defences

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Due to increasing anthropogenic pressure in the Arctic, the use of key bioindicator organisms can be of great importance to early detect the onset of biological disturbance. The scallop *Chlamys islandica* is an ideal sentinel species and oxidative stress responses are highly sensitive in polar species toward both anthropogenic and natural disturbance. To evaluate the influence of latitude on the basal antioxidant efficiency, *Chlamys islandica* were sampled along a geographical gradient from Tromsø fjord (69°40') up to Northern Svalbard (80°40'). Analyses of individual antioxidants (CAT, SOD, GPx, GR, GST, glutathione) were integrated with those of total oxyradical scavenging capacity toward peroxyl and hydroxyl radicals (TOSC-ROO·, TOSC-HO·), peroxisomal proliferation (AOX), accumulation of lipofuscin, MDA and neutral lipids. Results showed a significant correlation between antioxidants baseline values and latitudinal gradient, with higher levels of CAT, GPx, SOD, TOSC and AOX in scallops from the most Northern site. To further characterize responsiveness of these organisms toward oil spill events, scallops were exposed to different crude oil concentrations dosed alone or in combination with chemical dispersants. Results indicated significant bioaccumulation of PAHs but only moderate responses of antioxidant systems emphasizing the importance of additional studies on biological risks associated to hydrocarbon contamination and remediation strategies in the Arctic marine ecosystem.

S3.3 Vegetazione ripariale e servizi ecosistemici: analisi ecofisiologiche e accumulo di metalli pesanti in foglie di *Salix alba* L., lungo il corso del fiume Sacco (Lazio).

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L'alterazione di processi naturali nei Siti di Interesse Nazionale (SIN), dovute ad inquinanti di origine antropica, influenza la produzione di Servizi Ecosistemici. L'obiettivo di questo studio è stato quello di valutare il grado di esposizione della vegetazione ripariale del fiume Sacco (SIN del Lazio) ad elevate concentrazioni di inquinanti organici e inorganici mediante analisi floristiche, ecofisiologiche e chimiche. In due stazioni, ubicate a differente distanza dalle principali fonti di contaminazione (aree industriali e centri urbani), è stata caratterizzata la vegetazione e nel periodo 2010-2013 analizzati gli scambi gassosi e la fluorescenza della clorofilla *a* su *Salix alba* L.; si è anche analizzato il contenuto totale di nutrienti e metalli pesanti a livello fogliare e nel suolo. Nella stazione caratterizzata da un maggior impatto antropico, è stata rilevata nel suolo la presenza di un elevato contenuto di metalli (V, Pb, As, Zn, Cu), mentre a livello fogliare i valori di tali elementi rientrano nei valori fisiologici, ad eccezione dello Zn. Le analisi ecofisiologiche hanno evidenziato una riduzione della conduttanza stomatica, anche al termine della stagione estiva, in condizioni climatiche non limitanti. Sono attualmente in corso ulteriori studi anche in ambiente controllato, al fine di comprendere le potenzialità di fitoestrazione di *S. alba* in progetti di riqualificazione di aree ripariali.

S3.4 Biosorption of metals and semimetals ions from aqueous solution by nonliving macrophytes

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This study was aimed to assess the performance of different nonliving macrophytes in arsenic(V), vanadium(III) and molybdenum(V) sorption. Full factorial experiments were carried out where the main factors were the macrophytes (brown algae: *Cystoseira*, *Dictyopteris*, and *Eisenia*; green algae: *Caulerpa* and *Ulva*; red algae: *Ceramium*, *Gracilaria*, and *Porphyra*; and seagrass: *Zostera*), biosorbent washing pre-treatment (deionized water, acid and basic), equilibrium pH (1–8), under high (10 mg L⁻¹) and low (100 µg L⁻¹) arsenic concentration. All species exhibited significant adsorption with the highest observed for *Ceramium* and *Zostera*, comparable with those of activated carbon and other low-cost adsorbents. Moreover, red algae known in the literature to be bad cationic metal sorbents showed very good arsenic sorption performance. Vanadium and molybdenum biosorption was investigated using biomass of *Posidonia oceanica* (seagrass) previously treated with deionized water acid. The combined effects on biosorption performance of the equilibrium pH (range 1–12) and metal concentrations were investigated in ideal single metal system and real-like multicomponent systems. The results suggested that the biomass of *P. oceanica* can be used as an efficient biosorbent for the removal of V(III) and Mo(V) from aqueous solutions offering an eco-compatible solution for the reuse of the waste material consisting of leaves accumulated on the beach due to both human activities and sea storms.

S3.5 Ecotoxicology of nanomaterials: a Trojan horse effect in marine organisms?

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The aim of the present study was to investigate the interaction of n-TiO₂ with ATP binding cassette transport protein P-glycoprotein (P-gp) in the gills of mussel *Mytilus galloprovincialis* as part of a defense mechanism against nanoparticles exposure. P-gp encoded by *abcb1* gene actively pumps a broad spectrum of chemicals out of the cell preventing their intracellular accumulation and potential toxic effects. n-TiO₂ exposure (0.1-1mg L⁻¹, Aeroxide® P25) in mussel's gill biopsies has been investigated at gene and efflux activity levels both *in vitro* (90 min-2h) and *in vivo* (96h) and also in combination with cadmium (0.1 mg L⁻¹). The aim was to investigate a potential *Trojan horse* effect of n-TiO₂ towards Cd in a marine model species. *In vitro* no modulation of *abcb1* gene expression except in combination (n-TiO₂ + Cd) was observed with a slight increase compared to single chemicals. A significant reduction in efflux dye accumulation (2h) was also observed. *In vivo* both n-TiO₂ and Cd significantly increase *abcb1* gene expression (2-2.5 fold and 3.5-4 fold vs controls respectively) as well as in combination. No differences were observed at efflux level. Cd levels in whole organism (58-60 µg Kg⁻¹ dry weight) did not differ between single (Cd) and co-exposure (n-TiO₂ + Cd) conditions. HR-TEM confirmed n-TiO₂ (~27nm) uptake in gills in both large and small aggregates in endosomes. The absence of a Trojan horse effect of n-TiO₂ towards Cd in a marine species is suggested.

S3.6 Sea urchin embryo as a model for studying uptake, distribution and toxicity of nanoparticles

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The huge number of nanomaterials (NM) released in the marine environment might poses a risk for more sensitive biological stages, such as embryos. The bioavailability and toxicity of NM for the marine biota is strictly dependent on their behaviour in seawater and their interactions with the natural environment. The aim of the study is thus to characterize the uptake and disposition of carboxylated polystyrene NP (PS-COOH) in *Paracentrotus lividus* embryos. The uptake of fluorescent PS-COOH (25 µg ml⁻¹) was monitored within 48 h post-fertilization (hpf). During the first developmental stages PS-COOH seemed to adhere to the embryo surface, while after 24 hpf started to be accumulated mostly inside the stomach and excreted at later developmental stages (54 hpf). Embriotoxicity and modulation of defensome genes was also investigated in comparison with ammynated polystyrene NP (PS-NH₂), known to be more toxic in human cell lines. A low toxicity was observed for PS-COOH up to 50 µg ml⁻¹ while PS-NH₂ induced lysis of embryos above the threshold concentration of 5 µg ml⁻¹. The measurement of Z-average, PDI and Z-potential in seawater (35‰) showed that PS-COOH form substantial aggregates, while PS-NH₂ are better dispersed. This might explain the different toxicity observed for the two NPs. Preliminary results indicate that sea urchin embryos represent a good model for studying uptake and disposition as well as toxicity of nanomaterials during development in marine organisms.

S3.7 Are fin whales (*Balaenoptera physalus*) exposed to microplastics toxicological threat?

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The emerging issue of microplastics (plastic fragments smaller than 5 mm) in marine environment is recently raising increasing attention. The impacts of microplastics on baleen whales, which potentially undergo to the ingestion of micro-litter by filtering feeding activity, are largely unknown. Here we present the case study of the Mediterranean fin whale (*Balaenoptera physalus*), exploring the toxicological effects of microplastics on mysticetes comparing two populations living in areas characterized by different human pressure: the Pelagos Sanctuary (Mediterranean Sea) and the Sea of Cortez (Mexico). The work is implemented through three steps: 1) collection/count of microplastics in Pelagos Sanctuary (Mediterranean Sea); 2) detection of phthalates in superficial neustonic/planktonic samples; 3) detection of phthalates and biomarkers responses (CYP1A1, CYP2B, lipid peroxidation) in skin biopsies of fin whales collected in the Pelagos Sanctuary (n=18) and Sea of Cortez (n=7). High presence of plastic particles have been detected in superficial neustonic/planktonic samples collected in the Pelagos Sanctuary areas investigated (mean value 0.62 items m⁻³) with high concentration of phthalates (DEHP and MEHP), used as tracers of plastic derivatives. Relevant concentrations of MEHP and higher biomarker responses (CYP1A1, CYP2B, lipid peroxidation) were detected in the skin biopsies of fin whales collected in the Mediterranean areas in comparison to the specimens of Sea of Cortez. These results suggest the use of phthalates as a tracer of microplastics assumption in fin whales and represent a warning signal on this emerging threat in baleen whales.

S3.8 Quantificazione ed effetti istopatologici di composti perfluoroalchilati in popolazioni di anguilla (*Anguilla anguilla* L.) nella Provincia di Ferrara

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Persistenza e ampia diffusione nell'ambiente, capacità di interferenza endocrina, cancerogenicità sono alcune delle caratteristiche dei composti perfluoroalchilati (PFC) e le ragioni del crescente interesse attorno a questi inquinanti emergenti. Nel 2012 sono state campionate in provincia di Ferrara 35 anguille gialle (lunghezza 49-75 cm), 19 provenienti dal basso corso del fiume Po e 16 dalle Valli di Comacchio. Da ciascun esemplare sono stati prelevati campioni di vari tessuti/organi per l'analisi istopatologica e per la quantificazione di perfluorottano sulfonato (PFOS) e acido perfluorottanoico (PFOA), determinati tramite LC-ESI-MS/MS. Il PFOS era variabile tra 0.2 e 6.28 ng g⁻¹; il PFOA presentava valori maggiori, compresi fra 0.2 e 92.77 ng g⁻¹. I livelli di PFC nei campioni di fiume non differivano significativamente da quelli di valle per tutti i tessuti analizzati (Test U Mann-Whitney, p>0.05). Le concentrazioni più alte di entrambi i PFC sono state riscontrate nel sangue, seguito da fegato e gonade ed infine dal muscolo. L'analisi istologica ha evidenziato moderate alterazioni nei principali organi target ovvero fegato, rene e gonade; le anguille con i valori di PFOA più alti presentavano vacuolizzazione diffusa e abbondanza di centri melanomacrofagici a livello epatico. Questa indagine, la prima sui PFC nelle anguille in Italia, permette di aggiungere un tassello alle conoscenze sulle possibili minacce alla salute di questa specie in declino.



S3.9 Could molecular effects of *Caulerpa racemosa* metabolites modulate the impact on fish population of *Diplodus sargus*?

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The invasive green alga *Caulerpa racemosa* represents an important biological disturbance in the Mediterranean. Although several interactions between non-native and local species have been described, a relatively unexplored pathway is the possible transfer and adverse effects of algal metabolites into the trophic chain. A limited knowledge exists on bioaccumulation and molecular effects of such metabolites in ecologically relevant fish species which ingest the alga through the diet. In this respect, the aim of the present study was to investigate tissues concentrations of caulerpin, the main secondary metabolite of *C. racemosa*, and some ecotoxicological responses in the white seabream *Diplodus sargus*; organisms were sampled in 2 seasonal periods from 3 Adriatic locations, characterized by different conditions in terms of algal presence. To further characterize mechanisms of action of this algal compound, juvenile fish were also exposed under laboratory conditions to a caulerpin-enriched diet. Caulerpin was accumulated at concentrations ranging from a few up to hundreds of $\mu\text{g g}^{-1}$ in the liver. Biomarkers analyses revealed limited alterations of the main antioxidant defences while an increase of cytochrome P450 activity, and enhanced gene transcription for PPAR-alpha, CYP1A1 and Vitellogenin 1 were observed. These preliminary results suggest a certain modulation of the fatty acids metabolism and possible effects on physiological responses of exposed organisms.

S3.10 Preliminary tests for wastewater disinfection based on the natural bio-filtration process

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This study shows the preliminary results for the evaluation of the possible use of the freshwater bivalve *Dreissena polymorpha* within conventional wastewater treatment plants (WWTPs) as a refinement process. This bivalve has a high filtering capability, a significant bioaccumulation of lipophilic contaminants and can be able to diminish the pathogen load. Using the effluent from WWTP Milano Nosedo, all these characteristics were evaluated at laboratory scale. Ten specimens were placed in 300 ml of effluent for 24-48-72 hours in order to evaluate the removal efficiency of *E. coli*, polycyclic aromatic hydrocarbons (PHAs) and *Sabin Polio* Virus. The results showed that the removal of *E. coli* increased from 30 to 70% with increasing contact time (24 hours) and reached levels comparable to the traditional disinfection process without of course generating any potentially toxic disinfection by-product (DBPs). Furthermore, also the removal of PHAs was significant after bivalve treatment. No *Sabin Polio* virus infective particles were found into the effluent. 103 pfu ml⁻¹ were added to the effluent to evaluate the removal efficiency of *Dreissena* filtration. The results showed a significant removal of *Polio Virus*, added in laboratory; in fact this virus was inactivated by bivalves and active form virus was not found in the bivalve faces. Theses preliminary experiments showed that *Dreissena polymorpha* could find application in the final disinfection of treated effluents.

S3.11 Toxicity effects of TiO₂ engineered nanoparticles to a battery of marine organisms

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Engineered nanomaterials (ENMs) are increasing their presence in the worldwide market due to their innovative properties. In particular, TiO₂ nanoparticles (nTiO₂) are employed in many common products such as cosmetics and sunscreen creams. Despite the great increase in its use, few data exist about its ecotoxicological effects towards marine species, although seawater environment is indicated as the most probable final sink. Thus, the nTiO₂ toxicity was studied considering a battery of testing species including various trophic levels such as the bacterium *Vibrio fischeri*, the algae *Phaeodactylum tricornutum*, the mollusc *Mytilus galloprovincialis* and the crustacean *Artemia franciscana*. In general, treatments within the 0.1–100 mg L⁻¹ nTiO₂ carried on the various testing species evidenced no linear concentration-effect relationship, except for *A. franciscana*. For example, in the case of unicellular algae, sublethal concentration-dependent effects were observed, showing an impaired ability in cell duplication. Issues about their use as new endpoints together with the traditional ones are under evaluation. Indeed, from the analysis of literature on nTiO₂ physico-chemical behaviour in seawater as well as present original ecotoxicological results, various criticisms rose about the exposure scenarios for the biological models, confirming the necessity of changing the traditional way of results' interpretation.

S3.12 Hatching test on *Artemia* sp. (Crustacea, Anostraca) cysts to evaluate the toxicity of Diethylene Glycol and Sodium Dodecylsulfate

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Ecotoxicological assays are commonly used to evaluate the impact of several kind of environmental pollutant on biota and to determine the effectiveness of certain species as bioindicator. The brachiopod crustacean *Artemia* sp. is one of the major test organisms in ecotoxicology because of its wide geographic distribution, relatively simple laboratory culture and maintenance, resistance to manipulation, short life-span, large offspring production and comprehensive information on the life cycle. Cyst-based toxicity assays are underemployed although they are cheap, simple and reliable. The great majority of *Artemia* toxicity data deal with lethal effects and to a lesser extent on effects under subchronic exposure (endpoints: growth, reproduction, motility, etc.) because of the quite complex procedure. In this study the toxicity of diethylene glycol on the hatching rate of *Artemia franciscana*, on a short time lag (24-48 h) has been evaluated. These result are compared to acute and chronic test results to highlight the effectiveness of this test. Diethylene glycol is an additive largely used during oil and gas exploitation by offshore platforms. Toxicity data are also compared to a reference toxicant, *i.e.* Sodium Dodecylsulfate. Results highlight the medium toxicity of diethylene glicol and confirm the reliability of the hatching assay as a "short-term chronic test", suggesting its application for routine toxicity evaluations.

S3.13 An integrated, multidisciplinary weight of evidence approach to assessing the environmental impact of the Costa Concordia wreck

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After the Costa Concordia shipwreck, a monitoring plan was immediately activated to assess possible contamination events in the water column, sediments and biota. Biological effects were investigated at different levels of organization, from molecular targets to organism, population and community responses. A multidisciplinary, weight of evidence (WOE) investigation will be presented, based on the integration of chemical analyses on sediments, ecotoxicological bioassays, bioaccumulation and biomarkers in typical bioindicator organisms, like caged mussels, native fish species of different trophic levels, intertidal invertebrates. Tissue concentrations were measured for the main classes of potentially released chemicals (trace metals, PAHs, aliphatic hydrocarbons, PCBs and halogenated pesticides, organotin, PBDEs, detergents), while biomarkers covered a wide battery of responses indicative of exposure, detoxification, oxidative stress, cell damage and genotoxic effects. Results excluded serious contamination events or a consistent increase of environmental pollution although some episodic spills with reversible effects were detected. Data were elaborated within a quantitative WOE model providing synthetic hazard indices for each typology of data, before their overall integration in an environmental risk index, which generally ranged from slight to moderate. The proposed WOE model was confirmed a useful tool for ecological risk assessment and site-oriented management decisions.

S3.14 Alterazioni fisiologiche provocate dal Cr(VI) nel verme terrestre *Eisenia andrei*: dagli effetti a livello molecolare/cellulare alle risposte a livello di organismo

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Il verme terrestre *Eisenia andrei* è stato utilizzato per valutare gli effetti tossici provocati da concentrazioni ambientalmente rilevanti di Cr(VI) mediante test con suolo artificiale. Le concentrazioni di Cr(VI) utilizzate (1, 2, 15 mg kg⁻¹) rientrano nei limiti di legge italiani per i suoli. In assenza di effetti sulla vitalità e riproduzione, sono state osservate significative alterazioni di diversi biomarker. In particolare, nei vermi esposti anche alla concentrazione più bassa, si è evidenziata una riduzione dell'attività della Ca²⁺-ATPasi nell'epitelio intestinale; si è inoltre osservato un incremento del danno ossidativo al DNA dei celomociti. Nelle stesse cellule, alle concentrazioni più alte, il Cr(VI) ha provocato una significativa riduzione della stabilità delle membrane lisosomiali e un incremento della frequenza dei micronuclei, dato quest'ultimo che indica un persistente danno genotossico; infine, i risultati del rilascio di lattato deidrogenasi nel liquido celomatico hanno evidenziato un danno alle membrane cellulari. I risultati confermano che *E. andrei* è un organismo modello rilevante per la valutazione del rischio ecologico di siti contaminati. In particolare, l'utilizzo di sensibili parametri fisiologici subletali è essenziale per determinare il livello di vulnerabilità raggiunto dalle risorse biotiche negli ecosistemi terrestri. Infine, *E. andrei* quale test ecotossicologico ad endpoint multipli è stato utilizzato per valutare la qualità di suoli industriali contaminati da Cr; i risultati hanno evidenziato uno stato di stress dei vermi esposti, con alterazioni anche ai più alti livelli di organizzazione biologica.



S3.15 Hunting nanotarticles in marine fish: a Trojan horse in vivo study using n-TiO₂ in combination with 2,3,7,8- TCDD and cadmium in juvenile of European sea bass

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The aim of present study was to investigate Trojan horse effect of titanium dioxide nanoparticles (n-TiO₂, Aeroxide®) towards toxic contaminants as 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) and cadmium (Cd) in the phase 0, I, II and III of biotransformation in juveniles of *Dicentrarchus labrax*. An in vivo 7 d exposure was performed with n-TiO₂ (1 mg L⁻¹), TCDD (46 pg L⁻¹), Cd (0.1 mg L⁻¹) single and in combination. Modulation of selected genes as abcb1 and abcc1, c2 (Phases 0, III) and cyp1a (Phase I) as well as enzyme activities as EROD, GST (Phase II), CAT and MT were investigated in liver tissue. abcb1 resulted up-regulated by TCDD and in combination with n-TiO₂ (up to 2.15-fold) while no effects are observed for n-TiO₂ alone. A slight induction (up to 1.5-fold for both abcc1 and abcc2) was observed again by TCDD alone and more marked in combination with n-TiO₂ (up to 2.30-fold for abcc1 and abcc2). A modulation of abcs genes and a significant different MT content was observed both for Cd and n-TiO₂ single and in combination. cyp1a gene as well as EROD activities resulted significantly up-regulated by single TCDD exposure (25-fold) but not affected by the combination. GST and CAT are not affected in both experiments. HR-TEM confirmed n-TiO₂ (~27nm) uptake in liver both in large and small aggregates. Based on the overall results no Trojan horse effects can be hypothesized on 7 d exposure in European sea bass species.

S3.16 Assessing the environmental hazard of mixtures of pharmaceuticals: combined acute and chronic toxicity of fluoxetine and propranolol to the crustacean *Daphnia magna*

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The aim of the present work is to evaluate the acute and chronic toxic response of the crustacean *Daphnia magna* exposed to individual pharmaceuticals and mixtures. We tested fluoxetine, a selective serotonin reuptake inhibitor widely prescribed as antidepressant, and propranolol, a non selective β -adrenergic receptor-blocking agent used to treat hypertension. Acute immobilization tests and chronic reproduction tests were performed according to 202 and 211 OECD guidelines respectively. Single chemicals were first tested separately. Toxicity of binary mixtures was then assessed using a fixed ratio experimental design. Five concentrations and 5 percentages of each substance in the mixture (0, 25, 50, 75 and 100%) were tested. The conceptual model of Concentration Addition (CA) was adopted in this study, as we assumed that the mixture effect mirrors the sum of the single substances for compounds having similar mode of action. The MixTox model was applied to analyze the experimental results. This tool evaluates if and how observed data deviates from the CA model, and tests if significantly better descriptions of the observed data can be achieved using a set of deviation functions. These functions allow a differentiation between synergism and antagonism, along with deviations based on the dose-level and chemical ratio dependency. Results showed a significant deviation from CA model that indicated antagonism between chemicals in both the acute and the chronic mixture tests.



S3.17 Toward a new paradigm in Ecological Risk Assessment

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In the last few decades, ecological risk assessment was based on simplified tools to be applied in support of chemical regulations. This pragmatic approach produced transparent and easy methods, applicable using the scarce information available, and allowed the development of many international regulatory tools. In spite of their practical usefulness, these tools, mainly based on laboratory tests, suffer for a lack of ecological realism. Their capability to predict the actual consequences on structure and functions of natural ecosystems is poor. Therefore, there is the need for the development of new tools capable to accounting for the complexity of ecosystems. The Scientific Committees of the European Commission (SCHER, SCENHIR, SCCS) recently approved an Opinion on "Addressing the New Challenges for Risk Assessment". A number of relevant issues worth to be developed are highlighted: increasing the ecological realism of exposure assessment; assessing the effects of highly time-variable exposure; covering the gap between effects at sub- individual level and ecologically relevant endpoints; assessing vulnerability of ecosystems; assessing the role of indirect ecological effects; assessing the effect of multiple stress factors; developing trait-based risk assessment; improving ecological modelling. A short overview is given on the main issues and on their realistic applicability (in the short, medium and long time) in risk assessment procedures for regulatory purposes.

S3.18 Theoretical and experimental evidences of medium range atmospheric transport processes of polycyclic musk fragrances

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This study investigates some aspects of the environmental fate of galaxolide and tonalide musk fragrances (AHTN and HHCB), paying particular attention to the phenomenon of Atmospheric Transport of these substances. The problem was addressed theoretically and experimentally. Firstly, the application of a multimedia model allowed the analysis of their potential atmospheric transport. The obtained results argued in favor of a possible phenomenon of Medium Range Atmospheric Transport for both substances. These theoretical findings were supported by the experimental results, which showed their presence both, in the fresh fallen snow and in water samples taken from the Frodolfo, a glacial stream that originates from the Forni glacier (Alps, Northern Italy). Furthermore, the analysis of the air back-trajectories highlighted the prevalence of air masses of local origins, that reached the sampling area, passing through a densely anthropized area of Northern Italy. Finally, the experimental results discussed here are the first ever attempt in literature to evaluate the accumulation of these compounds in glaciers.



S11. Ecologia microbica: un tributo a *Vivia Bruni* [S4.1-S4.16]

S4.1 Blooms of the toxic benthic dinoflagellate *Ostreopsis cf. ovata* in the northern Adriatic Sea: role of environmental factors and substratum

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In the last decade, blooms of toxic benthic dinoflagellates *Ostreopsis cf. ovata* became widespread in the rocky coasts of the Mediterranean Sea. Blooms are associated with noxious effects on human health and with mortality of benthic marine organisms, due to the production of palytoxin-like compounds. We investigated the temporal trend of *O. cf. ovata* bloom in the Conero Riviera (N Adriatic Sea) and the role of environmental factors and substratum on the bloom dynamics. Sampling was carried out from 2006 to 2012 on several benthic substrata (macroalgae, pebbles, mussels) and in the water column. Annual maxima on macrophyte were observed in late-summer, with abundances of the order of magnitude of 10⁶ cells g⁻¹ fw. Significantly higher abundances were observed on seaweeds than on hard substrata. Hydrodynamism play a major role in regulating the bloom dynamics of *O. cf. ovata*: significantly higher abundances were observed in sheltered sites than in exposed ones, but only in the phase of intense proliferation. The abundances of *O. cf. ovata* showed a marked decrease with depth. N:P ratio near the Redfield value seems to affect the bloom development. Differently from what observed in other Mediterranean areas, blooms developed when temperatures were decreasing, although cyst germination occurs at T≥25 °C.

S4.2 Quantification of the toxic dinoflagellate *Ostreopsis* spp. by qPCR assay in marine aerosol

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Since the summer of 2005, in the Mediterranean Sea, growing concerns regarding exposure to harmful marine aerosols associated with toxic benthic dinoflagellate *Ostreopsis* spp. blooms have been reported, as they represent major health and economic risks to human populations. Toxic events in humans after inhalation have been reported during *Ostreopsis cf. ovata* blooms and were attributed to palytoxin compounds produced by this microalga. In this context, we developed a qPCR assay for the estimation of the toxic *O. cf. ovata* in the complex matrix of marine aerosol at Llanerres (Spain) during a bloom together with determination of PLTX-like compounds using hemolytic assay and liquid chromatography. Marine aerosol samples collected at two stations were analyzed by qPCR. The sensitivity was set at two rDNA copy number and 8 × 10⁻⁴ cell per reaction. Results showed that *O. cf. ovata* abundance in marine aerosol during the bloom varied in the range of 1–10² cells per filter. No PLTX was detected in the aerosol filters by analytical determinations, while the estimation of PLTX like-compound concentrations in microepiphytic assemblages varied between 0.1 and 1.2 pg cell⁻¹. The developed qPCR assay is a highly sensitive and specific quantification method for toxic *O. cf. ovata* in marine aerosol. This method will be further applied to aerosol monitoring along Italian beaches for determining toxic level of *Ostreopsis* blooms as prevention action towards people exposure during summer periods.



S4.3 Ecology and genetic diversity of *Escherichia coli* associated with macroalgae

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Interactions between epiphytic bacteria and macroalgae have been described in aquatic ecosystems. Like other eukaryotic organisms, seaweeds harbour a wide diversity of associated microorganisms with functions related to host health and defense. However, the occurrence of *Escherichia coli* and other potential human pathogens associated with macroalgae has been little investigated. From February to May 2013, we collected macroalgal samples (*Ulva* spp., *Undaria* spp. and *Sargassum* spp.) in the Venice lagoon, at three sites along a gradient of microbiological contamination. About 400 *E. coli* isolates were screened to confirm their identification as *E. coli*, to assign them to the phylogenetic group (A, B1, B2, C, D, E and F), to determine the presence of toxins and virulence factors genes, and to study their genetic diversity. All macroalgae hosted high abundance of *E. coli* (up to 103 cfu/g) belonging to all known phylogroups. Only few strains belonged to cryptic clades, and were prevalently isolated from seawater. No toxins or intimin genes were detected. Macroalgae-associated *E. coli* showed wide temporal variability, lack of correlations with populations in the overlying seawater, and ability to grow on macroalgal extracts as only source of carbon. We suggest the existence of an environmental reservoir of *E. coli* genotypes, which possibly includes “naturalized” genotypes adapted to the macroalgal habitat, with implications from either the public health and ecological perspectives.

S4.4 Microbial consortium associated with the Antarctic psychrophilic ciliate *Euplotes focardii*: a preliminary investigation from genomic sequences

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Being single cells directly exposed to environmental cues, protozoa represent excellent models to unravel the full suite of cold stable functions that allowed the ecological success of psychrophiles. As a contribution to the understanding of the molecular mechanisms responsible for cold adaptation, we are analysing the entire genome from *Euplotes focardii*, an Antarctic ciliate (Ciliophora, Alveolata). *E. focardii* is endemic of the Antarctic seawaters and it is strictly psychrophilic and sthenothermal. Among the 201,918 contigs obtained, we found 12,738 contigs that we considered to be of bacterial origin. Among these sequences, we identified 71 contigs corresponding to partial sequences of ribosomal DNA. Most of these sequences belonged to the phylum Proteobacteria, specifically to the Alphaproteobacteria, Betaproteobacteria and Gammaproteobacteria classes. One of these sequences corresponded to the 16S of a novel psychrophilic *Francisella*. We also characterised two ice-binding proteins (IBPs), that we named EFsymbAFP and EFsymbIBP. EFsymbAFP is 31% identical to the IBP from the *Stigmatella aurantiaca* strain DW4/3-1, isolated from the Lower Victoria valley glacier (Antarctica). EFsymbIBP is 52% identical to the IBP from the *Flavobacteriaceae* bacterium 3519-10, from the Lake Vostok glacial ice. The role of the bacterial consortium in cold adaptation is under study. This analysis will allow to understand whether different organisms can cooperate for environmental adaptation.



S4.5 Distribuzione e diversità del plancton procariotico nel lago meromittico di Faro (Messina)

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Il lago di Faro (Messina) è un bacino costiero meromittico caratterizzato da stratificazione stagionale delle acque. In periodi estivi nello strato di transizione (o chemocline) tra lo strato ossico e quello anossico si manifesta il “fenomeno dell’acqua rossa” per lo sviluppo di batteri fotosintetici solfo-ossidanti. La distribuzione e la diversità dei procarioti (Batteri e Archea) planctonici in relazione ai parametri ambientali sono state studiate mediante l'uso di tecniche molecolari convenzionali e di *Next Generation Sequencing*. I risultati hanno mostrato che i Batteri sono più abbondanti nello strato ossigenato, mentre gli Archea sono più numerosi in quello anossico. I filotipi batterici dominanti appartengono ai Proteobatteri (alpha, gamma, delta ed epsilon), ai Bacteroidetes, ai batteri solfurei verdi (BSV) e ai Cianobatteri. I principali filotipi degli Archea riscontrati appartengono agli Euryarchaeota (*Thermoplasmata* e *Methanomicrobia*) e ai Thaumarchaeota (Crenarchaeota mesofili, *Nitrosopumilales* e *Nitrososphaerales*). La distribuzione dei procarioti planctonici nella colonna d’acqua è influenzata dalle caratteristiche fisico chimiche e nutrizionali dei diversi strati. Al di sotto del chemocline sono più numerosi i BSV, i batteri solfato-riduttori ed i Thaumarchaeota. Questi ultimi possiedono un metabolismo chemioautotrofo e partecipano attivamente ai processi biogeochimici fondamentali nell'ecosistema del lago di Faro.

S4.6 Dense waters effects on bacterioplankton diversity and metabolism in the Southern Adriatic Sea

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During winter, the northern Adriatic Sea is subjected to intense cooling associated with dry and cold north-easterlies (the Bora wind). The resulting water mass (Northern Adriatic Dense Water, NAdDW), cold and dense, sinks and flows southward, reaching the proximity of Bari in early spring. NAdDW mixes with other Adriatic water masses to form the Adriatic Deep Water (ADW) and contributes to ventilate deep waters in the whole Eastern Mediterranean. This episodic event has the potential of influencing the diversity and metabolism of microbial assemblages at large spatial scales, with unpredictable effects. In spring 2012, we collected seawater samples along three transects in the Southern Adriatic Sea, during the outflow of dense water generated after a severe cold spell. Several stations were clearly sampling the veins of dense waters, with potential density anomaly as high as 29.7 Kg m^{-3} and temperature as low as 10.5°C . We measured bacterioplankton diversity (by a combination of fingerprinting techniques and 16S rDNA pyrosequencing) and key functional variables (heterotrophic C production, respiration and degradation rates). NAdDW were characterized by higher abundance of prokaryotes, respiration and organic matter degradation rates than observed in other deep water masses, and showed a distinct community composition. We suggest that dense water passage can have large-scale consequences for the ecosystem functioning and the biogeochemical cycles in the Southern Adriatic Sea.



S4.7 Microbial assemblages from pockmarks of the middle Adriatic shelf

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Shallow pockmarks have been identified in the Adriatic shelf since the 80's commonly associated with hydrocarbon ascent through the muddy sediment blanket. To date, no specific information is available on microbiology of Middle Adriatic pockmarks supporting the presence of hydrocarbons and of specialized microbiological chemosynthetic communities. We have, therefore, carried out an integrated chemical and microbiological survey of four Adriatic pockmarks adjacent to the Middle Adriatic Ridge and located at a depth of ca. 200 m. Such pockmarks present evidence of hydrocarbons seepage and host specialized chemosymbiotic thiotrophic metazoans, thus suggesting microbial mediated methane-oxidation. The abundance of sequences related to the *candidate division NC10*, suggests the presence of nitrite-dependent anaerobic methane oxidation (n-damo), raising interesting questions about the ecological significance in those area of n-damo metabolism, which will require further investigation to confirm its relevance.

S4.8 Nitrogen removal via denitrification in vegetated and unvegetated drainage ditches impacted by diffuse sources of pollution in an agricultural watershed of the Po River Delta (northern Italy)

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The Po di Volano (sub-basin of the Po River in northern Italy) is a deltaic area close to a network of eutrophic lagoons of particular interest for biodiversity conservation. Main features of this basin are the intensive agriculture, mainly sustained by chemical fertilizers and the extended network of artificial canals where previous scientific evidences have proved a notable removal of the excess nitrogen. Literature reports that canals and ditches have the potential to effectively mitigate excess nitrogen via denitrification but only a few studies provide experimental data. To test this hypothesis, we measured denitrification at the whole reach scale, in vegetated and unvegetated secondary canals, subjected to diffuse nitrogen pollution from agricultural sources. We selected replicated reaches, where denitrification was evaluated on the base of changes in dissolved N₂:Ar, measured by means of membrane inlet mass spectrometry. In vegetated ditches the rates of denitrification were on average one order of magnitude higher than in unvegetated canals, highlighting the great relevance of the effect of vegetation in promoting microbial nitrogen metabolism. Nitrogen removal via temporary storage in the plant biomass was two orders of magnitude lower than denitrification. Results from this study highlight the importance of actions aiming to minimize nitrogen pollution in impacted watersheds using low cost management practices based on the effectiveness of emergent vegetation.



S4.9 Stime dei flussi di carbonio nella rete trofica microbica nel basso Adriatico e nello Ionio

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Si è sempre ritenuto che nella zona eufotica il microzooplancton fosse il maggiore consumatore di fitoplancton, ma ci sono crescenti evidenze che in situazioni di oligotrofia anche in superficie, così come avviene nel batipelagico, il microzooplancton basa la sua dieta sui procarioti, direttamente o indirettamente attraverso la predazione del nanoplancton, che a sua volta preda il comparto picoplanctonico, trasferendo così energia dalla rete trofica microbica ai livelli superiori. Per testare questa ipotesi abbiamo condotto 4 esperimenti di grazing con il metodo delle diluizioni di Landry & Hassett (1982) nelle acque superficiali del basso Adriatico e dello Ionio. Le biomasse più abbondanti sono quelle picoplanctoniche ed in genere quelle dei procarioti eterotrofi sono il doppio di quelle della frazione autotrofa. Queste vengono sempre predate intensamente dal nanoplancton, che in 2 esperimenti viene attivamente predato dal microzooplancton, che ne riduce la pressione predatoria sul comparto picoplanctonico. In 2 esperimenti c'è evidenza di predazione diretta sul picoplancton da parte del microzooplancton. Il comparto fitoplanctonico contribuisce sempre alla dieta del microzooplancton, ma in misura irrisoria. Risultano generalmente predate diatomee e coccolitoforidi, che sono relativamente abbondanti, e il silicoflagellato *Dictyocha fibula* che invece è molto scarso.

S4.10 Intermediate concentrations of synthetic antibiotics drive drastic changes in aquatic bacterial communities

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The spread of resistances to commonly used synthetic antibiotics (AB) in natural environments is one of the major threats to human health. A large number of publications investigated the relations between different human pathogens and the spread of AB resistances, but a comparably low number of studies targeted the ecological effect of the presence of synthetic AB on non-pathogenic bacteria in waters. We tested the long-term impact of a cocktail of synthetic antibiotics of commercial use (Imipenem, Levofloxacin, and Tetracycline) on artificial bacterial communities miming a very simplified natural freshwater community. The experimental setup consisted in a 24 days-long continuous culture system where the bacterial communities were exposed to three different AB concentrations: no AB (control), sub-lethal AB concentration (comparable to anthropized European lakes), and in AB concentration 10 folds higher (comparable to heavily contaminated water treatment plants). Bacterial number and morphological distribution were daily monitored (epifluorescence microscopy), while community composition (CARD-FISH) and antibiotic resistance were assessed bi-weekly. Bacterial production, and thus abundance, dropped by 75% in the presence of AB, independently by their concentration, while bacterial community composition resulted highly affected by intermediate AB concentration, with reversal in the proportion of the dominant groups (*A. hydrophila* and *Brevundimonas* sp.). These results, for the first time focussing on the ecological consequences of AB on a experimental bacterial community, highlight the potential risk posed by low AB concentrations in waters. Their effect is not only limited to the spread of potentially pathogenic strains, but it extends to modification of interspecific ecological interactions, weakening the natural resistance of the aquatic communities to the success of allochthonous, and potentially dangerous, strains.



S4.11 Bacterial and fungal growth on litter of different trees in a Turkey oak soil

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Bacteria and fungi play key roles in organic matter cycling, releasing nutrients for plant growth, but little is known on the effect of different plant materials on the balance of fungal and bacterial activity in soil. There are two techniques to differentiate between fungal and bacterial growth in soil using radioactive tracer additions: the leucine incorporation technique to estimate bacterial growth (Bååth *et al.*, 2001) and the acetate-in-ergosterol incorporation technique to estimate fungal growth (Bååth, 2001). These methods were used to evaluate the effects of litter from different trees added to a forest soil. For this preliminary study, a Turkey oak soil from Italy was used. Additions of Holm oak, Beech and Turkey oak litters were evaluated. Wheat straw was included as a positive control, known to result in especially increased fungal growth. There was little difference in respiration between substrates. However, bacteria grew best on Turkey oak litter, with Holm oak as the least preferred substrate. Fungi preferred to grow on straw, with much less growth on the other substrates. This type of study could be useful to evaluate effects of environmental factors like temperature, pH, and moisture in connection with different tree species on soil microbial communities.

S4.12 Effetto della cumarina sulla biomassa, l'attività e la diversità della microflora edafica

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Gli erbicidi di sintesi usati in agricoltura possono danneggiare organismi non bersaglio. Composti alternativi per il controllo delle infestanti potrebbero essere alcuni metaboliti secondari prodotti dalle piante. Tra questi, la cumarina (1,2-benzopirone), prodotta da *Melilotus neapolitana*, si è rivelata un potenziale erbicida naturale contro *Avena fatua*, che infesta le colture di grano (*Triticum durum*). Tuttavia non si può escludere un effetto negativo della cumarina su organismi non bersaglio, come i microrganismi del suolo, che svolgono un ruolo fondamentale nel riciclo dei nutrienti. Obiettivo di questo studio è stato quello di valutare l'effetto della cumarina sulla biomassa, l'attività e la diversità genetica della microflora edafica, mediante un esperimento che ha previsto l'incubazione di campioni di suolo con quantità crescenti di cumarina (0, 100, 200 e 300 mg kg⁻¹) per 4 settimane. Alle dosi utilizzate la cumarina non ha avuto effetti negativi sulla biomassa totale, la mineralizzazione dell'azoto, la nitrificazione e la diversità batterica, ed ha addirittura stimolato l'attività microbica totale. Tuttavia alle dosi maggiori di cumarina (200-300 mg kg⁻¹) è stata osservata una riduzione del micelio fungino e un'alterazione della diversità genetica della comunità fungina. Questo studio consente di escludere un effetto negativo della cumarina alla dose minore (100 mg kg⁻¹) che pertanto potrebbe essere applicata al suolo senza rischio per la microflora edafica.



S4.13 Shedding light on the neglected genetic diversity of extracellular DNA in the deep-sea floor

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Extracellular DNA pool in surface sediments represents the largest reservoir of DNA in the world oceans (0.45 Gt) exceeding for at least 10 times the concentrations of DNA contained in living cells. Previous studies have also hypothesized that the extracellular DNA pool can represent a huge archive of genetic diversity, but this hypothesis has to be proven yet. Here we provide evidence, by using a metagenomic approach, that extracellular DNA pool in deep-sea sediments worldwide (including Atlantic, Pacific and Arctic Oceans, Mediterranean and Black Seas) contains an extraordinary diversity of gene sequences, belonging to viruses, prokaryotes and eukaryotes. We also show that the genetic diversity of extracellular DNA is higher than that associated with DNA contained within living cells, suggesting that extracellular DNA pool accumulates, at different temporal scales, gene sequences of different origin (e.g., supplied by the water column). Extracellular gene pool is also characterized by a high diversity of putative functions. In particular, the most represented functions are related to the clustering-based systems, mobile elements and protein and RNA metabolism. Our findings expand our knowledge on the whole genetic diversity of the largest biome of Earth and provide new clues for the comprehension of horizontal gene transfer processes and their implications for the evolution of microbial life.

S4.14 Does viral diversity assessment in deep-sea sediments depend on the selection of bioinformatic tools?

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Viruses have been recognized as the most abundant and diversified component of aquatic environments. The development of metagenomic approaches, indeed, has provided an unprecedented level of access to viral genomes from different environments, making it possible to characterize their taxonomic and functional diversity. Despite this, viral diversity in benthic deep-sea ecosystems is still completely unknown. Multiple bioinformatic tools were leveraged to analyze viral sequences in environmental samples and evaluate performance in virome analyses. In this study we compared three metagenomic sequence annotation pipelines (MG-RAST, VMGAP, MetaVir) to test their efficiency in the analysis of viromes from different deep-sea sediment samples. MetaVir identified a higher number of viral strains compared to MG-RAST and VMGAP (80% vs.45-55%, respectively) and a different pattern of assemblage composition. Instead, contrary to MetaVir, MG-RAST and VMGAP allowed the identification of putative proteins and functions providing important information on the hypothetical metabolic role of the viromes analysed. This study indicates that the integration of information from different bioinformatic tools can help to shed light on the enormous genetic diversity contained in viruses inhabiting the largest ecosystem of Earth.



S4.15 Viral metagenomics: new insights from abyssal benthic ecosystems

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Viral assemblages are very diverse and contain a high fraction of novel sequences with unknown functions. Despite there is evidence that deep-sea sediments can contain the largest microbial diversity on Earth, viral diversity is still almost unexplored in such ecosystems. We investigated, by using a metagenomic approach (by 454 pyrosequencing technology), several viromes from different deep-sea benthic ecosystems worldwide spanning Mediterranean, Atlantic, Pacific and Arctic sediments, from bathial to hadal depths (> 6000m). We found that viral diversity in deep-sea sediments worldwide is much higher than in shallow sediments, despite at hadal depths viral diversity decreases. The vast majority of viruses belongs to dsDNA families (Siphoviridae, Myoviridae and Podoviridae) and infects prokaryotic cells. Also the putative functional diversity in the viromes investigated is very high, particularly in the Mediterranean Sea, and the most represented functions are those related to the clustering-based systems, phages and prophages and protein metabolism. All viromes contain sequences dealing with auxiliary metabolic genes (AMGs), which allow us to hypothesize the relevance of horizontal gene transfer processes in benthic deep-sea ecosystems. This study was carried out in the framework of the FIRB EXPLODIVE and RITMARE projects.

S4.16 Viral decay provides an important contribution to deep-sea ecosystem functioning

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Marine viruses represent a significant source of mortality for a wide range of organisms, and they influence the ecological processes and biogeochemical cycles of the oceans of the World. Integrating the viral component into global models of carbon cycling and nutrient regeneration is becoming a priority for an improved understanding of the functioning of marine ecosystems. Viral dynamics are the result of the balance between the rates of viral production and decay. However, while an increasing amount of information on viral production is becoming available from both pelagic and benthic systems, limited information is still available on the rates of viral decay. To provide new insights on viral dynamics, we carried out contextual measurements of viral production and decay rates in a wide variety of benthic deep-sea ecosystems, spanning a broad range of bottom water temperatures and trophic conditions. The net viral production and decay rates were significantly correlated, but viral decay did not balance viral production at any of the benthic deep-sea sites investigated. We estimated that the carbon released by viral decay significantly contributed to the total C released by virus-induced prokaryotic mortality. Viruses non-infecting prokaryotes can also remain as a potential food source for benthic consumers, suggesting that viral decay can play an important role in benthic trophodynamic and biogeochemical cycles of the largest ecosystem of Earth.



S12. Ecologia delle macrofite [S5.1-S5.4]

S5.1 Influence of mathematical transformation on ecological analysis and interpretation of macrophyte performance in lakes along depth gradient

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Underwater light regime is widely considered the principal determinant of submerged aquatic plant distribution. The majority of previous studies have singled out Secchi disk transparency values (SD) as a key empirical factor to explain the maximum depth of macrophyte colonization (Zc). In fact, few studies have investigated the role of morphology, sediment features as well as temperature in structuring macrophyte beds. Using two datasets (20 Italian lakes and 173 Norwegian lakes), we explored the relationships among Zc, transparency and morphometric traits to investigate their possible effects on macrophyte depth distribution, also in relation to a possible latitudinal effect. Our results confirm i) a direct dependence of Zc on SD values and demonstrate ii) a significant role of lake area in the descriptive linear model. However, the SD–Zc relationship was best described by a similar polynomial correlation in both Italian and Norwegian lakes, emphasizing the importance of nonlinear analysis on non-transformed data in the description of ecological trends. On the other hand, the linear relation on log-transformed data allows the construction of predictive models.

S5.2 Processi degenerativi della vegetazione acquatica in laghi eutrofici di pianura: possibili cause e feedback loop interni

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Nella maggior parte degli ambienti acquatici poco profondi del bacino padano il carico dei nutrienti causa uno sviluppo incontrollato della vegetazione acquatica. Il rapido ed esteso accumulo delle biomasse vegetali può determinare fenomeni di distrofia caratterizzati da frequente anossia e da un generalizzato deterioramento della qualità dell'ecosistema e può culminare con l'interramento degli specchi d'acqua. Le cause sono molteplici e, spesso, sono legate alla fruizione dell'ambiente acquatico e/o del territorio circostante: l'allevamento ittico e certe tipologie di pesca sportiva, i prelievi irrigui e la restituzione di acque ricche di nutrienti, scarichi non controllati, sport nautici che possono causare alterazioni del fondale e del sedimento. In numerosi casi si riscontrano anche conflitti d'uso per la presenza di habitat e specie di interesse conservazionistico. La gestione di questi ambienti richiede pertanto un supporto scientifico alle decisioni che sia in grado di individuare i processi alterati e le loro cause, in modo da poter attuare interventi sostenibili di prevenzione e/o riqualificazione. In questo lavoro vengono presentati alcuni casi di laghi soggetti a forti pressioni antropiche. In particolare per uno di essi (Lago di Fimon, Vicenza) sono riportati i risultati di uno studio della relazione tra i carichi interno ed esterno e dei possibili feedback loop che determinano lo sviluppo incontrollato delle biomasse vegetali.



S5.3 Effect of water and sediment conditions on aquatic plant diversity in marginal habitats across a human-impacted floodplain

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In Northern Italy marginal aquatic habitats have been severely degraded through land clearing, water diversion and groundwater withdrawal. However, there are a large number of small, shallow remnant aquatic habitats that still harbour a rather rich biodiversity, also within highly simplified riverscapes. Nonetheless, the available knowledge on the ecological drivers of aquatic plants in marginal habitats of altered plains remains scanty. In this framework, we presented results from a study carried out on 18 marginal aquatic habitats located along the lower Oglio River – a heavily impacted mid-size river (northern Italy) – in order to relate (i) water and sediment conditions to (ii) aquatic plant species richness. The multivariate analysis of data highlights a significant dependence of aquatic plant richness on nutrients availability in waters and to a greater extent on sediment condition. Porosity, organic matter and total P in sediments contributed to the differences in plant and vegetation richness observed. As a general rule, the increase of the availability of P (in the water column and pore-water) and the compactness of sediments is coupled with the transition between free-floating and anchored aquatic plant communities. Our data confirmed the pivotal role of physico-chemical characteristics of surficial sediments in influencing the “bioreceptivity” of water bodies to aquatic plant colonization and vegetation maintenance.

S5.4 Interactive effects of variable regimes of disturbance and replacement of canopy-forming species on rockpool assemblages

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The ongoing decline of species playing ecological key roles (e.g. habitat-forming species) and their replacement by fast-growing species, can potentially modify the ability of natural systems to resist to or to recover from disturbances. We experimentally evaluated the effect of the loss of a canopy-forming alga (*Cystoseira brachycarpa*) and its replacement by a subordinate one (*Dictyopteris membranacea*) on cover and diversity of rockpool assemblages. We manipulated the presence/absence of *Cystoseira* and *Dictyopteris* in factorial combinations within each of eight rock pools that were randomly assigned to two levels of intensity (low vs high) and two levels of temporal aggregation of disturbance, generated by scouring of boulders (press vs pulse, simulating the effect of a natural regime vs a temporal aggregation of large storm events), in a factorial design. Boulders were continuously removed from four additional pools (controls). Once *Cystoseira* was removed, *Dictyopteris* was able to replace it and to reduce assemblage diversity, likely due to its fast growth and resistance to the imposed disturbance treatments, except to the press, low intensity one. Algal turfs consistently increased in abundance in the absence of *Cystoseira* and *Dictyopteris*, suggesting that turf-dominated assemblages represent a contrasting state to canopy-dominated ones in these rockpools.



S13. Ecologia quantitativa [S6.1-S6.24]

S6.1 A model-based approach to lagoon ecosystem classification

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The ecological status of aquatic ecosystems is defined in terms of the quality of the biological community, as well as of the supporting hydrological and chemical characteristics. Several simple indicators and multimetric indices, combining simple indices as multiple sources of information, account for the composition and abundance of biological communities and are widely used in the ecological literature. We focus on three multimetric indices dealing with the benthic macroinvertebrates, as sensitive biological quality element: M-AMBI, BITS and ISS that are likely to respond differently to different sources of natural and anthropogenic variability. To understand what drives multimetric indices disagree in classifying lagoons' ecological status, Statistical models linking multimetric indices values and ecological status categories with environmental variables have been used as suitable tools to address drivers of multimetric indices classification of lagoons' ecological status. Here we adopt two Bayesian hierarchical models, allowing for the inclusion of multiple sources of information and external prior knowledge.

S6.2 Eel population assessment in the Comacchio Lagoon: evidences of stock collapse

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Aim of the study was to assess the present conditions of the eel stock in the Comacchio lagoon (north-eastern Adriatic, Italy). Analysis was performed using meristic and age data of yellow and silver eels sampled in 2011. Silver eels were all caught at the beginning of migration (November-December) using two fixed trap structures, locally called "lavioreri" and located on the two canals which connect the basin to the sea, while yellow eels were caught using 20 modified fyke nets, locally called "cogolli", homogeneously distributed on the whole lagoon surface, in September-October, before migration. Modelling techniques were used to assess the stock of yellow eels, recruitment, survival and metamorphosis rates. The results indicate a yellow eel density of 6.11 individuals per hectare (ind. ha⁻¹) and a total abundance of yellow+silver eel of 6.67 ind. ha⁻¹. The recruitment in the same year was estimated in 3.43 ind. ha⁻¹. The comparison of the 2011 results with the ones of Rossi (1979) evidenced the collapse of the stock with a drastic change in all population parameters as growth age distribution, sex ratio and sex differentiation age. Results are discussed with respect to the measures for the application of the Regional and National Plans and the Council Regulation (EC) No 1100/2007 of 18 September 2007, establishing measures for the recovery of the stock of European eel.



S6.3 Early warning signals of impending regime shifts: experimental evidence of critical slowing down in a marine ecosystem

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Anticipating critical transitions in complex systems such as financial markets, the climate and ecosystems is crucial for human well-being. Recovery from small perturbations should decrease in complex systems approaching a tipping point, a phenomenon known as critical slowing down. This theoretical expectation has led to the proposition of early warning signals of impending regime shifts, such as rising temporal autocorrelation and variance of state variables. Laboratory experiments have shown how recovery rates of cyanobacteria and yeast populations reflect the proximity to a tipping point along a gradient of degrading environmental conditions, providing strong empirical support to critical slowing down. Here, we provide an empirical test of critical slowing down using data from a long-term (7 years) ecological experiment in a rocky intertidal community where reduced biomass of algal canopies promotes invasion of turf-forming algae driving understory assemblages towards collapse. Our results show how recovery of the system from small perturbations decreased along the gradient of canopy degradation, whereas temporal autocorrelation, variance and skewness increased as predicted by theory. These results illustrate the suitability of the proposed early warning signals for critical transitions to anticipate regime shifts in natural populations and pave the way for further experimental evaluation of critical slowing down in real ecosystems.

S6.4 Best Practicable Aggregation of Species (BestAgg): A step forward for species surrogacy in environmental assessment and monitoring

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The available taxonomic expertise and knowledge of species is still inadequate to cope with the urgent need for cost-effective methods to quantifying community response to natural and anthropogenic drivers of change. So far, the mainstream approach to overcome these impediments has focused on using higher taxa as surrogates for species. However, the use of such taxonomic surrogates often limits inferences about the causality of observed community patterns, which in turn is essential for effective environmental management strategies. Here we propose an alternative approach to species surrogacy in which surrogates exulate from fixed taxonomic schemes. The approach is based on null models from random aggregations of species and minimizes the number of surrogates without causing a significant loss of information on community patterns. Surrogate types are then selected in order to maximize ecological information. We applied the approach to real case studies on natural and human-driven gradients from marine benthic communities. Results showed that this approach is effective in detecting community changes allowing additional timesaving during sample processing up to 25% higher than when using classical taxonomic surrogates. The approach is virtually applicable to any environmental context, allowing exploiting alternative and multiple surrogacy schemes beyond stagnant perspectives strictly relying on taxonomic relatedness among species. This prerogative is crucial to extend the concept of species surrogacy to ecological traits of species, thus leading to ecologically meaningful surrogates that, while representing cost-effective tools in reflecting community patterns, may contribute also to unveil underlying processes.



S6.5 A stochastic equation with infinite components: an approach to evaluate the intrinsic stochasticity in ecosystemic assessments

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Ecosystems are complex systems as for number of components and connectivity degree. Many complex systems show non-equilibrium fluctuations, often determining the spontaneous evolution towards a critical state. The knowledge of the processes which could lead to permanent or temporary changes of ecosystems' state is relevant. Moreover variability of environmental changes could increase because of the global climate change. Rigorous mathematical analysis, numerous computer simulations and an increasing number of field experiments have been bridging the longstanding gap between deterministic and probabilistic descriptions in ecosystemic assessments. Therefore it is fundamental to endow oneself with effective methodological tools for understanding ecosystem dynamics and forecasting ecosystem evolution in response to natural and anthropogenic extreme events. By hybridization of fuzzy logic and Bayesian analysis, we derived a stochastic equation with infinite components able to describe linear, nonlinear and chaotic dynamics involved in the assessment behaviour of environmental systems. Understanding non-linearity in the basin jumps in the ecosystem dynamics is essential for proper management and effective monitoring.

S6.6 Ruolo di produttori primari e detrito in relazione alla pesca nel lago Burullus (Delta del Nilo, Egitto), analizzato mediante un modello di rete trofica

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Il ruolo giocato da produttori primari e detrito nel sostenere la pesca nel lago di Burullus, è stato analizzato mediante l'applicazione di un modello di rete trofica. La ricostruzione dei flussi di materia è stata realizzata a partire da una serie di dati provenienti da studi sito-specifici, condotti nei primi anni 2000. Le specie sono state aggregate in 15 gruppi funzionali, sulla base di analogie di taglia e di ecologia trofica. Il sistema di equazioni lineari che definisce il bilancio di massa è risultato essere sotto-determinato, ed è quindi stato risolto utilizzando una metodologia di ottimizzazione vincolata. I vincoli sono stati definiti sulla base di conoscenze eco-fisiologiche sul funzionamento del sistema (efficienze di assimilazione, ecotrofica, etc.) ed informazioni sito-specifiche, riguardanti catture e produttività primaria. Una successiva *network analysis* ha consentito di derivare un insieme di indicatori di funzionamento della rete, di potenziale interesse nel contesto dell'implementazione dell'approccio promosso da UNEP-MAP per la valutazione ed il monitoraggio dello stato dell'ecosistema. I risultati ottenuti suggeriscono che una frazione rilevante della produzione primaria non venga trasferita ai livelli trofici superiori attraverso la catena del pascolo, ma sia prima accumulata nel detrito. Questa via del detrito sembra quindi giocare un ruolo fondamentale nel sostenere le catture dell'attività di pesca nel lago.

S6.7 Hierarchical modelling of ecological processes: a case study

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In this work we propose a Bayesian hierarchical approach for modelling species distributions in the priority habitat "6110* Rupicolous calcareous or basophilic grasslands of the *Alyso-Sedion albi*" included in the Habitat Directive (92/43/CEE). Usually, in plant ecology observational studies, data are collected on spatial plots and sub-plots, which are regular grids composed by cells. Our dataset consists of observations concerning the occurrence of several vascular plants species, along with substrate classification, on a spatial plot of 300 by 300 cells. Measurements are taken at several subsequent times. Our target is modeling raster data: the main aim is to evaluate the effect of environmental covariates on species distribution. Particular focus is on the variability of *Sedum rupestre* within the habitat. Different spatial behaviour of species with respect to the type of soil and elevation is assumed. Some spatial and spatiotemporal models are proposed in order to evaluate the behaviour of species occurrence with respect to substrate classification. Since we manage a large spatial dataset, some efficient algorithms are adopted in order to improve the speed in the estimation of the Bayesian model.

S6.8 Limiting factors for macroinvertebrate assemblages in Lombardy streams: the quantile regression approach

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The individuation of which factors set limits to river biological community development and their specific weight is of great interest for management and restoration of impaired rivers. We analysed a large database with macroinvertebrate data and environmental variables from 357 river sites coming from the four-year long institutional survey conducted by ARPA Lombardia in the whole region. The database includes sites with pristine conditions and heavily modified sites in urban areas. The quality of the biological communities shows high data variability not only because of different impairment of sites, but also due to many other factors and also data stochasticity. In these conditions, classic statistical approaches may become uninformative. Quantile regression enables the various stressors to be considered as constraints to the development of biological communities, without compromising the model causal relationship. We used quantile regression to analyse the effects of alterations on several biological and ecological metrics, such as taxonomical, functional, diversity and richness attributes of communities. These metrics generally presented a scatter distribution along environmental gradients, due to the presence of many sources of variation and high data variability. Using quantile regression, the role of many alterations was defined as a constraint to the biotic distribution, and threshold values were set in order to achieve the good ecological status.

S6.9 Complex patterns of spatial distribution of epilithic microphytobenthos on a Mediterranean rocky shore

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Understanding how patterns and processes relate across spatial scales is one of the major goals in ecology. $1/f$ models have been applied mostly to time series of environmental and ecological variables, but they can be also be used to depict complex spatial patterns in population abundance. Since $1/f$ noises may display scale-invariant behaviour, ecological phenomena whose spatial variability shows $1/f$ type scaling are susceptible to further characterization using fractals or multifractals. Here we use spectral analysis and multifractal techniques (generalized dimension spectrum) to investigate the spatial distribution of epilithic microphytobenthos (EMPB), which develops in complex patterns on rocky intertidal surfaces. Spatially continuous measurements of the amount of chlorophyll *a* on the rock (used here as a proxy of EMPB biomass) were obtained from calibrated colour-infrared images of 3 transects, either 4 or 8 meters in length, sampled twice between January and November 2012. Results showed a pattern of near pink spectra ($\beta \sim 1$) for EMPB biomass distribution, that was consistent among transects, implying scale-invariance in the spatial distribution of EMPB. Multifractal analysis confirmed these results and highlighted a different scaling behaviour for low and high biomass patches. These outcomes can be interpreted as a footprint of complexity and suggest that some kind of criticality may be operating in the development and self-maintenance of a EMPB community.

S6.10 Predation on sea urchin by *Marthasterias glacialis* (L.)

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Asteroids, popularly known as starfish or sea stars, by virtue of their crucial role in shaping the structure and functioning of benthic ecosystems, are largely recognized as important predators in all of the world's oceans. The spiny starfish *Marthasterias glacialis* is usually mentioned in Northern Europe and Mediterranean Sea as a predator of bivalves. Recent papers showed that *M. glacialis* might play an important role in controlling sea urchin population and sex ratio. The aim of this study was to investigate on the feeding ecology of *M. glacialis* in the Marine Protected Area of Ustica Island. The diet was studied by both direct observations in the field and stable isotope analysis (SIA). SIA was also performed on the potential assemblage of the starfish preys. Starfish density was estimated and correlated with environmental factors. The most abundant prey were bivalves (38.1%) and sea urchin (31.4%). Diet was affected by starfish size. Large starfish (tip-to-tip diameter > 27 cm) fed preferentially (79.5%) on sea urchin *Paracentrotus lividus* and *Arbacia lixula*. SIA corroborated this finding as highlighted by $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values and by food resource partitioning elaborated using mixing models. Starfish density was influenced by environmental factors, such as barren percentage cover and the slope of the sea bottom. We suppose that these factors, particularly the percentage cover of barren, determined the success of *M. glacialis* in controlling sea urchin population at Ustica Island.



S6.11 Assessing physical habitat characteristics as limiting factors on brown trout (*Salmo trutta*) density

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The relations among brown trout densities and environmental variables have been deeply studied in freshwater ecosystems. These density–environment relations can be used in habitat-based association models to understand ecological dynamics and to predict changes in biological communities, especially when human-induced alterations are involved. However, the models proposed in literature are based on the study of the mean response, deliver information only about the preferences for certain habitat variables and are sometimes based on qualitative sampling. Habitat selection predictive models often do not account for ecological dynamics, especially density dependent processes. In stage-structured population, the strength of density dependent interactions between individuals of different age classes can exert a profound influence. The models produced in this work are based on the study of the limiting response and deliver information about the density that can be reasonably expected for each value of the considered habitat variable. In order to produce quantitative habitat suitability curves, a new sampling procedure has been performed and the acquired data were analyzed using quantile regression. The aim of this work is to demonstrate how the use of quantitative data and quantile regression analysis can be useful to describe the action of hydraulic variables and competition process on brown trout density in Alpine streams, where the flow can be considered as the main driving force.

S6.12 Effect of global warming on Mediterranean demersal communities: the case of *Parapenaeus longirostris* along the western coasts of Italy as indicator species for global warming in Mediterranean Sea

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The effect of temperature increase on the stock of the deep-sea pink shrimp was analysed along the western coasts of Italy. This crustacean is currently one of the most important commercial species of the trawl fisheries in the Mediterranean Sea. Landings of the species in the North Tyrrhenian-Ligurian Sea have grown consistently during the last years following a rapid increase in the stock size. Since the deep-sea pink shrimp stock is exploited on the same fishing ground of other heavily overexploited stocks in a full mixed and poorly selective fishery, its condition seems to be largely independent of the current fishing exploitation pattern suggesting a positive role of the ongoing environmental change on the dynamic of the stock. To test this hypothesis we investigated the effect of sea surface temperature (SST) on density and distribution of *P. longirostris* in the North Tyrrhenian-Ligurian Sea by means of general additive models (GAMs). Two different models were developed for the whole stock and recruits (CL<20 mm) using time series of Medits trawl survey density indices (n km⁻²) covering the period 1995-2010. Predictors included, geographical coordinates, quarterly averaged minimum SST, sampling depth and year. Spawners density was included into the GAM model for recruits. Although the GAMs output return interesting results, we are currently implementing Bayesian models to improve the understanding of the interaction between the deep-sea pink shrimp and temperatures.



S6.13 Valutazione del rischio di dispersione di specie non-indigene dovuto alla nautica da diporto con un modello fuzzy a due livelli

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La navigazione da diporto è un importante vettore di dispersione secondaria di specie non indigene (NIS) in ambiente marino. A seconda delle abitudini di manutenzione e spostamento di un'imbarcazione, però, il rischio effettivo può variare notevolmente. Natanti tenuti in secca o soggetti a frequente manutenzione, che operano solo spostamenti locali, hanno un rischio basso. Natanti rimasti in acqua per anni, non sottoposti per lungo tempo a pulizia e trattamento con vernici antivegetative, trasferiti via mare verso un areale biogeografico diverso, ad esempio in seguito a vendita, hanno invece un rischio elevato. Sulla base di queste assunzioni, è stato sviluppato un modello che quantifica il rischio di dispersione di NIS; per la natura qualitativa del dato utilizzato, è stato utilizzato l'approccio *fuzzy logic*. Il modello è strutturato su due livelli: nel primo livello si analizzano separatamente (i) il rischio che sul natante si sia sviluppato fouling (dati input: frequenza di pulizia e trattamento antifouling, tempo di permanenza in acqua, tempo di permanenza in secca, tipo di imbarcazione), e (ii) il rischio di dispersione verso nuovi areali (dati input: tragitti percorsi, frequenza degli spostamenti). Nel secondo livello, i valori parziali di rischio (i) e (ii), calcolati nel range 0-100, sono combinati per ottenere un rischio complessivo, anch'esso variabile tra 0 e 100. Il modello è in corso di validazione con dati raccolti da interviste ai proprietari di imbarcazioni.

S6.14 Assessing larval connectivity patterns in the Northern Line Islands: a long-term analysis with Lagrangian simulations

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Coral reefs are among the most diversified ecosystems of our planet. Spatial connectivity patterns among different reefs are determined by water circulation in the ocean. As such, climate change might seriously affect connectivity by influencing flows and currents. Assessing whether, and to what extent, larval dispersal could be altered represents an important challenge. This is particularly true for remote Pacific Islands, i.e. small states whose survival is based on the protection of their natural resources. Here we use Lagrangian simulations to study past, present and future connectivity patterns among the five islands of the Northern Line Islands archipelago, located in the Central Pacific Ocean. In particular, we focus our attention on Palmyra Atoll, a US natural reserve that can play a major role in conservation. We discuss how connectivity from and to Palmyra Atoll changes through the months of the year and how it is influenced by the Pelagic Larval Duration (PLD) of the dispersing species. Despite the long distances involved (on the order of thousands of kilometers), we find non negligible connections even between islands that are far apart, and for reasonable PLDs (from a few weeks to three months). As for the long-term scenarios, our simulations over the time horizon 1970-2098 do not reveal (at present) any clear trend, although some peaks in connectivities seem to emerge out of erratic patterns.



S6.15 Impacts of long-term changes in oceanic circulation on European eel recruitment

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Changes in the oceanic environment are indicated as one of the multiple factors contributing to the decline of the global European eel stock observed since the late 1970s. In particular, climate change is suspected to have affected the larval migration of this catadromous fish from reproductive areas in the Sargasso Sea to European shelves. In this work, we used an individual-based coupled physical-biological model to study the impact of ocean circulation on the geographical distribution and recruitment success of eel larvae. We ran Lagrangian simulations over the period 1958-2000 to test if migration duration, migration success, and latitudinal distribution of arrivals have changed over the last half century. Results show wide inter-annual variation, but no significant trend in the probability of success during the study period, while we detected a weakly significant, decreasing trend in migration duration (-6 days/year) and a strongly significant, decreasing trend in mean latitude of arrivals (-0.25° /year). High plasticity in vital traits makes eels tolerant to large environmental variation, but a change in the migration schedule may have caused a desynchronization with environmental cycles. On the other hand, a southward shift of arrivals would have displaced a larger proportion of the stock towards the Mediterranean Sea, with the probable effect of shortening the duration of the continental phase of the eel's life cycle.

S6.16 Effects of climate and population density on the fertility components of the Black grouse (*Tetrao tetrix*) in the Piedmont region (Italy)

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The black grouse (*Tetrao tetrix*) is a highly sensitive species to both human disturbance and climatic conditions. Previous studies outlined the importance of winter snow, that must be sufficiently abundant to let individuals dig their dens, and good meteorological conditions in the post-hatching period. Using census data from 2001 to 2009, collected in all the 17 Alpine districts of the Piedmont region (Italy), here we focus on three different components of fertility: percentage of nesting females (ψ_t), brood size (Φ_t) and breeding success (ρ_t). First, we cluster the districts where fertility components are similar. Then we develop predictive models using Bayesian Model Averaging techniques (BMA) and project the fertility components in future decades, using the IPCC climate scenario (A1B). We find that male population density significantly affects Φ_t and ρ_t , but not ψ_t . Also, the between-districts differences are negligible for ψ_t , significant for ρ_t and crucially important for Φ_t . Our results provide quantitative support for the importance of meteorological conditions in the post hatching period for ψ_t (positively affected by high temperature ranges) and ρ_t (negatively affected by high temperatures or low rainfalls). Moreover, ρ_t is positively affected by high temperatures in late November of the previous year, while Φ_t is negatively affected by high temperatures in late January, probably because of snow melting.



S6.17 Genetic structuring of red coral (*Corallium rubrum* L. 1758) recruits in a submarine cave

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For sessile marine organisms, understand the factors determining larval settlement and the inter- and intra-specific interactions during their initial stages of life is crucial to comprehend the distribution and density of the individuals. *Corallium rubrum* is an Atlantic/Mediterranean arborescent cnidarian with a patchy bathymetrical distribution. Because of its high economic value, red coral colonies have long been harvested, and nowadays most populations are greatly depleted. The aim of the study was to evaluate the spatial and temporal variability of the red coral settlers within a submarine cave using both demographic and genetic approaches. Submarine caves are small, accessible, stable habitat units and are thus good models to study the early stages of the life cycle. In June 2010 sixteen white PVC tiles were placed on the walls and ceiling of the Colombara cave (San Fruttuoso, GE). Tiles were removed in winter 2012 and all the settlers were counted and two recruitment events were recorded. Of the 389 settlers, basal diameter, height and numbers of polyps were measured. Differences of these parameters were carried out depending on temporal and spatial variability inside the cave. Individuals were genotyped using 8 species specific microsatellite loci and spatial, temporal genetic variability and structuring between tiles were detected. This study represents a step towards a better understanding of the ecological processes acting on red coral, including the environmental factors and biological processes which regulate their life and distribution.

S6.18 The challenge of spatial ecology in fisheries science: models for the assessment and management of disturbance and impacts through the analysis of fishing effort

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Anthropogenic impacts of fisheries can be summarized in two main issues: additional mortality on exploited populations and physical disturbance (or loss) on habitats. Furthermore, the assessment and management of fisheries are moving toward spatially explicit approaches in which both the impact of fishing activities and the response of resources and environments in space are taken into consideration and modelled. This is definitively aimed at reaching sustainable level of fishing pressure. During last years, we contributed to the development of a suite of tools and models for the analysis of geo-referenced data about the activity of the Italian commercial fishing fleet (i.e. the information gathered by the Vessel Monitoring System). The tools have been aimed at analysing fishermen behaviours under different bio-economic scenarios, while the developed models integrate fishing effort pattern as factor to predict resources trends in the near future and then evaluate different management scenarios in view of more sustainable approaches to fisheries. A short review of the progressive development of this kind of approaches, looking at the insights of the Italian experience, is presented. Main research findings, evidencing strengths, weaknesses, opportunities and threats of this frontier framework in fisheries science are discussed.



S6.19 Mechanistic bioenergetics models to link functional traits to population dynamics: a study case with a marine bivalve

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The persistence of a species is intimately dependent on the maximum reachable body size (Bs) and the fecundity (Fe) that the most elements belonging to population reach in a colonized habitat. Components of the energy budget (e.g. maintenance cost) are functional traits (FT) involved in the optimization of Bs and Fe of all living organisms. These traits are important life history end-points primarily determining the amount of viable off-springs by which a species may spread throughout the fundamental niche and play a role inside ecological communities. Here, we try to link FT to populations by means a combination of experimental and modeling approaches to answer to the crucial question on how FT drive dynamics at the upper levels of ecological hierarchy. We experimentally measured FT of 120 *Brachidontes pharaonis*, an invasive bivalve of some western Sicily ponds. FTs were used to feed a mechanistic model to estimate Bs and Fe; Fe estimates, in turn, were used to feed the simplest population model (a closed population - no immigration or emigration, a constant environment, and density-independent growth). We assumed our 120 individuals as a founder group and starting from their individual Fe, we run models to estimate the colonization of pond. We show that starting from that small founder nucleus in only few years, population density reached thousands of individuals as observed in field. This supports the idea that mechanistically linking FT to populations may be beneficial in a context of predictions of global changes effects on ecological equilibriums.

S6.20 Coupling oceanography and genetics to assess the connectivity of European green crab populations in the Adriatic Sea

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Identifying the spatio/temporal scale of connectivity among populations is crucial to understand the factors driving population dynamics, dispersal patterns and gene flow in marine species. Coupled physical biological models are increasingly used to investigate larval dispersal and contrast alternative hypotheses by simulation. We coupled individual-based Lagrangian simulations incorporating early-life-history traits with a genetic marker analysis to investigate larval dispersal patterns of the European green crab (*Carcinus aestuarii*) in the Adriatic Sea and study the connectivity among seven locations during three years (2006-2008). The coupled physical biological model explicitly allowed for pelagic larval duration, diel vertical migration and synchronization between reproduction and moon phases and provided an assessment of oceanographic connectivity. Genetic analyses, based on eleven polymorphic microsatellite loci, tested for genetic divergence among populations using pairwise F_{ST} and AMOVA. We eventually compared connectivity matrices resulting from the two approaches to point out the role of Adriatic Sea currents in determining retention and spillover patterns and their consequences on the genetic structure of the local European green crab populations. Results revealed the existence of weak but significant differentiation patterns, with three significantly differentiated groups of samples reflecting a oceanographic subdivision of the Adriatic Sea into three sub-basins.

S6.21 Estimation of canopy defoliation in Europe through an integrated approach based on non-linear modelling approaches

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Defoliation is one of the most important parameters monitored in the International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests). Defoliation is a morphological damage affecting the green biomass of plants and its assessment attempts to quantify foliage missing as an effect of several stressors including air pollutants. Nowadays, correlations found between tree canopy defoliation, air pollution and meteorological variables are weak or not significant in Europe. The study aims to evaluate the most important factors (air pollution and meteorological variables) affecting the defoliation of the most common European species (*Fagus sylvatica*, *Picea abies*, *Quercus ilex*, *Pinus sylvestris*, *Quercus petraea*), through a statistical approach based on Random Forest Analysis (RFA) and to predict the canopy defoliation by the application of linear and non-linear statistical models. Results based on RFA showed that defoliation was mainly related to meteorological variables in *P. abies*, whereas in *Q. ilex* it was linked to air pollution predictors. Canopy defoliation was similarly linked to meteorological and air pollution in *F. sylvatica*, *P. sylvestris* and *Q. petraea*. Moreover, results suggested that linear models were not able to predict the defoliation monitored in the test sites for all considered species. Conversely, non-linear regression models were more useful for modelling canopy defoliation giving highly promising results.

S6.22 Analisi dell'incertezza nello sviluppo di indici biotici multimetrici basati sulla fauna ittica

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La valutazione dello stato ecologico degli ecosistemi effettuata attraverso l'impiego di indici multimetrici continua a suscitare grande interesse tra la comunità scientifica, i gestori e le autorità competenti. Lo stimolo delle recenti normative europee ha, infatti, favorito l'incremento di studi mirati ad indagare diversi aspetti di questo approccio, come la risposta alle pressioni e la robustezza degli strumenti sviluppati. Lo scopo di questo studio è quello di valutare come le scelte metodologiche adottate nella fase di sviluppo influenzino la procedura di messa a punto di un indice. In particolare è stata condotta un'analisi dell'incertezza associata alle seguenti fasi: 1) preselezione delle variabili; 2) pretrattamento delle variabili; 3) aggregazione delle variabili. Sulla base di un protocollo incentrato sulle regressioni ai quantili e utilizzando dati di fauna ittica della laguna di Venezia come caso di studio, 100 simulazioni bootstrap sono state utilizzate per sviluppare gli indici per tutte le possibili combinazioni dei fattori considerati. I principali risultati indicano che la strategia di selezione delle metriche è il fattore più importante, influenzando soprattutto la struttura dell'indice, ma che gli indici sono piuttosto robusti come strumenti di classificazione dello stato ecologico. L'approccio messo a punto può inoltre essere utile nel supportare la scelta di un indice robusto, sensibile alle pressioni antropiche e interpretabile dal punto di vista ecologico.



S6.23 Long-distance dispersal capability of lesser flamingo (*Phoeniconaias minor*) across Indian and African populations: ecological and genetic inferences.

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Many highly mobile species can move and disperse over long distances, enhancing gene flow and reducing the genetic differentiation between isolated population. Movement capabilities may enable dispersal across wide geographic ranges, but gene flow may be restricted by cryptic barriers. In the present study, we examined pattern of genetic differentiation of lesser flamingo (*Phoeniconaias minor*), a colonial and vagrant waterbird confined to the Old World. We assessed population genetic structure and provide a first insight into geographic connections between the three major breeding populations. Blood and plucked feathers from 80 lesser flamingos, sampled from Lake Bogoria (Kenya), Rann of Kachchh (Gujarat, India) and Makgadikgadi Sua Pan (Botswana), were analysed using mitochondrial and microsatellite markers. Low levels of polymorphism, showing a 'radial pattern' around the widespread haplotype, and the mismatch distribution analyses indicated that populations have each undergone bottlenecks followed by rapid growth and expansion. The use of six variable microsatellite markers revealed high levels of allelic richness. Restricted genetic differentiation among Gujarat and Botswana breeding populations were detected using both markers, but the estimation of gene flow across the African and Indian populations supported longdistance dispersal capability of erratic lesser flamingo, providing an example of range-wide dispersal in a non-migratory bird.

S6.24 Exploitation Dynamics in small pelagic fishery in northern-central Adriatic Sea: where to search the fish?

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When the goal of fishery management is to preserve populations, the anthropogenic component of mortality (i.e. the humans as predators), cannot be ignored. Fishermen evolved and modulate individual and cooperative strategies to find and harvest resources. In small pelagic fishery, this is reflected by the challenge of harvesting resources which are moving into the space. Thus, searching for (often sparse) resources leads to a decision-making process regulated by information about biological (pattern of resources distribution), economic (costs, revenue) and institutional factors (regulation laws). This study presents a bio-economic model devised to simulate and predict fishing strategy adopted by the mid pair trawl ("volante") fleet in the Adriatic Sea during the resources searching. The model is based on high spatially-resolved data of fishing activities and apply the Game Theory's rationale to analyze the fleet strategies under different bio-economic scenarios, even identifying equilibrium points for different combinations of external factors (fuel and fish market prices, above all). The results show that fleet strategies are well adapted to respond at changing system's conditions and that the effort level is almost completely determined by returns/costs ratio. The findings indicate that the case of study falls within the concept of "tragedy of common resources" and that other exploitation systems should be applied to guarantee sustainability of this activity.



S14. Stress ambientali e servizi ecosistemici [S7.1-S7.20]

S7.1 Spread of alien plants across protected areas in Sicily: are ecosystem services at risk?

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After habitat alteration, biological invasion by non-native species is one of the major contributors to local and global loss of indigenous biological diversity. In particular, impacts of alien species are of utmost concern to managers of protected areas because the mandate of these areas is to conserve native biodiversity and ecosystem processes. Invasive species can threaten biological diversity in various ways, from reducing genetic variation and eroding gene pools, through the extinction of endemic species, and by altering habitat and ecosystem functioning. Although the mechanisms of biological invasions are relatively well known, the impact of alien species on ecosystem services is still poorly studied. Biological invasions can indeed cause economic impacts that can be valued as financial costs, based on expert extrapolations of high-profile alien pests. Ecological and economic impacts of invasions are rarely compared within or between either geographic regions or taxonomic groups. Even with increasing information, we still do not know the extent to which these impacts are correlated. This information is essential for prioritizing management actions. In particular, this study showed the preliminary investigation of the impact on the ecosystem services of three protected wetlands in Sicily, due to the spread of these alien plant species: *Pennisetum setaceum*, *Acacia karroo*, and *Carpobrotus* ssp.

S7.2 Agricultural ecosystem services, an opportunity for C mitigation and sustainable economic development: the IAGRICO2 approach

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Agroecosystems are generally regarded as one of the main sources of greenhouse gases. C and N cycle in agroecosystems are mostly altered by management practices which tend to stimulate soil organic decomposition and C loss, introduce extra reactive N and C into the environment which leads to GHGs direct and indirect emissions. However, this general assumption can have important exceptions. Depending on management practices and agroecosystem type the overall net exchange of CO₂ equivalents in the ecosystem (GHGs) can result into net gains of CO₂e rather than losses. The carbon footprint of the agroecosystem is an index which easily resumes the total amount of C-CO₂e net exchanges in the ecosystems in terms of GHG fluxes in and out. Here we propose a new methodological framework for calculation of the C footprint (IAGRICO2) of agroproducts, developed in the context of the RRN (Rete Rurale Nazionale, MIPAF) which can be applied to quantify the potentiality of agroecosystems for C mitigation, to improve the management of the agro-production chain so to have more environmental sustainable products.



S7.3 Competing Ecosystem Services related to biomass supply chain: the case of the Province of Rovigo (Veneto Region)

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Biomass production constitutes a relevant Ecosystem Service (ES) which is currently exploited to produce renewable energy. In order to reach European Union climate and energy targets for 2020, each Member State has adopted a proper National strategy and has divided targets through burden sharing at regional level based on territorial energy potentials. Theoretical potentials have been reduced according to environmental constraints (e.g. Nature 2000 sites), towards “reliable” potential. However, cumulative impacts from feedstock supply chain at territorial level, as well as competing anthropogenic uses on natural resources and related ES, are not yet taken into consideration while calculating energy potential, and so in localizing new biomass plants to achieve 20-20-20 EU targets. The present paper aims at evaluating conflicts between ES provision with respect to biomass production, as well as on operational and management aspects, to consider cumulative impacts related to the feedstock supply chain for energy production. The paper discusses conflicts between competing ES related to soil capacity and productivity, land use changes, hydrological balance, supporting biodiversity, as well as management bottlenecks for the Province of Rovigo (Veneto Region). Some conclusions are drawn on ecological criteria in biomass plants localization to assess “sustainable” bioenergy potential.

S7.4 Piccoli servizi su aree vaste: necessità di nuovi paradigmi per il reticolo idrografico secondario

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In ragione della notevole estensione lineare e della capillarità con cui si sviluppano sul territorio, nel contesto del bacino padano i canali del reticolo idrografico secondario possono essere identificati come il più importante elemento di connessione tra ambiente terrestre e corpi idrici principali. Nel contempo sono anche i primi recettori dei carichi inquinanti, soprattutto di quelli diffusi. Allo stato attuale, il sistema dei canali è gestito allo scopo di garantire la capacità di trasporto dell'acqua a fini irrigui e di sicurezza idraulica, tramite interventi di rimozione periodica della vegetazione acquatica e sponale. Sono invece scarsamente valorizzati i servizi ecosistemici offerti da questi elementi del paesaggio, in particolare quelli metabolici (trasformazione e abbattimento dei carichi inquinanti), di conservazione della biodiversità e di integrazione del microreddito locale. Vengono presentati tre esempi, a diverse scale spaziali, relativi a 1) potenzialità del reticolo di dissipare azoto, 2) analisi costi-benefici della gestione attiva della vegetazione sponale a fini energetici, 3) controllo dei nutrienti e dei gas serra mediato dalle interazioni tra radici, comunità microbiche e macrofauna. La valorizzazione del reticolo secondario richiede un approccio culturale nuovo da parte di enti gestori, amministrazioni e comunità scientifica, che si traduca in una più stretta integrazione tra la gestione dei bacini idrografici e degli ambienti marino-costieri.



S7.5 Application of the INFFER framework to assess agri-environmental measures promoting the provision of ecosystems services from farming activities in the Natural Reserve of Lucciola Bella, Tuscany

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Agricultural ecosystems provide services essential to human wellbeing as well as to support biodiversity, regulation of soil and water quality and carbon sequestration. At the same time, depending on management practices, agriculture can also be the source of numerous disservices, loss of wildlife habitat being one of the most significant. There is an urgent need for design tools to direct public investment towards effective measures to increase agroecosystem services while reducing negative externalities. This paper reports on the application of an environmental investment framework based on benefit:cost analysis principles (called INFFER) to compare alternative agri-environmental payment schemes in the Natural Reserve of Lucciola Bella, Tuscany. The current agri-environmental payment scheme was compared to an alternative scheme, locally targeted to promote the protection of endangered steppic avifauna habitats in the reserve. Only the alternative scheme was calculated to be a cost-effective project (benefit:cost ratio>1). The analysis showed that to increase the effectiveness of agri-environmental measures in the reserve at the current levels of public investment, payments per unit of land area would need to be increased and concentrated in areas of best habitat for endangered avifauna. Conclusions were able to draw on the potential use of INFFER for optimal design of Natura 2000 payment schemes within the framework of EU regional rural development plans.

S7.6 Maritime Spatial Planning as a tool for Ecosystem Based Management of Marine Environments: bottlenecks and barriers towards an effective implementation in Italy

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According to the Framework Proposal for the Directive COM(2013)133, Maritime Spatial Planning (MSP) has been envisaged as a tool to implement Ecosystem Based Management (EBM) approach towards the sustainable governance of marine waters, aiming at spatially and temporally allocating resources to support Blue Growth. The process of EBM establishes not only principles of biodiversity conservation, but informs with ecological assumptions and considerations according to ecosystem functioning the entire process of planning and management, based on stakeholders participation, acquiring the key principles of adaptive management. However, the recent applications of MSP have put in relevance several barriers and bottlenecks towards the implementation of the tool according to EBM principles, such as boundaries mismatches, data gathering, data gaps and policy-science communication gaps. Moreover, the general issue on how ecological dynamics can significantly inform the decision making process is emerging to achieve an effective integration between chains of stressors, impacts and environmental dynamics with planning regimes. The present paper analyzes MSP experiences recently adopted according to EBM principles, picturing some hypotheses for an effective implementation of MSP in Italy, considering the case of Abruzzo Region coastal and marine waters (central Adriatic Sea) through the discussion with local actors and stakeholders. Finally, some conclusions are drawn according to the contents of the MSP framework directive.



S7.7 Livestock manure sustainability in a Nitrogen Vulnerable Zone (NVZ): evaluation of environmental impact costs

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Starting from 1957 the European common policies have impressed a drastic change to EU Countries agriculture and manure practices with the promulgation of CAP (Common Agricultural Policy) rules. CAP introduced directives oriented to environmental protection that progressively were implemented at the beginning of 1990th. In 1991 was then approved the Nitrate Directive, linking agriculture and zootechnique practices through the regulation of the amount of soil applied nitrogen in farming via livestock manure. Nitrate Directive imposed to EU countries both to identify Nitrogen Vulnerable Zone (NVZ) and to establish adequate measures for these areas. Furthermore the EU measures for NVZ areas imposed a limit of 170 kg h⁻¹ yr⁻¹ to the applied nitrogen to prevent soil and water eutrophication. The Nitrate Directive entered in force nearly ten years later in Italy. The aims of this work were both to analyze the potential benefit effect of Nitrogen Directive application in the Pontina Lowland NVZ (Southern Lazio, Italy) and to compute the negative externalities due to nitrogen exceeding production on environment. The data analysis, which followed a temporal trend of 3 decades (starting from 1982 to 2010), gives the opportunity to evaluate nitrogen amount ex-ante and ex-post Nitrate Directive's application. The ecosystem sustainability and ecological balance was also evaluated in terms of Ecosystem Services (ES), considering both the ES positives externalities provided by the neighbouring of Circeo National Park (PNC) and the life cycle costs (LCC) of livestock manure.

S7.8 The effects of multiple stressors on coralligenous assemblages

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Ensuring the persistence of critical habitats requires to understand the effects of multiple stressors caused by human activities. Many studies have addressed the effects of individual threats on coralligenous formation. However, understanding the effects of different combinations of threats is still a challenge. Here, using the region Apulia as a case study, we document changes of coralligenous assemblages addressing two questions: (1) Does the composition of assemblages change under the pressure of different combination of stressors? (2) Is there evidence that specific combination of human disturbance can drive the shifts from undisturbed to degraded assemblages? To address these issues we quantified changes in species richness, functional groups, assemblages structure and composition (beta diversity). Results show that fishery, sewage discharges and portual and urban infrastructures are the most pervasive threats across the region. No areas can be considered virtually unimpacted. Assemblage similarities among different locations are clearly driven by different combination of threats, masking regional patterns of species distribution. The substantial lack of quantitative information on the intensity of the different threats can surely represent a limit for deriving cause-effects relationships. However, this large-scale approach of assessing the effects of human induced changes can represent a baseline for the understanding and the management of multiple threats on coastal areas.



S7.9 Orientation of *Talitrus saltator* and macrofaunal analyses on an dynamic sandy shore before and after the construction of a stone bank against erosion

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The Collelungo sandy beach (Maremma Regional Park, Italy) shows an erosion/accretion gradient, with a strong erosion in the N-E sector (near the Ombrone River mouth), gradually turning into accretion toward S-W. In 2010 the Park managers decided to build an anti-erosive stone bank along 1200 m at the left side of the river mouth. In autumn 2002 and spring 2003 (before the intervention) orientation experiments on the amphipod *Talitrus saltator* (Montagu, 1809) and samplings of macroinvertebrates were done along this beach. In spring and autumn 2011 we repeated the experiments and samplings in the same sites, to verify the long-term effects of the intervention and the possibility of using orientation as a bioindicator of impact on sandy beach stability, with the macrofaunal analyses as a control. Circular statistics and multiple regression models adapted to circular distributions were applied to the orientation data, and the results were compared with the previous ones. Univariate and multivariate analyses were performed (Primer 6 & Permanova+ software) on macrofaunal data to compare results of the two sampling sets. The worsening of sandhoppers' orientation at all the sites and the changes in macrofaunal communities confirmed that the variation in orientation may potentially be used as a bioindicator of shoreline changeability, to monitor the effects of hard-engineering interventions on sandy beach ecosystems.

S7.10 Laboratory studies on fecundity and development of the benthopelagic species *Pseudocyclops umbraticus*: temperature effects.

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The shallow-living, benthopelagic copepod species *Pseudocyclops umbraticus*, collected seasonally during nighttime samplings, from the brackish water Lake Faro (North-eastern Sicily), showed marked seasonal fluctuations in population abundances, with maximum numbers recorded in autumn. In the laboratory, mean daily egg production rates were positively correlated with temperature, with values ranging from 2.3 ± 6.3 (14°C) to 6.1 ± 10.2 (24°C) (mean $\pm$ S.D.) eggs per female per day. In terms of total egg production for the entire female lifespan, maximum values occurred at 14°C and minimum at 24 °C. At 32° C, females stopped egg production. Temperature also dramatically affected female life span, which was shorter at higher temperatures. Development time of eggs decreased with increasing temperature, as also development time from egg to adulthood. The unique egg-laying behaviour may ensure higher survival rates of egg stages compared to free-spawning and egg-carrying calanoid species. Although egg production rates in this species are low compared to other pelagic copepods, they are within the range of values reported for egg-carrying species. The greater fecundity at higher temperatures compared to other subtemperate species indicates that the species is well adapted to the higher temperatures of coastal lagoons and brackish water lakes where it contributes to enhance the biodiversity of plankton community at night, when they migrate from the substratum to water column.



S7.11 Interazioni tra componenti biotiche e abiotiche in sistemi fluviali di pianura soggetti ad elevata pressione antropica: una sintesi di sei anni di sperimentazione nei bacini di Oglio e Mincio

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I fiumi Oglio sublacuale e Mincio sono sistemi modificati da centinaia di anni, inseriti in contesti densamente popolati, con agricoltura intensiva e usi industriali delle acque. Come tali sono casi di studio in cui valutare gli effetti di lungo termine di pressioni antropiche multiple. In tal senso ricerche sulla chimica delle acque, sulle componenti biotiche (macroinvertebrati e macrofite) e sui processi metabolici sono state condotte tra il 2007 e il 2012 con l'obiettivo di definire paradigmi robusti relativi alle relazioni tra deflussi, geomorfologia, comunità e processi. Le comunità di macroinvertebrati e macrofite riflettono i carichi trofici generalmente elevati e la forte discontinuità idrologica; associazioni caratteristiche, indipendenti dal continuum fluviale, contraddistinguono i tratti sottesi, bacinizzati e potamali dei due sistemi. L'eccedenza di azoto nelle terre coltivate si traduce in una generale contaminazione da nitrato delle acque superficiali e di falda, anche in conseguenza della semplificazione degli elementi strutturali del paesaggio (es. fasce riparie). Rilevante risulta l'apporto di azoto nitrico al fiume dalle falde nelle zone di interazione, sia per le quantità in gioco che per le implicazioni riguardo i tempi di recupero dall'inquinamento. Eutrofizzazione e bacinizzazione determinano uno shift da eterotrofia ad autotrofia netta del sistema fluviale, cui è associato un peggioramento della qualità chimica e biologica delle acque e dei sedimenti.

S7.12 Benthic community structure and sedimentary organic matter in intertidal beaches subjected to different management practices

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Overcrowding of coastal oceans has brought an almost exponential increase in anthropogenic pressures on sandy beaches. These transitional habitats are characterized by different degrees of human exploitation, from natural shores with dunes to highly exploited ones protected by hard artificial structures or managed with nourishment and other soft engineering options. Sandy beaches represent the first receptor habitat of flooding impacts and a potential first-level barrier to many other anthropogenic pressures at sea. As part of the EU-funded THESEUS project, we investigated the effects of different management options of sandy beaches on both meio- and macrofauna and on the biochemical composition of sedimentary organic matter. Three beaches located along the coast of the NW Mediterranean Sea and subjected to different managing options (i.e. hard vs. soft engineering) have been visited twice a year, depending on the seasonal timing of management. Samples for all the investigated variables were taken along transects perpendicular to the shoreline, and sites placed at high, medium, and low tidal levels. Our results allowed identifying complex responses of benthic communities and of the trophic conditions of the sediment to the different management options. The complexity and interactive nature of the observed responses suggests the adoption of sandy beach monitoring practices and impact mitigation measures, that should be as site-specific as possible.



S7.13 Stable isotope analysis ($\delta^{13}\text{C}$, $\delta^{15}\text{N}$) in river communities subjected to anthropogenic disturbance

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Rivers are open ecosystems that receive energy and matter inputs from the surrounding terrestrial ecosystems; along their course they may cross urban and agricultural areas undergoing human disturbance that alters ecosystem processes. This study was carried out along a stretch of about 80 kilometers of the Sacco River (Lazio) characterized by the presence of urban, agricultural and industrialized areas, dumps, and dams that interrupt the natural water flow. In the surveyed sites, samples of macrobenthos, fish and basal resources (detritus, epilithon, riparian vegetation) were collected and their stable isotopes signatures of carbon and nitrogen were analysed. Stable isotope analysis (S.I.A.) indicates what an organism had really assimilated, thus it was useful to reconstruct the community structure and therefore to investigate the role of anthropogenic disturbance on niche metrics. The results showed the increases of isotopic signatures, along the river stretch, for all the studied biotic components, proving that the community architecture (trophic levels) is site-specific and potentially vulnerable to localized impacts. The community-wide metrics and the isotopic signatures vary along the river course according to the major disturbance factors. The results suggested S.I.A. as an interesting approach to implement management actions on disturbed rivers.

S7.14 Valutazione degli effetti indotti dall'acidificazione degli oceani sul organismo micro bentonico modello *E. crassus* e sull' alga cloroficea *D. tertiocleta*

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Il rapido aumento dei livelli di anidride carbonica in atmosfera dovuta all'uso di combustibili fossili e alla distruzione delle foreste non solo ha causato un aumento globale delle temperature, ma anche una variazione negli equilibri chimici di molti ecosistemi. Le acque marine hanno subito un moderato ma progressivo abbassamento di pH diminuendo da 8,2 a 8,1. Seppur apparentemente modesta tale variazione appare rilevante se confrontata con le ricostruzioni paleo climatiche. Con l'attuale tasso di crescita dell'anidride carbonica in atmosfera all'inizio del nuovo secolo, tale valore potrebbe scendere ulteriormente. Il grado di acidificazione degli oceani è attualmente oggetto di dibattito e di pareri discordi in seno alla Comunità scientifica internazionale. Il presente studio mira ad evidenziare gli effetti indotti dalla progressiva acidificazione dell'ambiente marino sugli organismi acquatici tramite l'utilizzo di due organismi modello: l'alga marina cloroficea *D. tertiocleta* ed il protozoo marino microbentonico *E. crassus*. Per seguire efficacemente la sindrome di stress lo studio ha previsto l'applicazione di diversi indici letali e subletali tra cui i tassi di sopravvivenza e di replicazione cellulare, di endocitosi e l'indice di stabilità lisosomiale mentre nel caso dell'alga è stato valutato il tasso di crescita. I risultati preliminari ottenuti tendono ad evidenziare alcune alterazioni al livello sub letale negli organismi modello utilizzati. Livello di stress che tende ad aumentare con l'incremento del pH.



S7.15 Ocean acidification harms coral-reef threat

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Coral reefs are marine biodiversity hotspots, but their existence is increasingly threatened by global change and local pressures. Population explosions of coral-eating crown of thorns seastars (COTS) are reported as the major contributor to recent coral decline in the Great Barrier Reef (GBR). Here, we demonstrate how the conditions of near-future ocean acidification (OA) can impact on the predator (COTS), potentially delivering positive outcomes for the prey (corals). OA had significant negative effects on all three early life history stages investigated. An increase of $p\text{CO}_2$ to $\sim 900\text{--}1200 \mu\text{atm}$ reduced fertilisation success at relevant sperm concentrations and also had a more subtle negative effect on larval development. However, the most distinct impact of OA was on settlement surfaces such as biofilms and algae which in turn decreased the success of COTS larvae to recruit. Overall, reductions in fertilisation and settlement rates alone would reduce COTS population replenishment by over 50%. While COTS outbreaks are considered among the most serious immediate threat to the GBR, corals may paradoxically benefit from acidification due to reduced predation rates. However, whether future negative impacts of OA on COTS populations are early and great enough to provide respite from other negative anthropogenic impacts remains in doubt.

S7.16 Cascading Effects Of Ocean Acidification In A Rocky Subtidal Community

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Temperate marine rocky habitats may be alternatively characterized by well vegetated macroalgal assemblages or barren grounds, as a consequence of direct and indirect human impacts (e.g. overfishing) and grazing pressure by herbivorous organisms. In order to highlight how the effects of increased $p\text{CO}_2$ on individual calcifying species will be exacerbated by interactions with other trophic levels, we performed an experiment simultaneously testing ocean acidification effects on primary producers (calcifying and non-calcifying algae) and their grazers (sea urchins). Our study highlighted a direct $p\text{CO}_2$ effect on calcifying algae and on sea urchin defense from predation (test robustness). There was no direct effect on the non-calcifying macroalgae. Additionally, we highlighted diet-mediated effects on test robustness, test mineralogical composition and on Aristotle's lantern size. Overall, these results provide relevant clues in terms of bottom-up processes (algal diet) affecting top-down ones (fish predation) in rocky subtidal communities, modulating test robustness of sea urchins and consequently their vulnerability to predation. We hypothesize contrasting effects of ocean acidification: in the absence of other human impacts, we expect a decrease of biodiversity in vegetated macroalgal assemblages, whereas a lower density of sea urchin could help the recovery of shallow subtidal rocky areas affected by overfishing from barren grounds to assemblages dominated by fleshy macroalgae.

S7.17 Openness and parsimony in ecological quality indices: revisiting the benthic index M-AMBI

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The Water Framework Directive (2000/60/EC) stimulated the development of indices to assess the ecological quality in water bodies. These include M-AMBI (Muxika et al., 2007), a multimetric index applied to marine and transitional waters, now enforced in Italy and in several other European countries. M-AMBI is based on benthic macroinvertebrates and integrates the biotic index AMBI, Shannon diversity and species richness by means of factor analysis. A user-friendly freeware is available to calculate the index, however, the software code is not open source. We reproduced and analysed the algorithm using the open source R software. Three data sets, one of them artificially created to allow for statistically independent metrics, were used to test the algorithm. The following are the main outcomes: 1) Factor analysis itself is not functional to M-AMBI, and its omission does not appreciably change the results. 2) M-AMBI can be approximated by the simple mean of the normalised metrics with no need for multivariate techniques, in this way removing the original dependence to the number of samples in the data set. 3) A bivariate version is proposed, which integrates the species sensitivity index with a single diversity measure to avoid redundancy and is still highly correlated with M-AMBI. The relationship of these indices to spatial scales is analysed. Properties of the indices, such as simplicity, transparency, robustness, openness, and ecological significance, are discussed.

S7.18 Sviluppo di un sistema di valutazione della qualità ecologica per i fiumi di Cipro secondo un gradiente di stabilità idrologica

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Cipro, la terza isola più grande del mediterraneo, ha scarsa disponibilità d'acqua, per cui è necessario implementare una gestione accurata di questa preziosa risorsa. Una delle priorità è sviluppare dei metodi di valutazione della qualità ecologica che possano essere applicati al carattere mediterraneo dei suoi corsi d'acqua. L'identificazione del regime idrologico dei corsi d'acqua è riconosciuto come uno strumento chiave per la gestione delle risorse acquatiche. Dati biologici, fisico-chimici e idromorfologici sono stati raccolti tra il 2005 e il 2011 nelle stazioni di monitoraggio dell'isola, per un totale di più di 500 campioni raccolti lungo un gradiente di stabilità idrologica. Dato che la maggior parte delle stazioni sono situate in corrispondenza di stazioni di misura della portata, è stato possibile calcolare gli "Indicators of Hydrological Alteration". Grazie a questi dati e seguendo l'approccio di Oueslati et al. (2010) è stata realizzata una classificazione del regime idrologico. Nel contesto dell'esercizio Europeo di intercalibrazione, sono state testate metriche biologiche e indici multimetrici già esistenti o sviluppate ex novo. L'importanza della variabilità idrologica nella valutazione della qualità ecologica è stata chiaramente confermata grazie alle differenze significative osservate nelle comunità biologiche. In questo contesto, un sistema di valutazione della qualità ecologica è stato sviluppato e validato considerando le pressioni presenti nell'area.

S7.19 Habitat Monitoring in Natura 2000 sites: the BIO_SOS European Initiative

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The main objective of BIO_SOS (Biodiversity Multi-Source Monitoring System: From Space To Species) is the development of a knowledge-based pre-operational ecological modeling system suitable for effective and timely multi-annual monitoring of NATURA 2000 sites and their surrounding areas particularly exposed to different and combined type of pressures. Based on the expert knowledge of botanists, ecologists and local site managers, the BIO_SOS is developing a deductive-learning classification system that is able to integrate remotely sensed data from satellite sensors and on-site data. Different areas in Europe (Mediterranean and Atlantic regions) are under investigation and examples of integration of habitat map and biodiversity data (different taxa and species: birds, amphibians, wild boar) in order to build Ecological Niche Models (ENM) can be provided as an example of usefulness of the approach. The results of our analysis demonstrate the usefulness and importance of ENM based on habitat and landscape features for further linking habitat maps derived from Earth Observation (EO) data with biodiversity distributions in the field. The habitat maps derived by EO earth observation systems play an important role in increasing the quality and explanatory power of ENM. The results are of special importance for several stakeholders, because it is made clear that ENMs can improve the way of management of species and habitat.

S7.20 Applicazione della procedura BIOHAB in un bacino idrografico appenninico come monitoraggio delle trasformazioni ambientali e dei servizi ecosistemici

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Procedura per la sorveglianza e il monitoraggio sugli habitat europei e la fornitura di dati spaziali Monitorare habitat e paesaggi deve diventare un punto chiave delle politiche ambientali, dentro e fuori le aree protette. A scala europea è stata adottato un criterio di classificazione degli habitat basato sulle forme biologiche della vegetazione dominante. In questo modo è possibile ottenere mappe di habitat derivate da indagini di campo o da dati telerilevati, integrando e uniformando le informazioni eterogenee che derivano da prassi e tradizioni differenti. In questa presentazione esponiamo i risultati di un'analisi sulle trasformazioni del paesaggio nel bacino del fiume Foglia tra il 1978 e il 2003 mostrando come, a partire da habitat definiti utilizzando le forme biologiche, è possibile esprimere un giudizio di naturalità sull'insieme degli ecosistemi analizzati, e attribuire ad ognuno di questi un valore per i Servizi Ecosistemici svolti. Attraverso queste procedure è possibile esprimere un giudizio, qualitativo e quantitativo sulle trasformazioni del paesaggio utile ad indirizzare le politiche di pianificazione che promuovano la tutela integrata del territorio e una governance adattativa ai cambiamenti climatici riconoscendo il ruolo dei SE anche al fine di diminuire i costi delle emergenze territoriali.



S7.21 La distribuzione della variabilità genetica del genere *Salmo* in Italia: ruolo dei fattori ambientali e antropici

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Sui salmonidi italiani gravano diverse fonti di minaccia: introduzione di specie aliene, eccessivo sforzo di pesca, inquinamento e alterazione degli habitat. Nostri recenti studi (Splendiani et al., 2013. Fresh Biol, doi:10.1111/fwb.12193) hanno messo in evidenza che in Italia centrale la presenza della variabilità genetica aliena è stata fortemente condizionata dalle caratteristiche idrogeologiche dell'Appennino Umbro-Marchigiano, con un'ampia diffusione sui terreni impermeabili e una più difficile "invasione" dei corsi d'acqua che decorrono su terreni calcarei. In questo studio abbiamo esteso l'approccio della landscape genetics a tutto il territorio italiano, utilizzando dati inediti e dati bibliografici. Due marcatori molecolari (DNA mitocondriale e DNA nucleare) sono stati utilizzati per descrivere la variabilità genetica delle popolazioni di *Salmo* sp. Per l'analisi dei dati sono stati adottati due approcci: i) uno multivariato, per studiare la relazione esistente tra variabilità genetica e caratteristiche ambientali, e ii) uno filogenetico, per valutare il ruolo delle diverse aree idrogeologiche che caratterizzano la Penisola italiana come possibili aree rifugio per i salmonidi. I risultati ottenuti confermano che le caratteristiche idrogeologiche hanno giocato un ruolo determinante per spiegare l'attuale diffusione della variabilità genetica aliena. Inoltre, l'analisi filogeografica evidenzia un'elevata diversità genetica esistente tra le diverse popolazioni analizzate, probabilmente come conseguenza di ripetute fasi di diffusione e isolamento alternatesi durante le vicende paleoclimatiche del Pleistocene.



Educazione ambientale e didattica nell'ecologia [S8.1-S8.12]

S8.1 Ambiente, territorio ed alimentazione: il progetto Echi di in/sostenibilità

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Una riflessione a più voci sulla (in)sostenibilità (ambientale, economica e sociale) nel settore agroalimentare attraverso un viaggio nel territorio è il tema attorno a cui si sviluppa il progetto “*Echi di in/sostenibilità...*”, coordinato dal CIREA (Dip.to di Bioscienze, Università di Parma) in collaborazione con i Centri di Educazione Ambientale e l'Assessorato Ambiente della Provincia di Parma (co-finanziato dalla Regione Emilia Romagna/Bandi INFEA). Il contesto di riferimento è il territorio di Parma e della Pianura Padana, la cui economia ruota attorno all'agricoltura e all'industria agro-alimentare, caratterizzate da produzioni tipiche di qualità conosciute in tutto il mondo. Questa comunità ha una forte identità radicata nell'idea di “Food Valley”, in cui oggi il legame tra *produzione di qualità* ed *ambiente di qualità* rischia di diventare uno stereotipo, a causa del forte impatto delle attività antropiche sulle risorse ambientali. Le numerose attività svolte nell'ambito del progetto, unitamente al documentario “*Terramacchina*”, uno dei prodotti realizzati, hanno affrontato diversi temi di forte rilevanza locale/globale (tra i quali l'uso della risorsa idrica, il consumo di suolo e la qualità e tipicità delle produzioni alimentari), promuovendo confronto e condivisione nei cittadini ed in tutti i soggetti che a vario titolo agiscono nel territorio, al fine di favorire l'acquisizione di consapevolezza e responsabilità nella gestione delle sue risorse.

S8.2 Biophilia in action. Mindful Silence enhances children connection to Nature.

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In this study we focused research hypothesis as follows: Can the perception of the restorative value of nature, the feeling of connection with it and the attentional capacity of pre-adolescents change between the beginning and the end of a trekking experience on the basis of the activity performed? 60 subjects (aged 10- 11) were randomly assigned to three conditions: immersion in Nature only (N), Theatre (T), Mindful Silence (M). All subjects were administered at a week distance (experimental design: pre-post) the Perceived Restorativeness Scale (PRS-ch), the Connection to Nature Scale (CNS-ch) and two attentional tests: the Sky Search (SS) and the Map Mission (MM). As hypothesized, to be in contact with nature enhances the perception of its restorative value: the PRS-ch score increases significantly from the pre- to the post-session independently from the condition; whereas, surprisingly, the feeling of connection with Nature, measured with the CNS-ch, increases only in the M condition. With regards to the attentional tests, SS time of performance decreases significantly from the pre- to the post-session in all conditions (the effect cannot be attributed to learning) but they are significantly lower in M condition ($M < N < T$), as the number of correct responses that is significantly greater in M ($M > N > T$). Differently from adults, to be simply in contact with the natural environment is not enough to grow empathy with nature and to enhance attentional capacity in pre-adolescents. Again, Mindful Silence has turn out to be a good instrument to train attention, making subjects more aware of the surrounding and enhancing attentional performance.



S8.3 Ambiente rurale e interdipendenze: rappresentazioni fra reale e virtuale alla ricerca di una identità ecologica

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Il contesto agricolo, luogo di vita e sostentamento della maggior parte della popolazione italiana fino a metà del secolo scorso, è via via diventato spazio lontano ed estraneo, determinando in particolare per le nuove generazioni una perdita di consapevolezza ed identità ecologica. Poco per volta il distacco è stato metabolizzato e si è assistito oggi ad una progressiva idealizzazione spesso stereotipata, distorta o addirittura fantastica del mondo rurale. Ne sono testimonianza i moltissimi testi che ogni anno vengono pubblicati per i bimbi piccoli sul tema della fattoria e della campagna, così come i cartoons, i videogiochi ed i browsergames. Salvo eccezioni in queste rappresentazioni dominano cuccioli da accarezzare e paesaggi idilliaci, senza che nulla riesca a trasparire rispetto al ruolo che quell'ambiente e le persone che ancora ci vivono e lavorano, rivestono sul nostro quotidiano urbano. Analizzare criticamente e utilizzare dal punto di vista educativo storie, personaggi, materiali e soprattutto giochi molto conosciuti ed amati dai ragazzi, può configurarsi come una delle modalità a disposizione degli educatori per far riflettere sul concetto sostenibilità, limite e risorsa, sui flussi e le trasformazioni di materia e energia, sul fatto che, per quanto difficile da percepire, tutto ciò di cui disponiamo ogni giorno e tutto ciò che facciamo è connesso con molteplici fili a ecosistemi ecologicamente produttivi. Si tratta certo di smascherarne i limiti, gli aspetti paradossali e problematici, ma anche di riconoscerne la funzione "ponte" che questi materiali possono avere rispetto all'esperienza diretta: talvolta dietro rappresentazioni fantastiche, caricaturali e stereotipate si nascondono aspetti della realtà che possono essere svelati con un po' di ironia per ri-motivare non solo lo studio scolastico, ma anche l'immersione nel contesto rurale.

S8.4 Formazione Ambientale: le esperienze del progetto LIFE MAESTRALE

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Il progetto europeo LIFE10 NAT IT 000262 Azioni mirate al ripristino e alla conservazione di habitat dunali e retrodunali in Molise (acronimo MAESTRALE) ha come scopo la protezione delle dune costiere e l'educazione ambientale, finalizzata alla sensibilizzazione della popolazione alle tematiche di tutela ambientale connesse al progetto, e la mitigazione dei conflitti di interesse tra stakeholders, per garantire una migliore consapevolezza ambientale e comportamenti orientati ad una maggiore sostenibilità dell'uso delle spiagge e della pineta litoranea. In questo contesto l'Università del Molise, in collaborazione con i partner di progetto, (Comune di Campomarino, Comune di Petacciato; Ambiente Basso Molise onlus, Centro Studi Naturalistici onlus) ha realizzato percorsi formativi sul tema del turismo sostenibile e tutela della biodiversità. Per l'anno 2013 è stata ideata una mostra itinerante e un calendario di incontri estivi. La mostra itinerante, che è stata esposta presso 9 comuni del Basso Molise descrive le caratteristiche e la vulnerabilità degli habitat e delle specie animali di interesse comunitario prioritario presenti sulla costa molisana, traccia le linee per un turismo sostenibile, indica le buone pratiche da adottare. Il calendario estivo ha previsto attività culturali e ricreative, tra cui 8 incontri con docenti Universitari, che hanno riportato esperienze virtuose e progetti di valorizzazione socio-economica, culturale e ambientale dei territori del Basso Molise.



S8.5 Educating for sustainability when studying ecology

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Education for sustainability has two primary objectives: the epistemological change of knowledge and learning and substantial changes in behavior in the every day life. We present three proposals with the aim of education to change of attitudes in every day life. *Learn to wait, cultivate a desire*: we propose two educational pathways: one on the germination of seeds and one on the life cycle *Bombyx mori* to the adult stage. The inevitable waiting time can be exploited to stimulate wide-ranging imagination, peer discussions, free metaphors. *The group makes the difference*: The proposed activities (analysis of bark and sod study) were carried out in a group and individually: the results were used for a comparison in order to highlight the added value of collaboration. *The appreciation and enjoy of natural beauty*: for those who live in the city parks, gardens, beaches and protected areas in general are places for daily contact with the natural environment. Reclaiming the aesthetic enjoyment and psychological well-being is the goal of a project moving between ecology and art, carried out at different age levels. These examples provide an opportunity for studying the environment and at the same time develop attitudes that are the foundation of education for sustainability. Different skills (ecological, communicative, educational, artistic, etc..) need to be exploited for them to develop.

S8.6 SUSTAINABILITY: un sito web per la divulgazione della ricerca scientifica su tematiche ambientali

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I risultati delle ricerche in campo ambientale raggiungono il grande pubblico principalmente attraverso i mass media, che usano spesso un approccio superficiale. D'altra parte le riviste specializzate "peer reviewed" utilizzano un linguaggio incomprensibile ai non addetti ai lavori. La rete internet offre l'opportunità di divulgare dati scientifici, ma non sempre garantisce l'affidabilità delle informazioni. Attraverso il web le Università italiane diffondono informazioni su aspetti burocratici, ma generalmente non sui risultati delle ricerche svolte. Questo lavoro propone un modello di divulgazione di ricerche scientifiche rivolto al grande pubblico. Alcuni articoli scientifici su tematiche ambientali, prodotti da ricercatori della Seconda Università di Napoli, sono stati rielaborati, usando un linguaggio divulgativo, e pubblicati in un sito web istituzionale (<http://www.sunability.unina2.it/>), che è stato pubblicizzato attraverso i social network FACEBOOK e TWITTER. Sono stati poi monitorati, per 28 giorni, il numero e la tipologia di utenti. I social network hanno permesso di raggiungere molti più utenti rispetto al sito web (62600 vs 3306), ma il maggior numero di apprezzamenti alle ricerche proposte è stato registrato sul sito web. Pertanto i social network sono risultati utili per ampliare l'audience, ma per divulgare dati scientifici è necessario presentare le ricerche in modo esaustivo e affidabile, come attraverso un sito web all'interno di un dominio istituzionale.



S8.7 Nuclei fondanti e competenze nell'insegnamento dell'Ecologia

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In questa sede si vuole presentare alla Società Italiana di Ecologia il dibattito in corso, su scala nazionale ed internazionale, sui contenuti ecologici oggetto di insegnamento scolastico. La selezione delle conoscenze ecologiche, essenziali nel processo di apprendimento scolastico è una operazione di primaria importanza perché si possa favorire e diffondere lo sviluppo di conoscenze e competenze ecologiche, nel rispetto della rapida evoluzione qualitativa e quantitativa della disciplina. Dall'analisi della letteratura scientifica di settore, dei documenti redatti dalle commissioni ministeriali, dalle associazioni nazionali di insegnanti e dalle commissioni internazionali, si rileva un quadro programmatico del sistema scolastico in continua trasformazione; tuttavia, continuano ad essere scarse e certamente non adeguate alle attuali emergenze ambientali, le indicazioni a sostegno dell'insegnamento dei saperi ecologici.

S8.8 Citizen Science: una nuova frontiera per ricerca, divulgazione e lifelong learning?

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Negli ultimi 10 anni l'interesse per la Citizen Science è aumentato, in particolare nel Nord Europa, anche in conseguenza del successo del progetto Open Air Laboratories (OPAL), lanciato nel Regno Unito dal National History Museum. Questa spinta ha portato alla recente costituzione della European Agency for Citizen Science, una ONG che si propone di coordinare iniziative di Citizen Science a livello sovranazionale. La Citizen Science è potenzialmente uno strumento estremamente potente di informazione e di ricerca, che può avere il duplice scopo di: 1) informare i cittadini su determinati problemi, consentendo così una formazione scientificamente corretta e rigorosa dell'opinione pubblica, e 2) fornire al mondo della ricerca ed ai policy makers quei preziosi dati la cui raccolta è oggi rallentata – se non resa impossibile – dai tagli dei finanziamenti alla ricerca di base. Nell'Europa meridionale ed in Italia, nonostante l'impegno di svariati enti, che sviluppano iniziative lodevoli, le attività di citizen science raramente ottengono l'attenzione mediatica necessaria per prendere effettivamente piede. Anche grazie al lavoro della nascente infrastruttura europea Lifewatch, in Italia sta per essere intrapresa una strada di pianificazione di iniziative coordinate di citizen science, che potrebbero fornire grandi moli di dati anche alla ricerca ecologica a lungo termine.



S8.9 Per una pedagogia dell'ambiente, nell'ambiente e per l'ambiente

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Condividere la conoscenza e le metodologie della pedagogia nell'affrontare il tema dell'educazione ambientale, vista come una riflessione sulle tematiche e i problemi connessi alla conoscenza dell'ambiente e soprattutto alla relazione che con esso ha l'essere umano. Percepire, sentire, osservare, porsi domande e abbozzare spiegazioni. Dal vedere le cose separate e distinte al costruire tra loro nessi e relazioni. Dal guardare la natura e l'uomo, la donna e il bambino come fossero mondi distinti al leggere nella natura i segni dell'essere umano e in questi ultimi l'impronta della natura. Tutto ciò è possibile attraverso una programmazione che tenga sempre presente la gradualità dei processi cognitivi e le finalità generali della scuola. Educare nell'ambiente, per l'ambiente e all'ambiente significa formare il cittadino, consapevole, responsabile e rispettoso del suo futuro: rispondendo a quelle finalità cognitive, estetiche ed etico sociali.

S8.10 Contenuti ecologici nelle nuove indicazioni nazionali per la scuola primaria

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La scuola primaria continua a svolgere un ruolo decisivo nella formazione dei cittadini in primo luogo attraverso la scelta dei contenuti disciplinari, degli aspetti metodologici ed organizzativi e del complessivo orientamento educativo. A questo proposito rivestono grande importanza le indicazioni curriculari elaborate dagli organi ministeriali nazionali. Tali indicazioni descrivono gli orientamenti e le finalità del sistema scolastico, gli obiettivi di apprendimento e le competenze da perseguire in riferimento alle singole discipline. Al fine di rilevare l'attuale orientamento nazionale verso le tematiche ecologiche da veicolare nei processi educativi e di insegnamento nella scuola primaria, si propone in questa sede uno studio comparato dei documenti: Indicazioni Nazionali per il Curricolo, emanate in Italia alla fine del 2012, e Indicazioni per il Curricolo, in vigore dal 2007. I risultati indicano una significativa contrazione dello spazio dedicato ai contenuti ecologici nel documento del 2012, attualmente in vigore. L'importanza dell'Ecologia per la costruzione di una conoscenza complessa viene tuttavia dichiarata, in ambedue i documenti, nella parte introduttiva.



S8.11 Educare alla Biodiversità e alla Sostenibilità: verso un approccio metodologico innovativo, multidisciplinare e transdisciplinare.

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Il Progetto di *Educazione Ambientale per la Sostenibilità* adotta un modello olistico e si basa su un approccio e una metodologia multidisciplinari e transdisciplinari finalizzati allo Sviluppo di Capacità umane ben integrate con la Biosfera. Il percorso didattico adottato parte dallo studio del Sito NATURA 2000 del Carso triestino-goriziano con l'esame delle componenti floristiche e faunistiche e lavora sul Paesaggio avvalendosi di un inquadramento geografico fondato sulla metodologia G.I.S. (Sistemi Informatici Geografici). Leggere il territorio attraverso un G.I.S. significa effettuarne una lettura multidisciplinare (*multilayers*), in quanto esso viene indagato, sulla base della documentazione fotografica e delle relative ricerche floristiche esistenti a partire dal 1800, anche nel suo dinamismo storico: le modificazioni che si sono verificate nell'uso del suolo infatti si rispecchiano nel passaggio dalle attività di pascolo alle preminenti attività ricreative attuali. Oggi sono prevalenti i Servizi ecosistemici di tipo culturale, non dimenticando il ruolo svolto dalle formazioni boschive nello stoccaggio del carbonio. Nel percorso educativo si affina la partecipazione attiva e le intelligenze degli studenti mediante *esperienze dirette e vicarianti di naturalità*, nonché la produzione di testi, disegni naturalistici, lavori multimediali che gli studenti presentano nel corso di una manifestazione conclusiva in cui vengono coinvolti le famiglie e i media locali in un'azione sociale di comunicazione e apprendimento ecologici.

S8.12 L'educazione ambientale come tessuto di saperi plurali. Spunti di riflessione sulla formazione iniziale degli insegnanti di scuola dell'infanzia e primaria.

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A differenza delle didattiche di saperi disciplinari tradizionali, che possono riferirsi ad un'epistemologia più o meno solida, a linguaggi specifici, a reti concettuali e metodi di indagine riconosciuti da una comunità di ricerca, l'Educazione Ambientale (EA) non è identificabile con un singolo sapere o con un insieme definito di contenuti essenziali, ma è il risultato di un intreccio che interseca più discipline, ponendo il problema di come conciliare approcci, linguaggi, epistemologie, contenuti e pratiche diversi. Essa, inoltre, ha una forte connotazione metodologica: se i contenuti sono un mezzo per conseguire abilità, competenze, chiavi di lettura, motivazioni, attitudini, diviene centrale il modo in cui essi vengono proposti, le caratteristiche del contesto e dei media utilizzati, la qualità delle relazioni che i soggetti mettono in atto (tra di loro, coi docenti, con l'oggetto di apprendimento), la risonanza affettiva e motivazionale che viene attivata e che dovrebbe supportare comportamenti desiderabili, dapprima negli insegnanti e poi nei loro futuri alunni. Il presente contributo, a partire dalla considerazione dei principali passaggi che storicamente hanno modificato la natura dell'EA e dalla lettura critica di alcuni documenti nazionali e internazionali, si propone di suscitare la riflessione sulla formazione iniziale degli insegnanti, con particolare attenzione ad aspetti ritenuti nodali, anche se non facilmente conciliabili con l'impianto accademico tradizionale.



POSTER



P1. Biodiversità e funzionamento ecosistemico: un tributo a Carlo Heip

P1.1 Dinamica dell'ecosistema roccioso dell'AMP "Isola di Ustica" nell'ultimo cinquantennio attraverso la conoscenza dei veterani del mare

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I dati di monitoraggio attualmente disponibili per le aree marine protette (AMP) mediterranee risultano nella maggior parte dei casi limitati nel tempo. Per ovviare a tale mancanza, si possono sfruttare le conoscenze ecologiche di persone appartenenti al mondo scientifico e non, che risultano avere avuto un prolungato legame con l'ambiente marino. Nel seguente studio sono stati intervistati 35 soggetti tra ricercatori, pescatori, fotografi e sportivi subacquei. Le interviste hanno permesso la raccolta di dati quantitativi sui cambiamenti di specie di importanza ecologica ed economica avvenuti nell'ultimo cinquantennio ad Ustica. Tali risultati sono stati validati con dati provenienti da monitoraggi. I cambiamenti riportati dagli intervistati risultano simili o minori a quelli registrati durante i monitoraggi, dimostrandosi conservativi. Nonostante la protezione, gli intervistati riportano un continuo declino delle specie di importanza ecologica ed economica come: *Dentex dentex*, *Spondyllosoma cantharus*, *Diplodus vulgaris*, *D. sargus*, *Palinurus elephas*. Il declino di altre specie come *Epinephelus marginatus* si è arrestato con l'istituzione dell'AMP. Altre variabili quali l'abbondanza dei ricci e la copertura delle macroalghe erette sembrano subire oscillazioni nel tempo. I risultati di questo studio evidenziano il valore della conoscenza ecologica locale per valutare l'efficacia della protezione e più in generale per lo studio dei cambiamenti "storici" degli ecosistemi marini.

P1.2 The last soft-bottoms habitat formers of the western Adriatic Sea

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In the Mediterranean Sea the order Pennatulacea (Cnidaria, Anthozoa) is represented by nine species and six are known for the Adriatic Sea. Little information is available on their ecology and biology and, living mainly on soft mesophotic bottoms, their distribution is endangered by trawling activities. Their presence is considered very important from a functional point of view, likely affecting edaphic conditions and representing a possible nursery giving refuge to eggs, invertebrates, and small fishes. A description of the spatial and bathymetric distribution of the most common sea pens *Funiculina quadrangularis*, *Virgularia mirabilis*, *Pennatula rubra* and *Ptereoidea spinosum* is here carried out, to create a first baseline for future monitoring and to compare historical information with newly collected data. As sea pens share the same habitat with some of the most commercial value species (e.g. *Nephrops norvegicus*), they could be very useful indicator of the quality of sand-mud habitats and associated communities. Sea pens and their associated habitat are not directly protected by legislation but, since 2004, they have been the object of OSPAR that classified sea pen and burrowing megafauna communities as 'Threatened and/or Declining Habitat'. A more detailed knowledge of sea pens distribution and their related community could be important in order to contribute to develop spatial (GIS) management measures to protect the last habitats structured by their presence.

P1.3 Development of innovative monitoring systems and implementation of molecular tools to explore marine biodiversity assessing Good Environmental Status (GES)

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The Marine Strategy Framework Directive (MSFD) was signed following the request of EU Member States to find a solution to protect and preserve the quality of the marine environment across Europe. The MSFD aims to achieve a Good Environmental Status in the marine ecosystems by 2020 and it requires the study of 11 Descriptors, of which biological diversity represents a key element interlinked to all the others. The EU project DEVOTES (www.devotes-project.eu) holds a strong focus on developing tools to understand and describe biodiversity status at a pan-European scale. Remote sensing, molecular techniques such as Next Generation Sequencing and Microarray will be used to identify species comparing classical VS innovative approaches. Several biodiversity elements will be studied, including microbes, phytoplankton, meiofauna and macroinvertebrates. In particular, CONISMA will focus on toxic species of dinoflagellates and other key taxa determining Harmful Algal Blooms (HABs), which are potentially dangerous to human health and they could contribute to alter food-web dynamics. DNA-chip developed in previous EU projects will be applied to key areas by using a high throughput system of multi-species microarray applied to the identification of HABs. The main novelty of DEVOTES will be to transfer these advanced technologies to routine monitoring programs assessing biodiversity and to find the correct balance between innovation and determining cost-effective monitoring strategies.

P1.4 Benthic trophodynamics and biodiversity as influenced by ecosystem engineers: a comparison between coral forests and mounds

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Though amongst the less explored marine regions, the mesophotic zone is inhabited by several ecosystem engineers, nowadays severely threatened by climatic change and human activities. We investigated the effects of the presence of coral forests (one characterised by the gold coral *Savalia savaglia* and another one characterised by the hydroid *Lytocarpia myriophyllum*) and coral mounds on sedimentary organic matter composition and meiofaunal biodiversity in the surrounding incoherent bottoms. We show that the presence of all of these structures have significant effects on sedimentary organic matter concentrations and benthic biodiversity, but also that these effects are not spatially consistent in the different coral forests or mounds. While the presence of *S. savaglia* and of coral mounds exerts an increased availability of organic substrates, the sediments just below the forests dominated by *L. myriophyllum* are characterised by a higher variability in the food availability of sedimentary organic matter. Overall, meiofaunal taxa and nematode species richness decreased from below to outside the coral forests and mounds, suggesting that these habitats have a prominent role in controlling the levels of benthic 'alfa' (point) biodiversity at different levels of taxonomic organization. The presence of both coral forests and mounds is also associated with an enhanced turnover diversity between coral colonized sediments and neighbouring incoherent bottoms. This result indicates that these habitats, as previously observed for deep-water coral grounds (e.g., *Lophelia pertusa* banks), promote high levels of gamma (regional) diversity. The prominent role of these habitats in controlling biodiversity of surrounding incoherent bottoms claims for an increased effort to identify adequate measures for their conservation.



P1.5 L'ecologia trofica di *Liza ramada* Risso, 1826 in ecosistemi acquatici di transizione: analisi della dieta e degli isotopi stabili.

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L. ramada è, tra le specie di Teleostei, quella più comune negli ecosistemi estuarini mediterranei. Lo studio della sua ecologia trofica può costituire uno strumento complementare di analisi delle complesse reti trofiche che si instaurano in questi ambienti. Inoltre, tale specie gioca un ruolo importante nell'acquacoltura estensiva, risultando strategica per l'abbondanza di giovanili disponibili e per la sua resistenza alle condizioni di eutrofizzazione. Il caso di studio riguarda le popolazioni del basso corso del fiume Tevere e dei laghi costieri di Sabaudia e Fondi (80 esemplari adulti in totale). L'analisi della dieta è stata effettuata analizzando i contenuti gastrici e calcolando la frequenza di ritrovamento (FO); mentre l'analisi degli isotopi stabili $\delta^{13}\text{C}$ e $\delta^{15}\text{N}$ è stata utilizzata per il calcolo di Mixing Model. Tra le categorie alimentari, le Bacillariophyceae sono risultate il gruppo dominante con una $\text{FO} > 50$ seguito dalle Chlorophyceae $10 < \text{FO} < 50$ e altri taxa occasionali con $\text{FO} < 10$ (nematodi, oligocheti, anfipodi, larve di chironomidi, zooplancton). Le tre popolazioni ittiche presentano firme isotopiche sito-specifiche e differenze stagionali, con range di variazione da -33 a -15‰ per il $\delta^{13}\text{C}$ e da 6 a 13‰ per il $\delta^{15}\text{N}$. I mixing model rivelano che l'accrescimento della specie è supportata essenzialmente dai consumatori primari (nutrimento realmente assimilato). I risultati confermano, che l'utilizzo integrato dei due metodi aiuta ad ampliare le conoscenze sulle abitudini alimentari e il ruolo trofico di tale specie all'interno di questi ecosistemi.

P1.6 Trophic shift from terrigenous-to-marine carbon source along a latitudinal gradient in the gulf of Gaeta: evidences from $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ analysis

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Mediterranean coastal ecosystems are characterized by complex dynamics and high species diversity. Elucidating the fate of organic matter sources and the trophic linkages between species is an important way to understand how these systems work. Isotopic signatures of carbon ($\delta^{13}\text{C}$) and nitrogen ($\delta^{15}\text{N}$) and Bayesian Mixing Models were used to determine the origin of predominant basal resources and their contribution to macro-benthic food webs. This study was carried out along the subtidal zone of the Gulf of Gaeta (Central Tyrrhenian Sea) an area strongly affected by fish farming and seasonally constrained by freshwater inputs originating from the Garigliano river. The study area is characterized by sand-muddy generally unvegetated sediments, populated by soft-bottom communities. Benthic organisms and their basal resources were collected at 8 sampling sites. All specimens were processed for C and N stable isotopes analyses. Results show that the two predominant sources of organic matter affecting the benthic communities appeared to be: i) autochthonous, derived from marine primary producers (phytoplankton, seagrasses and benthic macroalgae) and ii) allochthonous, derived from the input of the river Garigliano (terrigenous detritus). The results of the Bayesian Mixing Models show a latitudinal shift in the basal resources used as food by macrobenthic consumers, in particular from phytoplankton (Northern sampling sites) to allochthonous detritus (Southern sampling sites).



P1.7 $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ variations in *Ulva lactuca* and benthonic food-web metrics to monitor the ecological status of three coastal lakes

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Several methodologies have been applied in European countries in order to achieve the assessment of the Ecological Quality Status (EcoQS) as required by the Water Framework Directive (WFD). Accordingly, guidelines defining typologies, reference conditions and classifications of coastal and transitional waters have been drawn up and a series of concepts, terminologies and tools were developed for the WFD implementation. We have studied three coastal lakes in central Italy (Caprolace, Fogliano and Sabaudia) which were managed for different purposes. In our study we applied isotopic methodology both to define the quality and origin of the Nitrogen inputs (not approaching by chemical analysis) and to assign the ecological status of each lake. Using *Ulva lactuca*, collected in a reference habitat, as $\delta^{15}\text{N}$ -Trap in 25 points, and collecting macrobenthos, as indicator of the trophic status, in 4 points in each lake respectively, we have assessed the points of Nitrogen input and its organic/inorganic origins by macroalgae signal variations and the trophic status in different part of each coastal lakes by food web metrics. Our results show clearly that three lakes are different both for nitrogen inputs that for community food web metrics. The output of the two approaches were consistent with the potential disturbance due to the human activities around the lakes, and could be promising tools to monitor the EcoQS of these three “very close” but “very different” lakes.

P1.8 Exploring the use of metagenetic analyses to assess the biodiversity of marine nematodes

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Obtaining realistic estimates of species diversity and ecosystem functioning is one of the main challenges of marine ecology. There is a large incertitude in the study of small organisms, and large problems exist in the analysis of the biodiversity of several small metazoans included in the meiofauna. The most abundant metazoans on earth are nematodes; they are ubiquitous in all marine habitats, play a key role in benthic trophodynamics and display high taxonomic and functional diversity. Marine nematode species richness is expected to be very high, but so far only a few thousands have been described. Nematode identification is typically based on the analysis of classical morphological characters, but this approach does not allow to recognize cryptic species or closely related species. The advent of molecular techniques provides new perspectives to investigate the biodiversity of marine nematodes. Metagenetic analysis, performed using next-generation sequencing techniques (e.g., 454 sequencing), represents a novel field for biodiversity assessment. Here we report the results of a combined approach of morphological identification and 454 sequencing of nuclear (i.e., 18S rDNA) and mitochondrial genes (cytochrome oxidase I, COI) aimed at: i) developing a metagenetic approach to characterize deep-sea nematode biodiversity; ii) comparing the analysis of biodiversity based on classical morphological and molecular approaches and iii) comparing the biodiversity of nematode assemblages in coastal and deep-sea sediments. Our results indicate that the amplification of diagnostic gene loci from the whole community can provide important insights on nematode diversity patterns in relation with different environmental and ecological settings.



P1.9 Approfondimenti tassonomici sulla comunità degli Efemerotteri (Ephemeroptera) rilevati nei corpi idrici umbri

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Nell'ambito del monitoraggio dei macroinvertebrati, attuato da ARPA Umbria sui corpi idrici fluviali della Rete Regionale delle acque superficiali in ottemperanza alla Direttiva Quadro per le Acque 2000/60/CE, dal 2011 è stato avviato uno studio di approfondimento tassonomico sulle larve degli Efemerotteri (Ephemeroptera). Questo gruppo di macroinvertebrati bentonici è di particolare interesse ai fini della valutazione della qualità delle acque e presenta un'ampia diffusione nei diversi habitat fluviali. Anche se allo stato attuale il calcolo dell'Indice STAR_ICMi applicato per la definizione dello stato ecologico dei corpi idrici guadabili richiede la determinazione dei macroinvertebrati fino a livello di famiglia, nei siti sottoposti al controllo di sorveglianza, l'identificazione degli Efemerotteri è stata eseguita fino a livello di Unità Operazionale (OU), come indicato dal D.M 260/2010. Le Unità Operazionali rappresentano gruppi di *taxa* stabiliti in base ad affinità tassonomiche, morfologiche o ecologiche tra le specie di Efemerotteri. Tali raggruppamenti coincidono generalmente con il livello tassonomico di *genere*, fatta eccezione per *Baetis*, *Caenis* e *Rhithrogena* per i quali è necessario arrivare all'identificazione di *specie*. I dati derivanti da tale approfondimento tassonomico incrementano l'informazione ecologica sugli habitat fluviali umbri indagati, in quanto forniscono un quadro più esaustivo sulla biodiversità, permettono di formulare un giudizio sul grado di integrità strutturale della comunità degli Efemerotteri e sulla loro distribuzione nelle diverse tipologie fluviali, consentono inoltre di individuare le specie più vulnerabili da tutelare. Ci si auspica che i dati raccolti possano essere utilizzati a breve per il calcolo di metriche aggiuntive ai fini della classificazione ecologica dei corpi idrici.

P1.10 Tide affects food availability in rock pools: evidence from Mediterranean intertidal habitats

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The ecosystems at the interface between land and sea as intertidal pools on rocky shores host many forms of life living at the edge of their tolerance limits. Rock pool organisms experience large variability of chemical and physical features of the water and in particular during the midday of summertime at low tide, at the most southern latitudes, they need to cope with hard conditions due very high temperatures of the rock pool water. Here, we hypothesize that due to evaporation mechanisms, food density available to rock pool's consumers increase to a such level in order to buffer the detrimental effect of high temperature. In doing so, we studied the changes on short term (few hours) of physical and chemical features, due to isolation of rock pools at low tide, on the food availability for consumers living in the intertidal rock pools, along the coasts of northwestern Sicily. Our results showed a large daily spatial and temporal variability in food density and quality due to tide excursion. Amount of food at low tide during the midday significantly increased respect to other moments of the day at low tide. The isolation of pools at low day affected the content of particulate organic matter every six hours, which is dispersed in the adjacent intertidal habitat at the time of the connection with the sea in the subsequent high tide. Given the large number of rock pools found along the rocky shores, the export of labile organic matter produced daily is quantitatively important. This important sink of energy contributes to the enhancement of the maintenance of high levels of biodiversity of these typical environments of the Mediterranean Sea. The results of this study provide new information about the processes of marine-coastal interface ecosystems, which were, up to now, the most important resource supply for the coastal population of the entire planet.

Ancona, 16-18 settembre 2013



P1.11 L'attività cellulosolitica della comunità edafica come misura sintetica di funzionalità ecosistemica

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Alla comunità batterica e fungina del suolo sono riconosciuti ruoli importanti quali il riciclo dei nutrienti, la funzione tampone rispetto ad eventi di inquinamento, il ruolo di contribuire alla capacità intrinseca di molti ecosistemi di essere resistenti o resilienti nei confronti di disturbi più o meno intensi. Il monitoraggio qualitativo e quantitativo dei cambiamenti cui incorrono le comunità edafiche è però complesso poiché l'entità e la struttura delle comunità di microrganismi del suolo sono per molti *habitat* ancora poco conosciute. Alcune funzioni fondamentali delle comunità del suolo (es. cellulolisi, ligninolisi, etc.), frutto della sinergia metabolica di più specie, possono misurare l'efficienza e la salute degli ecosistemi. Nel presente lavoro è stata studiata l'attività cellulosolitica in un suolo di ambiente mediterraneo al fine di comprendere e di prevedere, con opportuni modelli cinetici, le conseguenze degli stress ambientali sul ruolo della cellulosa nello stoccaggio o nel rilascio di anidride carbonica nell'atmosfera. La decomposizione in campo di campioni di cellulosa è stata accompagnata da misure del contenuto in microelementi (analisi EDS) e di colonizzazione da parte dei microrganismi del suolo (microscopia elettronica, metodi colturali e misure di biomassa). Il lavoro ha permesso di attribuire un ruolo funzionale alla successione con cui ha luogo la colonizzazione della riserva di carbonio organico nel suolo.

P1.12 Hearing the ecology: a remote sensing approach to monitor wildlife

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The study of the soundscape, defined as the aggregation of sounds from physical (wind, water, etc.), biological (animal vocalizations) and anthropogenic (cities, roads, ships, etc.) sources, has recently opened new perspectives in the field of environmental monitoring. Here we present a review of recent studies in which the soundscape approach has been used to monitor wildlife populations, especially the avian fauna, both in silent and noisy conditions. Daily acoustic animal activity was sampled using autonomous recording devices in different sampling areas. The presented case studies well-illustrate a new way that data can be collected, analyzed, and interpreted via the use of a recently developed algorithm, the Acoustic Complexity Index. The ACI demonstrates to be efficient in filtering out anthroponies (such as airplane engine noise), to synthetically describe the complexity of soundscapes, and to identify the compositional changes and acoustic fluctuations activity of a local community. The proposed methodology shows to be a powerful tool in identifying the complex patterns of the soundscape across different temporal scales (hours, days and seasons) that can be adopted in long-term studies to monitor animal dynamics under different environmental scenarios involving landscape transformations under the challenges of human development.



P1.13 Short term signals of thermophilization process on abundance pattern of plant species in two Italian high elevation LTER-sites

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In European alpine habitats, a thermophilization process and an upslope shifting were documented as a consequence of climate change. However, little is known about recent changes at local scale in Endemic cryophilous species and life form distribution patterns of Southern Europe mountains. We therefore analyzed the abundance patterns of vascular plant species, Endemic species and life forms, across the last 10 years in two LTER sites: West-Southern Alps (ITMAV) and central Apennines (ITCAM). In the years 2001/2002 and 2012 plant species frequency data were recorded in 112 permanent plots (1x1m) arranged in 3x3 grids, along an elevation gradient (from 2340 to 3014 m a.s.l.), according to GLORIA multi-summit approach. Then a Wilcoxon's signed-rank paired test was performed to detect significant differences of each variable between the two dates. We observed a significant increase of the thermic vegetation indicator "S" (sensu Gottfried et al. 2012) in both mountain regions, as well as the increase of Chamaephytes total frequency (particularly on ITCAM), and of Hemicriptophytes (ITMAV only). Conversely we recorded a significant decrease of Endemic species abundance in ITCAM region. Our results so suggest that in Italy a thermophilization process is ongoing, determining a turnover in life form abundance patterns, a decline of Endemic cryophilous species on Apennine summits, and a consistent increase of the total frequency of plant species at high elevation on West-Southern Alps.

P1.14 Pictorial Analysis for hard bottom Species Turnover (PAST) long-term monitoring

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Owing to climate changes and to fast increasing of human pressure along coastlines worldwide, we are loosing marine habitat complexity very fast. The main risk of the fragmentation of benthic populations is biodiversity loss and a dangerous decrease in habitats resilience, negatively affecting ecosystems services. Since hard-bottom communities undergo this kind of changes, becomes important to track an historical baseline of communities as much as possible pristine and undisturbed. The aim of this work is to consider two habitats generally well documented by underwater photographers since the 60-70's, coralligenous and wrecks, 1) to describe the benthic communities of the past, 2) to compare these with current benthic communities and, finally, 3) to evaluate possible causes of the long-term variations observed. To do this, we collect historical photographs about coralligenous and wrecks, we analyse them with dedicated software, and we compare the results with those obtained from the analysis of a current photo of the same area. The images are analysed in terms of abundance and evenness of a set of characteristic species and presence and composition of recognizable biocoenosis. As preliminary results, for some pictures about both coralligenous and wrecks, we have found a reduction of the complexity of the hard-bottom community, with the decrease of the animal component and the disappearance of characteristic species (e.g. massive sponges and gorgonians).



P1.15 Are seamounts 'oases' for deep-sea benthic biomass and diversity? A response from the Condor Seamount meiofauna

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Seamounts are isolated cone-shaped elevations of the deep sea. These features are considered hot-spots of biomass and biodiversity. Recent investigations have shown that they are characterised by highly variable topographic features, which can contribute to the heterogeneous distribution of nutrients and biota. Although in the last years increasing knowledge has been accumulated about seamount's ecology, the biodiversity and distribution of their small metazoan components is still poorly known. We explored the meiofaunal assemblage inhabiting the Condor seamount (NE Atlantic Ocean). Five different areas of this seamount were investigated: the summit, the north and the south flanks, the north and the south bases. Sampling depths ranged from 200 to 2000 m. An outer site located 37 km away from the seamount was selected as reference. Sediment samples were collected by independent multi-corer deployments and in each site four replicated cores were analysed. We investigated meiofaunal abundance, biomass, community structure, richness of higher taxa and nematode biodiversity in relation with sediment grain size and available food resources. Meiofaunal abundance and diversity were higher in the seamount than in the reference sites. The southern flank and base showed higher abundance and different taxa composition compared to their northern counterparts. These findings provide new insights on the biodiversity of the Condor seamount and on the factors controlling biodiversity and distribution of the fauna inhabiting the deep seamounts.



P2. Ecologia dei parassiti e delle malattie infettive

P2.1 Analisi preliminare sul monitoraggio di *Aedes albopictus* nella provincia di Cosenza e Vibo Valentia

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In Calabria, nell'ambito del progetto regionale "Piano per la sorveglianza, prevenzione e controllo delle malattie da importazione trasmesse da insetti vettori", è stato attivato il protocollo di monitoraggio di *Aedes (Stegomyia) albopictus* (Skuse 1894). La finalità dell'indagine è quella di studiare l'ecologia (abbondanza, distribuzione, preferenze ecologiche, vagilità altitudinale) di una specie divenuta in Italia l'elemento di maggiore importanza sanitaria. *A. albopictus* è infatti considerato un potenziale vettore di arbovirus di cui è nota la presenza nel bacino del Mediterraneo. Le aree monitorate sono 60, ricadenti nella provincia di Cosenza e Vibo Valentia. La scelta dei siti sensibili non ha seguito sempre un reticolo geometrico definito, ma è stata effettuata opportunamente in riferimento alla presenza di habitat idonei alla colonizzazione o di una potenziale infestazione. Per individuare i nuclei di maggior interesse è stata condotta l'analisi spaziale mediante il software ArcGIS 9.2 considerando il numero di uova/trappola conteggiate in ciascuna stazione georeferenziata. La distribuzione di *A. albopictus* è stata valutata attraverso la *Cluster analysis* e analisi delle componenti principali. L'individuazione delle aree con maggiore positività saranno quelle maggiormente controllate dagli enti pubblici che opereranno con piani di controllo delle popolazioni ed interventi di prevenzione la trasmissione di arbovirus ed elminti.

P2.2 Confronto tra comunità di elminti parassiti di anguille delle Valli di Comacchio, del fiume Po e del lago Piediluco

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Sono state studiate la composizione e la diversità delle comunità elmintiche in 262 esemplari di *Anguilla anguilla* (L.) provenienti da tre diversi habitat: uno salmastro, le Valli di Comacchio (FE), e due d'acqua dolce, il basso corso del fiume Po (FE) e il lago Piediluco (TR). La comunità di parassiti delle Valli è risultata ricca in specie (tutte marine, eccetto una) e dominata da trematodi digenei; dal 1997 al 2012 si sono registrate piccole modifiche della sua composizione (elevati indici di similarità), pur essendo cambiate abbondanza relativa e dominanza delle specie. Le comunità degli ambienti dulciacquicoli sono risultate entrambe povere in specie (tutte tipicamente d'acqua dolce) e dominate da acantocefali. Confrontando i campioni delle Valli con quelli del fiume e del lago e quelli delle due località d'acqua dolce tra loro, emergono bassi indici di similarità della parassitofauna. Le strutture delle comunità elmintiche delle anguille di Comacchio, del Po e di Piediluco sono simili a quanto riportato rispettivamente in lagune costiere, fiumi e laghi di altre parti d'Europa. Il nematode della vescica natatoria *Anguillicoloides crassus* presenta prevalenza ed abbondanza nettamente inferiori nelle Valli rispetto agli altri due siti: tale dato suggerisce che questo temuto parassita abbia un minimo impatto sulle anguille destinate alla migrazione e quindi una irrisoria importanza nel recente declino delle popolazioni di anguille.



P2.3 Spatiotemporal invasion conditions for waterborne pathogens

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Waterborne diseases can be transmitted through ingestion of pathogenic microorganisms that are found in contaminated water or food. Diarrheal disease, commonly associated to waterborne pathogens, represents one of the leading causes of death among children in low-income countries. The transmission of waterborne diseases is heavily linked to environmental drivers and their seasonal patterns. Here we derive the condition for pathogen invasion in a territory with specific demographic, epidemiological, hydroclimatic and socioeconomic characteristics, subject to seasonal variations of the relevant environmental forcings. If seasonal fluctuations are assumed to be strictly periodic, the quantity that actually controls pathogen invasion is the largest Floquet exponent ξ_{max} of the linearized system describing epidemic dynamics. Specifically, the threshold condition is $\xi_{max} > 0$, which does not require that local values of the basic reproduction number be larger than one. Our analysis shows that not only the amplitude, but also the geographical signatures (e.g. the predominant direction) associated with the environmental fluctuations contribute to defining pathogen invasion conditions. Also, we show that Floquet analysis can effectively be used to outline the geography of epidemic outbreaks, i.e. to identify the spatial locations that will be initially hit by an epidemic, with important implications for timely allocation of interventions and health-care resources.

P2.4 Expansion of the climatic niche in the Eurasian ticks *Ixodes ricinus* and *Ixodes persulcatus* under future climatic changes

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Understanding the effects of climatic changes on the distribution of tick vectors is pivotal for predicting the diffusion of pathogens they transmit. In this study we investigated how future climatic changes could affect the climatic niche of *Ixodes ricinus* and *I. persulcatus* (Acari, Ixodida), which are among the most important tick vectors of pathogens of medical and veterinary concern. Species Distribution Modelling (SDM), using the "maximum entropy" algorithm, was used to reconstruct the climatically suitable areas of the two species. Then we projected them into the future conditions for 2050 and 2080, under two climatic scenarios: the A2 scenario that proposes a continuous human demographic growth and a severe increase of gas emissions, and the scenario B2 that proposes lower human demographic growth than A2, and a more sustainable gas emissions. On the whole our results show that: (i) the areas of climatic suitability will drastically increase under both the two scenarios herein tested; (ii) the areas of co-occurrence between the two species could significantly increase and new areas of sympatry could arise. The potential changes in geographic distribution of *I. ricinus* and *I. persulcatus* driven by climatic changes and their impact on the epidemiological dynamics of vector-borne diseases are discussed.



P2.5 Prevalence, host range and spatial distribution of black band disease in the Maldivian coral reef

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Little research has been conducted on diseases affecting reef-building corals in the central-Indian Ocean. During 2010 and 2011, we performed a quantitative assessment of black band disease (BBD) in the central Republic of Maldives. Distribution, host range and prevalence of BBD were investigated in six coral islands (Magoodhoo, Adanga, Ihuru, Vabbinfaru, Thudufushi and Athuruga) belonging to three different atolls. BBD was found to be widespread among the atolls. All the islands showed a prevalence lower than 0.5 %. Magoodhoo island showed the highest mean disease prevalence. In the whole surveyed area shallow sites showed higher overall mean BBD prevalence than that of deep ones. BBD was recorded from 6 scleractinian families (Acroporidae, Faviidae, Poritidae, Siderastreidae, Agariidae, Fungiidae), and 13 scleractinian genera. Two of them, Gardineroseris and Sandalolitha, constitute new records for the disease. The siderastroid Psammocora (5.33 ± 1.41 %, mean $\pm$ SE) was the most affected genus followed by Goniopora (2.7 ± 1.3 %). BBD prevalence was positively correlated to the respective host density in both genera. Favites and Acropora were the less affected genera (both < 0.1 %). Although we observed an extremely low overall disease prevalence in the surveyed area (< 1 %), the large number of different scleractinian genera affected and the widespread distribution of BBD indicate need for further investigation.

P2.6 A spatially explicit model of cholera spreading in Bangladesh: the role of climate and mobility

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Cholera is a disease transmitted through exposure to water contaminated by the bacterium *Vibrio cholerae*. The disease is clearly linked to the variability of climatic factors, as infections are enhanced by intense seasonal precipitation (e.g. monsoon season). Here we propose a spatially explicit model for cholera and apply it to Bangladesh, where the disease is endemic, integrating the role of precipitation and temperature annual cycles. River networks represent one of the major pathways of disease spreading. The data structure designed for the application of the model is thus based on the hydrological connectivity network, as well as on the spatial distribution of the population and on the connections that regulate human mobility among communities. In this region, cholera incidence exhibits two annual peaks, although the main environmental drivers peak once per year during the monsoon season (from June to September). The proposed model attempts to explain these particular dynamics taking into account the annual fluctuations of water availability and considering hydro-climatological forcings as inputs for the model. For this purpose, a compartmental SIRB (Susceptible-Infected-Recovered-Bacteria) epidemiological model is integrated with a hydrological model. Results show that the introduction of two terms of transport (hydrological transport and human mobility) allows to generate spatial patterns of cholera prevalence that reproduce the bimodal pattern typically observed in this region.



P2.7 Patterns of genetic variation of a Lessepsian parasite

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Abstract Genetic studies of Lessepsian species often demonstrate the absence of a genetic bottleneck in a wide plethora of taxa, from plants to fish, but information regarding the genetic responses of their parasites in the newly colonized ecosystems is still lacking. This study compared genetic diversity of Red Sea (Eilat, Nabq), Suez canal (Ismailia) and Mediterranean (Rhodes, Tel Aviv) populations of the Monogeneoidea *Glyphidohaptor plectocirra* by sequencing a portion of the mitochondrial CoxI gene. Despite evidence of a slight decrease in the genetic diversity of Mediterranean populations, a simulation analysis based on coalescent theory demonstrated the absence of significant bottlenecks, but there was directional selection along a cline moving further from the Suez canal. The absence of bottlenecks was congruent with that described for *G. plectocirra* hosts *Siganus rivulatus* and *Siganus luridus*, and reflected a common history of high propagule pressure during initial colonization, and constant or repeated gene flow from the Red Sea to the Mediterranean area. However, directional selection was peculiar to the parasites and likely originated from parasite genotype 9 environment interactions. Finally, an anisotropic contribution of Red Sea populations to the Lessepsian invasion was demonstrated.

P2.8 Anisakid parasites of striped red mullet (*Mullus surmuletus* L.) from Porto Cesareo Marine Protected Area (Southern Italy, Ionian Sea)

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Mullus surmuletus is a species of high commercial interest and represents one of the main targets of artisanal fishing. This species lives in shallow coastal areas, over rocky to sandy bottoms, and recruits in *Posidonia oceanica* beds. Its particular feeding habit of scouring in the sediment in search of preys makes this fish a susceptible host for several parasites species. Several studies about the parasite fauna of *M. surmuletus* in Mediterranean sea have been carried out in the last decades, however there is a lack of knowledge about Ionian sea. In the present study, a total of 90 specimens of *M. surmuletus* were sampled from the Marine Protected Area of Porto Cesareo (Ionian sea) from January to June 2013. Fish were caught by trammel nets and collection sites geo referred. Each specimen was measured and weighted, and then dissected for parasitological examination mainly aimed to investigate the presence of anisakid nematodes. The collected anisakids were then identified, through morphological and molecular analyses, as *Hysterothylacium fabri* (Nematoda, Anisakidae). The occurrence of different developmental stages of *H. fabri* was observed in all (100%) of the examined specimens, with infection intensities ranging from 1 to 77 (Mean Intensity 22.86). Although *H. fabri* has already been reported from *M. surmuletus* in Mediterranean sea, our results show the highest prevalence so far observed in this host. Ecological and environmental determinants are discussed.



P3. Ecotossicologia, alterazione e restauro ambientale

P3.1 *Ecosafe* nanomaterials for seawater remediation: spermio and embriotoxicity of two n-TiO₂ formulations in sea urchin

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The use of nanomaterials (NMs) for in situ remediation referred as nanoremediation represents a promising and cutting-edge solution, by ensuring a quick and efficient pollutants removal. However, the use of such materials should not pose any additional risk to environmental and biota. In this regard, there is the need to evaluate the ecosafety of NMs for seawater remediation, thus the aim of this study is to investigate the ecotoxicity of two different n-TiO₂ formulations as Aeroxide® P25 and mesoporous n-TiO₂ (newly synthesized). Cadmium, was also tested as model toxic marine contaminant to be remediated. Sea urchin spermio- and embriotoxicity was performed in specimens of Mediterranean sea urchin *Paracentrotus lividus* as model marine organisms. Spermio- and embriotoxicity seemed not affected by n-TiO₂ Aeroxide® and mesoporous in the range of 0.01-10 mg L⁻¹, while Cd blocked the fertilization above threshold concentrations of 1 mg L⁻¹. On the contrary, embryos showed moderate developmental defects in both n-TiO₂ Aeroxide® and mesoporous while as expected those exposed to Cd showed several morphological aberrations. Results highlight the need to promote ecosafety tools such as the development of marine organisms in order to assess the risk related to use the NMs for sea water remediation.

P3.2 *Dreissena polymorpha* (Mollusca: Bivalvia) come agente bio-filtrante: prove preliminari di depurazione delle acque reflue

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Lo scopo della presente ricerca è stato quello di valutare il possibile abbattimento dalle acque di scarico di alcuni inquinanti ambientali recalcitranti mediante l'utilizzo del bivalve d'acqua dolce *Dreissena polymorpha*. Questo mollusco presenta alcune caratteristiche che lo renderebbero idoneo al fine sopra citato: un elevato tasso di filtrazione, compreso tra i 5 e i 400 mL/bivalve/h, un'elevata densità di popolazione e un'indiretta capacità di bioaccumulo di contaminanti lipofili nei tessuti molli. A tale scopo è stato costruito un impianto-pilota presso il depuratore di Milano-Nosedo, all'interno del quale sono stati posti circa 40,000 esemplari del bivalve, deputati alla filtrazione del refluo. È stata valutata inizialmente la capacità filtrante di *D. polymorpha* misurando l'abbattimento del valore di COD e dei solidi sospesi totali (SST) presenti nello scarico in analisi. Successivamente si è saggiata l'eventuale rimozione di alcuni microinquinanti, come droghe d'abuso e composti farmaceutici, attualmente non eliminabili dagli impianti di depurazione tradizionali. Le analisi preliminari mostrano una diminuzione dei parametri considerati, incoraggiando futuri approfondimenti sull'abbattimento dei contaminanti nelle acque di scarico associato all'attività filtrante di *D. polymorpha*.



P3.3 Dell'uso delle Black List di specie vegetali

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Sebbene negli ultimi vent'anni il tema delle invasioni biologiche sia stato ampiamente trattato dalla comunità scientifica e siano state attivate norme a differenti livelli, gli strumenti attuativi a sostegno delle azioni di eradicazione e di contenimento sembrano ancora carenti. Il censimento delle specie elencate nelle Black List è il primo passo per intraprendere opportune forme di lotta e in tal senso l'attività di audit riguardante il monitoraggio delle Grandi Opere e delle opere assoggettate a VIA consente di disporre di dati vegetazionali sufficienti per comporre un quadro dettagliato e dinamico della presenza di focolai in ambiti non protetti quali le superfici agricole, le pertinenze stradali e ferroviarie, gli ambiti fluviali. Tale patrimonio conoscitivo potrebbe favorire la realizzazione di interventi mirati di contenimento, per la realizzazione dei quali andranno però definite competenze, metodologie e risorse. Allo stato attuale infatti – a fronte di una certa attenzione per promuovere campagne informative e per approfondire le conoscenze su biologia ed ecologia delle specie alloctone invasive – non è chiaro il panorama del management e dei mezzi finanziari per elaborare e attuare le misure di lotta contro tali specie. L'unica eccezione sembra essere rappresentata dalle norme regionali per contenere la diffusione di *Ambrosia artemisiifolia*, che individuano nel Comune l'istituzione delegata ad adottare provvedimenti per realizzare gli interventi di contenimento.

P3.4 Mosses as bioindicators of nitrogen emissions from mud volcanoes around Mt. Etna

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Nitrogen emissions were assessed by using mosses as bioindicators in a densely inhabited area affected by mud volcanoes. Such volcanoes, locally called *Salinelle*, are phenomena that occur around Mt. Etna (Sicily, Italy), and are interpreted as the surface outflow of a hydrothermal system located below Mt. Etna, which releases sedimentary fluids (hydrocarbons and Na-Cl brines) along with magmatic gases (mainly CO₂ and He). To date, N emissions from such mud volcanoes have been only quantitatively assessed, and no biomonitoring campaigns are reported about the cumulative effects of these emissions. This study analyzed N concentrations in moss, water and soil samples, collected in a 4-year monitoring campaign. The bryophyte *Bryum argenteum*, a species widely adopted in surveys of atmospheric pollution, was used as a biological indicator. N concentrations in biomonitors showed relatively low values in the study sites. However, the results of this study suggest that N emissions from *Salinelle* may have an impact on surrounding ecosystems because N values in moss and water showed a significant correlation. N oxides, in particular, contribute to acidification of ecosystems, thus multitemporal biomonitoring is recommended, especially in those areas where N emitting sources are anthropogenic and natural.



P3.5 Pre-screening of soil water intended for reuse of treated wastewater

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Soil pollution has enormously increased in the last decades. New biological approaches to soil monitoring, such as the measurement of biochemical and cellular responses to pollutants (i.e. biomarkers) on organisms living in the soil (i.e., bioindicators), have become of major importance for the assessment of the quality of soil. The aim of the present work was to assess the performance of a suite of cellular and biochemical biomarkers in two earthworm species *Eisenia foetida* and *Lumbricus terrestris* exposed to copper sulphate or methiocarb in OECD soil at the maximal concentrations recommended in agriculture. Granulocyte morphometric alteration, lysosomal membrane stability, metallothionein concentration, and acetylcholinesterase activity were considered. In particular pollutant induced granulocyte enlargement, detected in either copper sulphate or methiocarb exposed organisms, showed to be a potential general biomarker that may be directly linked to organism health. Compared to the other biological responses to pollutants, it showed high sensitivity to pollutant exposure suggesting its possible applications as a sensitive, simple, and quick general biomarker for monitoring and assessment applications. This study was granted by PON01_01480.

P3.6 Livelli di ftalati in campioni di sangue di *Anguilla anguilla*

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Per la loro lipofilicità ed il largo impiego, soprattutto come additivi dei materiali plastici, gli ftalati sono diffusi in numerose matrici ambientali. Poiché alcuni ftalati esercitano un'azione di interferenza sul sistema endocrino gli studi sull'esposizione umana sono piuttosto numerosi; al contrario l'esposizione e l'accumulo di queste sostanze in organismi animali risulta scarsamente indagata. Appare pertanto importante incrementare le conoscenze sull'esposizione reale degli organismi, attraverso l'utilizzo di biomarcatori di esposizione. Lo ftalato più comune nell'ambiente è il di-(2 etilesil) ftalato (DEHP), che, una volta assunto dagli organismi, viene rapidamente metabolizzato a mono-(2 etilesil) ftalato (MEHP), largamente utilizzato come marcatore dell'esposizione a DEHP. In questo studio campioni di sangue prelevati da 20 esemplari di *Anguilla anguilla* (L.) provenienti dalla provincia di Ferrara, in parte dalle acque salmastre delle Valli di Comacchio e in parte dalle acque dolci del Po. Il MEHP è risultato il composto prevalente (rilevato in 15 campioni sui 20 analizzati, tra 2.07 e 3.28 ng/g), mentre il DEHP è stato riscontrato in una frazione inferiore di campioni (8 su 20) a livelli sempre di poco superiori al limite di rilevabilità (tra 10.23 e 11.73 ng/g). Questo studio pilota ha permesso di ottenere i primi dati in assoluto sulla presenza di ftalati nelle anguille.



P3.7 Development of a multidisciplinary, weight of evidence (WOE) model for Ecological Risk Assessment (ERA) in freshwater environments

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Ecological Risk Assessment (ERA) is a hierarchical, multidisciplinary procedure to characterize environmental quality and associated risks. Its application is often a normative requirement for any industrial development or remediation activities in contaminated sites, to support the adoption of the best management options. According to the general structure of this methodology, a conceptual and software-assisted weight of evidence (WOE) model has been developed for freshwater environments, aimed at weighting and integrating heterogeneous data from different types of chemical and biological investigations. Logical flow charts, based on expert judgment and legislative constraints, were converted into mathematical algorithms to elaborate specific hazard quotients and classify various elements of quality: such elements included 8 different lines of evidence (LOEs), i.e. chemical characterization of freshwater sediments and water column, bioaccumulation and biomarkers in typical bioindicator organisms, ecotoxicological bioassays, macro-invertebrates, diatoms community and macrophytes. The hazard quotients elaborated from individual LOEs are integrated in a Risk Index with an increasing weight according to the ecological relevance of various lines of evidence. The developed model is versatile, easy to update or adapt to local specificities, representing a useful tool for stakeholders in a more comprehensive process of risk assessment and "site-oriented" management decisions.

P3.8 Experimental and predicted assessment of the acute toxicity of antibacterial compounds and their mixtures using the luminescent bacteria *Vibrio fischeri* as biological target

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In this paper we have investigated the bioluminescence inhibition effects of the antimicrobials triclocarban, triclosan and its metabolite methyl triclosan, using the marine bacterium *V. fischeri* as test organism (Microtox®). The concentration response analysis was performed for the three individual substances and for a mixture in which the three compounds were mixed in the ratio of the IC₅₀ of the individual components (equitoxic ratio). The toxicity values (the median inhibitory concentration value, in mg/L) in decreasing order of sensitivity were triclosan (0.73) > triclocarban (0.91) > methyl-triclosan (1.76). The comparison of the experimental data with those obtained by using quantitative structure-activity relationship (QSAR) equations indicated that triclosan and triclocarban act as polar narcotic compounds towards *V. fischeri*, whereas methyl-triclosan as a narcotic (baseline toxicity). The toxicity of the mixture was measured experimentally and predicted by two models (CA: concentration addition; IA: independent action). The results showed that the observed mixture toxicity (IC₅₀ = 0.23 mg/L) had no significant differences from those predicted by both models.



P3.9 Toxicity of priority pollutants (Cadmium nitrate and Chlorpyrifos) on larval stages of the barnacle *Amphibalanus amphitrite* and the jellyfish *Aurelia aurita*

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Priority pollutants are chemicals found in aquatic environment as result of human and industrial activities; most of them may potentially cause deleterious effects at environmentally relevant concentrations. A list of priority pollutants present in the waters (sea or fresh waters) has been drawn up by the European Community. The aim of this study was to investigate the toxicity of two pollutants included in the list, cadmium nitrate $\text{Cd}(\text{NO}_3)_2$ and chlorpyrifos, on two marine model organisms: the crustacean *Amphibalanus amphitrite* (Darwin, 1854) and the Scyphozoan jellyfish *Aurelia aurita* (Linnaeus, 1758), an innovative model organisms in marine ecotoxicology. Nauplii of *A. amphitrite* and ephyrae of *A. aurita* were exposed in laboratory to different concentrations of contaminants (up to 10 mg L⁻¹) for 24 and 48 hours in order to analyze acute and behavioral end-points: for crustaceans mortality and swimming alteration have been evaluated and, for ephyrae, immobilization and frequency of pulsations. As regards ephyrae, results indicate that all the investigated end-points were able to underline toxic effects caused by the two contaminants and these effects have been quantified by means of the EC₅₀ values. The same results were observed in nauplii of *A. amphitrite* exposed to $\text{Cd}(\text{NO}_3)_2$, while no lethal and sub-lethal responses were detected after 24 hours of exposure to Chlorpyrifos. In conclusion, the obtained results contribute to the knowledge of the tested priority compounds effects and, above all, show the both organisms, especially the very new one for ecotoxicology (*A. aurita*), are very good promising model organism for ecotoxicological tests.

P3.10 Monitoraggio ambientale di un'area di sversamento a mare per materiale di dragaggio del porto di Ancona (Mar Adriatico)

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Le attività di dragaggio in ambito portuale sono talvolta necessarie a causa dell'insabbiamento dei fondali e più in generale per motivazioni legate all'organizzazione e gestione dei bacini portuali. Gli stessi dragaggi possono però comportare alcuni effetti a livello ambientale, sia nella fase di raccolta dei sedimenti che nella successiva fase di gestione del materiale dragato. L'immersione deliberata in mare di materiale di escavo dei fondali e dei terreni litoranei emersi è disciplinata dall'articolo 109 della legge 152/2006; tale norma rende necessaria la procedura di valutazione dell'impatto ambientale al fine di evidenziare possibili criticità associate a tali attività. Lo studio condotto è stato volto alla descrizione delle caratteristiche fisiche, chimiche e biologiche dei fondali dell'area di scarico dei sedimenti provenienti dai lavori di escavo del Porto di Ancona, al fine di valutare l'impatto causato dalle operazioni di sversamento e di verificare i tempi di ripristino delle condizioni ambientali naturali. Il piano di lavoro ha previsto un'iniziale caratterizzazione della zona (pre-survey) e due campagne successive: la prima al fine di monitorare lo svolgimento delle operazioni di dumping in corso d'opera e la seconda al termine dei lavori. Diverse metodologie di analisi sono state considerate nel piano di monitoraggio tra cui: rilievi dei fondali con Multibeam Echosounder (MBES) e Side Scan Sonar (SSS), indagini fisiche e chimiche dei sedimenti, la risposta di saggi biologici di tossicità dei sedimenti ed infine analisi della composizione delle comunità bentoniche. I risultati tendono ad evidenziare una iniziale diminuzione della qualità ambientale nell'area investigata come dimostrato dai risultati delle analisi chimiche ed ecotossicologiche sul sedimento e le indagini sulle comunità bentoniche. Questa situazione tende comunque a migliorare nel tempo ritornando, nell'ultimo survey, a una condizione comparabile a quella evidenziata nel corso del presurvey.



P3.11 A novel tool to improve the effectiveness and sustainability of seagrass restoration

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Seagrasses and the valuable ecosystem services they provide are threatened world-wide by impacts of human activity. Numerous revegetation efforts have attempted to restore seagrasses. Most restoration programmes use plants collected from the field because of limited seed availability, low seedling survival and difficulty in culturing plants. However, this practice risks damage to donor populations and has the potential to reduce genetic diversity, which may counteract the desired effects of restoration. A novel aquaculture system for producing plants (mother plants and cuttings) from a limited number of seeds was tested using *Cymodocea nodosa* as model species. The ability of transplanted cuttings to survive and grow in the natural habitat was also evaluated. Seed germination was high (48%) compared with field conditions, and most seedlings produced mother plants with up to 7-8 m of rhizome and 300 shoots within 4 years in culture. All cuttings from mother plants regenerated new plants. Up to 100 transplants were produced from two seeds, and most (85%) of them survived and initiated the colonization of substrate, 1 year after planting. This study provides a robust protocol that can reduce plant and/or seed collection pressure on donor populations, produces a high number of transplants which show lower mortality rates during the early transplantation phases and can preserve genetic diversity in restored populations.

P3.12 Cellular responses to chemical stress exposure in the land snail *Cantareus apertus*

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Terrestrial gastropods are known bioindicator organisms for ecotoxicological soil risk assessment. The study of snail hemolymph is becoming very interesting from a toxicological perspective for the development of novel cellular biomarkers. The aim of the present work was to investigate possible pollutant induced morphometric alterations in hemocytes of the terrestrial gastropod *Cantareus apertus*, as novel ecotoxicological biomarker for future monitoring and assessment application. In parallel, a well known standardized biomarker such as lysosomal membrane stability was analysed. Animals were exposed to the pesticide carbaryl for 15 days. Morphometric alterations of haemocytes were determined by image analysis on Diff-QuickR stained cells, while the lysosomal membrane destabilization was determined by the neutral red retention assay. Exposed organisms showed a dramatic enlargement of granulocytes, accompanied by cell rounding with loss of pseudopods with respect to the control group. In parallel, they showed a significant decrease of lysosomal membrane stability. Due to the important immunological role of granulocytes, the observed adverse effects may increase the susceptibility of animals to diseases and reduce their survival. The observed pesticide induced alteration in granulocytes and has been shown to be a sensitive biomarker of exposure in the snail *Cantareus apertus* suitable for future applications as an effective biomarker in monitoring and assessment programs.



P3.13 Toxicity and bioaccumulation as tools supporting the decision making process for selecting new materials for piling in the Venice lagoon

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Wood is extensively used for maritime works (e.g. mooring piles, docks, bulkheads and navigation channel marks - “briccole”), especially in estuarine and marine coastlines. In Venice lagoon (Italy), it has been observed a great acceleration in the decay of traditional natural piling materials mainly due to woodborers in addition to the water mechanical and bacterial actions. Local authorities in order to keep navigation safety and increase environmental protection identified a set of potentially ready-to-use piling materials concerning allocthonous wood, traditional wood with specific add-ins or treatments and others that are completely synthetic. The assessment of materials was based mainly on ecotoxicological and bioaccumulation issues (*Mytilus galloprovincialis* – translocated and caged), also looking at H14 implications. Analyses were carried on leachates generated considering various exposure scenarios. A battery of toxicity tests composed of selected saltwater species was taken into account with acute, sub-chronic and chronic endpoints (i.e. *Vibrio fischeri*, *Phaeodactylum tricornutum*, *Crassostrea gigas*, *Amphibalanus amphitrite* and *Tigriopus fulvus*). Species-specific toxicity scores and a final index were generated on the basis of some literature suggestions to facilitate toxicity data interpretation. The merge of data from ecotoxicological and bioaccumulation studies promoted the identification of a series of suitable piling materials for proper applications.

P3.14 Synthesis of Ag nanoparticles in living plants: distribution and promoting agents

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The biosynthesis of metal nanoparticles in living plants was observed in some plant species even though it is still a poorly known process. The driving force of such process inside the plant tissues is the redox potential that plants can put at play. Some hypotheses have been proposed about the source of redox potential. A series of experiments were carried out to verify the possible relationship between the formation of Ag nanoparticles and the concentration of certain products of plant metabolism. Seedlings of *Brassica juncea*, *Festuca rubra*, *Medicago sativa* and *Sorghum bicolor* previously germinated were grown in hydroponic culture for about 30 d. At the end of the growth cycle the concentrations of glucose (GLC), fructose (FRU), citric acid (CA), ascorbic acid (AS) and polyphenols (PPs) in young leaves of plants were determined. The plants were treated with a solution of AgNO₃ 1,000 ppm for 24 h, then samples of roots, stems and leaf tissues were collected. Plant samples were observed using TEM to localize the Ag NPs whereas the dimensional characterization of the Ag NPs was carried out by SEM-EDX. The Ag concentration was determined by ICP-OES. The results verified the relationships between the concentration of some plant metabolites and the amount/size of Ag nanoparticles synthesized by plants.



P3.15 Ecotoxicological potential of pharmaceuticals in aquatic environment: biomarkers in mussels exposed to Acetaminophen, Diclofenac, Ibuprofen, Ketoprofen and Nimesulide.

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Pharmaceutical compounds have been recognized as important emerging contaminants, potentially threatening also marine ecosystems. Due to their continuous release into the environment, such active substances represent a topic of concern for the possible adverse effects on non- target organisms. In this study the onset of sublethal effects were investigated in mussels *Mytilus galloprovincialis* exposed to environmentally realistic concentrations of five pharmaceuticals belonging to the same therapeutic class. Organisms were maintained for 4 weeks at 0.5 µg/L of Acetaminophen, Diclofenac, Ibuprofen, Ketoprofen or Nimesulide, dosed in separate experiments. Results on bioaccumulation of pharmaceuticals were integrated with mechanistic effects at cellular level; analyzed responses included alterations of the immune system in freely circulating haemocytes (lysosomal membrane stability, phagocytic activity and granulocytes/hyalinocytes ratio), variations of oxidative stress biomarkers (individual antioxidants and total oxyradical scavenging capacity toward peroxy and hydroxyl radicals), appearance of genotoxic damage (DNA integrity and micronuclei frequency). The overall results showed some variation of biological parameters, i.e. Ibuprofen and Ketoprofen appeared to modulate the immunological responses, increasing the granulocytes-hyalinocytes ratio and phagocytic activity; while no variation was observed neither for antioxidant parameters nor for genotoxic damage.

P3.16 Hatching test on *Artemia* sp. (Crustacea, Anostraca) cysts to evaluate the toxicity of Diethylene Glycol and Sodium Dodecylsulfate

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Ecotoxicological assays are commonly used to evaluate the impact of several kind of environmental pollutant on biota and to determine the effectiveness of certain species as bioindicator. The brachiopod crustacean *Artemia* sp. is one of the major test organisms in ecotoxicology because of its wide geographic distribution, relatively simple laboratory culture and maintenance, resistance to manipulation, short life-span, large offspring production and comprehensive information on the life cycle. Cyst-based toxicity assays are underemployed although they are cheap, simple and reliable. The great majority of *Artemia* toxicity data deal with lethal effects and to a lesser extent on effects under subchronic exposure (endpoints: growth, reproduction, motility, etc.) because of the quite complex procedure. In this study the toxicity of diethylene glycol on the hatching rate of *Artemia franciscana*, on a short time lag (24-48 h) has been evaluated. These result are compared to acute and chronic test results to highlight the effectiveness of this test. Diethylene glycol is an additive largely used during oil and gas exploitation by offshore platforms. Toxicity data are also compared to a reference toxicant, i.e. Sodium Dodecylsulfate. Results highlight the medium toxicity of diethylene glicol and confirm the reliability of the hatching assay as a "short-term chronic test", suggesting its application for routine toxicity evaluations.



P3.17 Seawater and sediment toxicity assessment of the area affected by the Costa Concordia wreck using algal and sea urchin bioassay

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On 13 January 2012, the cruise ship “Costa Concordia” collided with submerged rock a few hundred metres from the island of Giglio (Tuscany coast). The impact made a 70-metre gash in the hull that caused the sinking of the ship, claimed 32 victims and created a potential environmental disaster the extent of which is still to be evaluated. One of the goals of the monitoring plan financially supported by the Civil Protection Department and conducted by ISPRA is to assess the possible toxicity of water and sediment linked to the Costa Concordia wreck. Water and sediment samples were collected periodically at different stations, including a reference site located on the southern coast of the island of Giglio. The evaluation of toxicity was attempted by using ecotoxicological bioassays with marine organisms. Specifically, the inhibition of algal growth with unicellular algae (Bacillariophyta) *Phaeodactylum tricornutum*, and the fertilization and embryo-development bioassay with sea urchin *Paracentrotus lividus* (Echinoidea) were performed. Preliminary results show an increase in toxicity in the water stations near the ship towards the end of February 2012, particularly for the embryo bioassay with *P. lividus*. However, during the ensuing period the result did not show particularly critical conditions in terms of toxicological disturbance due to the shipwreck. Further investigations are still in progress for a better and more comprehensive evaluation.

P3.18 Influence of environmental parameters on lethal and sublethal responses of larvae of *Amphibalanus amphitrite*

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Laboratory biological tests (bioassays) have increased in development and application over the last 10 years in the field of aquatic ecotoxicology, the constant search for simplicity and cost efficiency of testing are reasons explaining the expanding use of bioassays. Recently, with UNICHIM support, we completed the standardization process of the acute toxicity assay with larvae (II stage nauplii) of *A. amphitrite*. In this work, we performed a study about the influence of two main environmental parameters (salinity and temperature) on three end-points having an increasing level of sensitivity. Salinity and temperature represent two environmental variables able to influence most of biological processes. Usually, test protocols provide fixed values for these parameters, but their effect on the ecotoxicological response of model organisms is mainly unknown. Aim of this work was to identify for each of the three considered end-points (mortality, immobilization and swimming speed alteration) the reference values (minimum and maximum value) within no effect ascribable to the variation of the environmental parameter is observed. A series of bioassays with different ranges of salinity (10,20,30,40,50,60,70 ‰) and temperature (2.5, 5, 10, 15, 20, 25, 30, 35, 37.5, 40°C)) has been performed and a non-effect range has been defined for each end-point. Having knowledge of these ranges can enhance the possibility of applying this multi end-point bioassay also with samples that can present a variability of environmental parameters (i.e. sediments).



P3.19 Indagine preliminare sugli effetti di deltametrina in esemplari di trota iridea (*Oncorhynchus mykiss*)

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La Deltametrina è un pesticida appartenente alla famiglia dei piretroidi di tipo II, largamente utilizzato in campo agricolo e veterinario. In Europa, la deltametrina è inserita nell'allegato I del decreto legislativo n. 194 (17 marzo 1995). Nel presente studio, gli esemplari di trota iridea (*Oncorhynchus mykiss*) sono stati trattati, mediante unica iniezione intraperitoneale, con concentrazioni sub-letali di deltametrina (0,033, 0,1 e 0,3 mgKg⁻¹). Dopo 48, 96 e 192 ore sono stati valutati gli effetti del pesticida su alcuni biomarcatori epatici di stress ossidativo e sui micronuclei negli eritrociti periferici. L'esame necroscopico e anatomopatologico nei pesci trattati non ha evidenziato lesioni correlabili al trattamento con deltametrina. Tutti i soggetti esaminati presentavano un numero di micronuclei compreso nel range fisiologico. Tuttavia le trote trattate con la deltametrina hanno evidenziato attività enzimatiche deplese di GPx e GST dopo 48 e 96 ore. Dopo 8 giorni dal trattamento con il pesticida, ambedue le attività enzimatiche hanno mostrato livelli simili a quelli del controllo, indicando pertanto un transitorio effetto tossicologico della deltametrina a tali dosaggi.

P3.20 Application of "weighted" criteria to classify sediment quality in harbour areas.

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Sediment quality characterization is a crucial step for dredging and management activities in harbour areas. National guidelines elaborated by APAT-ICRAM provide technical elements which, in respect to regulatory frameworks relying exclusively on chemical characterization, allow to classify sediments based from the combination of chemical results and ecotoxicological bioassays; these results are evaluated with a pass-to-fail approach relative to chemical limits or considering the worst ecotoxicological result. During an ongoing research study in the harbour of Trapani, the above procedure was compared with a quantitative weight of evidence (WOE) model which elaborates both chemical and ecotoxicological data using weighted criteria. Among these, the chemical classification considers numbers, magnitude and typology of exceeding pollutants, while the indexing of biological responses is based on the relevance of measured endpoints, tested matrix, time of exposure, magnitude and statistical difference of effects compared to specific thresholds. The model provides synthetic indices of hazard for chemical and ecotoxicological data, before their integration in a sediment quality class. The proposed adaptation of the WOE model allows a quantitative characterization of sediment quality and a better discrimination of on the basis of various types of chemical and biological data, providing new criteria and suggestions for a normative revision of dredging operations in harbour areas.



P3.21 Uso di fitofarmaci nella coltura del riso: valutazione degli effetti biologici in differenti organismi modello

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L'utilizzo di fitofarmaci è diventato parte integrante dell'agricoltura ed in particolare nelle monocolture, come nel caso della coltura del riso; tali sostanze per loro stessa natura provocano nel sito di utilizzo una forte alterazione della biodiversità. Questa ricerca si propone di valutare la tossicità su differenti organismi di singoli fitofarmaci e della loro miscela simulando in laboratorio i trattamenti effettuati nelle risaie. A tale scopo i suoli sono stati trattati nell'arco di 28 giorni con un insetticida (Contest), un zanzaricida (Diflubenzuron), un erbicida (Gulliver) e un fungicida (Beam) secondo quanto previsto dai produttori. Gli effetti biologici delle sostanze chimiche sono stati valutati mediante bioassay esponendo crostacei (*D. magna*), alghe (*P. subcapitata*), batteri (*V. fischeri*) e protozoi (*D. discoideum*) agli elutriati ottenuti dai suoli trattati. Si è inoltre valutata la tossicità di tali inquinanti mediante l'utilizzo del verme *E. andrei* esposto ai suoli contaminati. I risultati dimostrano che i fitofarmaci hanno effetti trascurabili a livello di organismo/popolazione. Tali sostanze provocano invece rilevanti effetti subletali come evidenziato in *E. andrei* dalla forte riduzione della stabilità delle membrane lisosomiali e della funzionalità mitocondriale dei celomociti, così come una inibizione dell'attività della Ca²⁺-ATPasi nelle cellule della mucosa intestinale. L'incremento della frequenza dei micronuclei dimostra inoltre che i composti chimici utilizzati nel trattamento delle risaie provocano negli organismi danno genotossico.



P4. Ecologia microbica

P4.1 Gene expression study in the toxic dinoflagellate *Alexandrium minutum* by qPCR

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Despite technological advances implemented during the last century, foodborne illnesses are increasing. Among the microorganisms that are potential health risks, there are some species of marine microalgae that produce toxins. Bivalve molluscs feed primarily on phytoplankton and ingestion of contaminated shellfish by humans, may lead to the onset of pathological states also very serious. The purpose of this project is to develop innovative molecular method for monitoring water and shellfish in aquaculture systems. This molecular method will aim at identification of microalgae species producing marine biotoxins (saxitoxin) and also quantification of the expression levels of saxitoxin genes involved in the production of these hazardous molecules by quantitative PCR (qPCR) analysis. The qPCR conditions for relative quantification of cDNA were optimized and preliminary results on variations in the levels of genes expression of *sxtA* and *sxtG* between the exponential and stationary phase in various strains of the toxic dinoflagellate *Alexandrium minutum* were obtained. The data were recovered using two different approaches: using endogenous control-like house keeping genes (actin and 5.8S rDNA) or one exogenous control of human origin (β -2-microglobulin). The results obtained showed that in stationary phase of growth there was a slight down regulation of *sxtA* gene. Finally, the relative quantification results were correlated with toxin amount produced by each strain in the two phases of growth.

P4.2 Spatio-temporal scales of variability of the benthic allochthonous mucilage-forming microalga *Chrysophaeum taylorii*: investigating the predictability of cell abundance

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Chrysophaeum taylorii Lewis and Bryan (Pelagophyceae) is an allochthonous benthic microalga recently recorded in the Mediterranean Sea, where its blooms are visible to the naked eye due to the large amounts of mucilage it produces. As no information on the multiple scale dynamics of variability of this mucilage-forming species are available yet, a four year (2008-2011) mensurative experiment was carried out on this topic in Tavolara Punta Coda Cavallo Marine Protected Area (Western Mediterranean Sea). *C. taylorii* cell abundance was estimated at several spatial (areas, sites, zones and replicates) and temporal (times and years) scales and the contribution of each scale to the total observed variability was calculated. The results indicate time and year as the most relevant scales of variability in this microalga cell abundance and highlight the unimportance of small spatial scales (zone and replicates) in determining the species total variability. Therefore, as patterns in *C. taylorii* cell abundance seem to be strictly dependent on the investigated scale, different scales of variation must be certainly considered when studying processes related to this species performance in the future. Furthermore, as oceanographic conditions such as sea water temperature and water movement seem to play a major role in determining *C. taylorii* cell proliferation, these environmental factors must be taken into account when trying to predict the cell abundance of the microalga on the substratum.



P4.3 Relazione pianta - suolo nella cv. Pisciotana (*Olea europaea* L.) del Parco Nazionale del Cilento e Vallo di Diano

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L'olivo, sclerofilla sempreverde tipica del Mediterraneo, è capace di adattarsi a lunghi periodi di siccità, alle alte temperature e all'intenso irraggiamento. Sebbene l'olivo abbia sviluppato specifici meccanismi anatomici, fisiologici e biochimici, le risposte allo stress idrico sono molto variabili tra cultivar, a causa della elevata diversità genetica delle specie. Ciascuna cv. è generalmente associata a specifiche proprietà fisiche, chimiche e biologiche del suolo e a determinati tratti fogliari funzionali indicatori di come la pianta utilizza le risorse dell'ambiente. Lo scopo di questo lavoro è stato quello di investigare le relazioni pianta-suolo nella cv. Pisciotana del Parco Nazionale del Cilento, ed evidenziare le variazioni delle condizioni edafiche e delle caratteristiche fogliari funzionali in risposta alla stagionalità e al disturbo dovuto all'azione di *Sus Scrofa* L. I suoli sotto la cv. Pisciotana hanno mostrato la più elevata attività microbica nelle stagioni autunno e inverno in relazione probabilmente al più alto contenuto idrico. La presenza e l'attività dei cinghiali ha comportato un incremento della sostanza organica del suolo indipendentemente dalla stagione. Durante il periodo estivo si è invece osservato un aumento della biomassa fungina e microbica. Per quanto riguarda i tratti fogliari funzionali i valori più bassi di RWC e più alti del rapporto C/N sono stati osservati nel periodo primaverile.

P4.4 Effect of pentachlorophenol concentration and pH on adsorption capacity of *Anthracophyllum discolor* pellets

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Pentachlorophenol (PCP) is a pollutant worldwide and dangerous for the ecosystems and humans health. It has been introduced into the environment mainly as a wood preservative but, the indiscriminate use of PCP has led to the contamination of water and soil systems. In this study we have detected as PCP concentration and pH can influence PCP biosorption by *Anthracophyllum discolor* pellets for the bioremediation of PCP contaminated water. PCP adsorption was evaluated after 24 hours in KCl liquid medium at PCP concentrations of 2.5 and 5 mg L⁻¹ and pH values between 4 and 9 (with intervals of 0.5). Finally, the Fourier transform infrared spectroscopy (FTIR) was used to identify functional groups of fungal biomass that can interact to PCP. PCP adsorption by *A. discolor* was >85% to pH values of 5 and 5.5 at two concentrations analyzed. PCP adsorption significantly decreased in basic medium. FTIR results showed that amines, carboxylates, alkanes and C-O groups can be important to PCP adsorption for pellets of *A. discolor*. Finally, the pellets of *A. discolor* can be considered a good PCP biosorbent from aqueous solutions.



P4.5 Bacterioplankton dynamics in a jellyfish-dominated coastal ecosystem: the lake of Varano (Apulia)

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Microbial engines drive the biogeochemistry of any ecological system. In aquatic systems, the largest fraction of the organic C cycles through the microbial food web. Decaying biomasses from jellyfish blooms may influence the amount of dissolved organic and inorganic nutrients and regulate bacterial dynamics in coastal waters. In 2000, a population of the invasive jellyfish *Aurelia sp.* entered the coastal sound of Varano (Apulia), turning into a key component of the present-day lagoonal biota. The impact of jellyfish biomass on the Varano bacterioplankton dynamics was investigated on seawater samples collected in different lagoon areas. Samples were fixed with formalin, DAPI-stained and filtered on 0.2-µm black polycarbonate filters. Bacterioplankton counts were performed by epifluorescence microscopy and cells were sorted into three size classes: small, medium and large. Bacterioplankton biomass was estimated using a carbon: volume conversion factor of 310 fg C µm⁻³. The highest values of bacterial biomass (468 µgC l⁻¹) and abundance were recorded in September, when jellyfish disappeared from the water column. In presence of jellyfish, the highest bacterial biomass was recorded in May (78.5 µgC l⁻¹), when large-sized bacteria were the prevailing size class. Coupling bacterioplankton and jellyfish dynamics with environmental parameters will contribute to highlight changes in trophic pathways and to unravel the impact of jellyfish blooms on the ecology of coastal zones.

P4.6 Extracellular RNA in marine sediments: methodological approaches and ecological implications

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In the framework of the National Flag Project RITMARE (Marine Italian Research) we investigated, for the first time, the quantitative relevance of extracellular RNA in different benthic marine ecosystems characterized by different environmental conditions. Extracellular RNA concentrations vary widely among the investigated benthic systems showing the lowest values in surface sediments of highly eutrophic coastal sites. We provide evidence of fast uptake rates of extracellular RNA suggesting that this molecule could be an important trophic source for benthic organisms. Despite this, a fraction of extracellular RNA (ca. 30%) escapes utilization and can be preserved in the sediments as also indicated by the high extracellular RNA concentrations found in sub-surface sediment layers. Using Real-Time PCR analyses we show that the extracellular RNA pool contains low amounts of prokaryotic 16S and eukaryotic 18S rRNA gene sequences suggesting that the majority of such pool can contain other and/or damaged genes. Our findings open new perspectives for exploring the role of extracellular RNA in benthic trophodynamics and biogeochemical processes and provide new cues for paleoecological investigations.



P4.7 Emissioni di N₂O ed attività microbica in una coltura di patata cresciuta con fertilizzante addizionato con l'inibitore della nitrificazione "DMPP".

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I suoli agricoli contribuiscono in larga parte all'emissione globale di N₂O; ciò a causa dell'impiego di fertilizzanti azotati in eccesso rispetto alle reali esigenze della coltura. L'N₂O è prodotto dall'attività dei batteri nitrificanti e denitrificanti, influenzati dalla disponibilità di azoto nel suolo. Tra le strategie proposte per ridurre le emissioni di N₂O, l'impiego in agricoltura di fertilizzanti addizionati con inibitori della nitrificazione trova sempre più consenso in quanto è richiesta una bassa dose di questi fertilizzanti rispetto ai concimi convenzionali, con un incremento della resa colturale. In questo lavoro è stato valutato l'effetto dell'inibitore della nitrificazione "DMPP" sull'emissione di N₂O e sull'attività biologica in un suolo coltivato a patata. Due trattamenti sono stati messi a confronto: tre parcelle sono state fertilizzate con NH₄NO₃ addizionato con il 3,4-dimetilpirazolo-fosfato (DMPP) ed tre fertilizzate senza l'inibitore (Controllo). L'emissione di N₂O è stata monitorata attraverso un sistema di camere automatiche collegato ad un gas cromatografo. Misure settimanali di emissione di N₂O, con camere statiche, sono state effettuate assieme alle misure dell'attività microbica. Inoltre la comunità edafica di questi suoli è stata caratterizzata attraverso misure di biomassa microbica e fungina e di diversità funzionale, misure che consentono di valutare gli eventuali effetti del DMPP sulla composizione e le attività della comunità microbica.

P4.8 Batteri produttori di biosurfattanti appartenenti al genere *Joostella* isolati dal polichete *Megalomma claparedei* (Gravier, 1906).

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12 ceppi batterici affiliati al genere *Joostella* sono stati isolati da colture di arricchimento allestite usando omogenati del polichete *M. claparedei*, e selezionati come produttori di biosurfattanti (BS). La tecnica di fingerprinting (ERIC)-PCR ha evidenziato una buona similarità dal punto di vista filogenetico, nonostante differenze ceppo specifiche. Sulla base di uno screening preliminare per la produzione di BS, *Joostella* sp. A8 è stato scelto per indagini più approfondite. I saggi fisiologici hanno condotto ad una conoscenza più completa del metabolismo del ceppo: optimum T 25-37°C; optimum pH 5.3– 7.6. Il GN2BIOLOG ha evidenziato una migliore efficienza media durante l'incubazione a 35°C. Gli acidi grassi a catena ramificata C4:0(46.98 %), C14:0(3.39%), C16:0(38.02%), C20:2(2.76 %), C6:0(1.47%) sono risultati più abbondanti. *Joostella* sp. A8 ha mostrato resistenza a cloramfenicolo, neomicina, acido nalidixico, penicillina, tobramicina, agente vibriostatico O/129. L'esperimento in bioreattore ha evidenziato un'ottima velocità di crescita, e indici di emulsione stabili fino a un massimo di 66% a 49.17 ore. L'ottimizzazione ha determinato i seguenti parametri ottimali: crescita in terreno minerale 25/30°C in presenza di NaCl (3%, gr/l), con differenti fonti di azoto (NH₄Cl, NH₄NO₃, NaNO₃; 1 gr/l). *Joostella* sp. A8 ha prodotto emulsioni stabili in presenza di Zn, Cu e Cd a differenti concentrazioni. I dati ottenuti hanno sottolineato le grandi potenzialità biotecnologiche del genere considerato, e approfondito aspetti ancora poco noti.



P4.9 Unveiling the secrets of the microbial biodiversity and ecosystem functioning of the hadal oceanic sediments

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Viruses are the most abundant biological entities in the world's oceans and play key roles in the functioning of marine ecosystems. The impact of viral infections (the so called viral shunt) becomes even more relevant in the deep ocean. Here viruses, by lysing their hosts, convert nearly all of their biomass production into debris and labile macromolecules, fueling the metabolism of the surviving microorganisms. For testing the drivers of these processes, we collected samples from the surface and sub-surface sediments from abyssal to hadal depths, down to 9776 m (i.e., from the outside to the deep interior of the Izu-Ogasawara Trench, Pacific Ocean). Viruses, total prokaryotes, bacteria and archaea, as well as bacterial and archaeal 16S rRNA and amoA genes were quantified. Classical bacterial and archaeal 16S rRNA and amoA gene clone libraries were coupled with direct 454 pyrosequencing of previously isolated intracellular and extracellular DNA pools. We found higher abundances of viruses, bacteria and archaea, higher rates of viral production and cell lysis and higher amounts of extracellular DNA at hadal depths. The taxonomic and functional diversity differed at abyssal vs hadal depth and in surface vs sub-surface sediments, with surprisingly high β -diversity values. We show here that the Izu-Ogasawara Trench acts as a bioreactor of microbial activity, with viral infections enhancing prokaryotic metabolism, recycling of organic matter and prokaryotic turnover biodiversity.

P4.10 Efficienza biodegradativa e produzione di biosurfattanti da parte di batteri isolati da policheti.

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Esperimenti in microcosmo e in consorzio (J-A; J-P) sono stati effettuati per uno studio di efficienza biodegradativa e di produzione di biosurfattanti (BS). I ceppi studiati *Joostella* sp. A8, *Alcanivorax* sp. A53 e *Pseudomonas* sp. A6 sono stati isolati da colture di arricchimento allestite utilizzando omogenati di campioni di policheti. I microcosmi hanno evidenziato un tasso di crescita in ordine decrescente A6>A53>A8. Tutti i ceppi hanno mostrato ottimi risultati allo screening della produzione di BS, ma *Joostella* sp. A8 è risultato il più performante, con indici di emulsione stabile e tassi di idrofobicità più elevati (E24 78.33%; idrofobicità 62.67%), una riduzione della tensione superficiale di 33.43 mN/m. Dalle indagini condotte sui consorzi batterici tramite tecniche di ibridazione (FISH) è risultato che in entrambi i consorzi i ceppi hanno assunto valori simili di abbondanza. Emulsioni stabili e tasso di idrofobicità hanno avuto andamento fluttuante, anche se una maggiore efficienza è stata evidenziata dal consorzio J-P. Le indagini gas-cromatografiche hanno riportato un'efficienza biodegradativa di 52.75%, 38.22%, 26.83% per i ceppi A53, A6 e A8. I consorzi batterici hanno evidenziato un aumento di tali valori, con percentuali di 99.39% e 99.17% per i consorzi J_A e J_P. Il lavoro proposto propone un'indagine comparativa tra generi batterici di grande importanza nell'ambito dei biosurfattanti e della bioremediation, i consorzi sono risultati utili per prospettare una applicazione più vicina a quelle che sono le condizioni *in vivo* riscontrabili nell'ambiente.

P5. Ecologia delle macrofite**P5.1 Effetto della struttura fogliare di *Posidonia oceanica* sull'invasione della macroalga alloctona *Caulerpa racemosa* al margine delle praterie**

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Nell'Area Marina Protetta Tavolara Punta Coda Cavallo (NE Sardegna) è stato condotto un esperimento manipolativo atto a valutare la performance invasiva della macroalga alloctona *Caulerpa racemosa* (Forsskal) J. Agardh nelle praterie della fanerogama *Posidonia oceanica* (L.) Delile. Unità sperimentali (40x40 cm) sono state realizzate al margine di una prateria considerando fasci fogliari naturali, di plastica trasparente o colorata (controllo procedurale), di cui è stata manipolata sia la densità (20%, 50% e 100%) che l'altezza (lunghi e ridotti) (n=3). In ogni unità sono stati trapiantati due frammenti di *C. racemosa*. La performance dell'alga è stata valutata attraverso la lunghezza delle sue fronde e il ricoprimento percentuale; inoltre, è stata indagata l'influenza dei fattori illuminazione, idrodinamismo, sedimentazione e abrasione dovuta al movimento delle foglie della fanerogama. Contrariamente alle aspettative, lo sviluppo di *C. racemosa* è risultato maggiore in presenza di *P. oceanica* naturale lunga e di densità 100%; la performance invasiva della macroalga, inoltre, non è sembrata direttamente influenzata da nessuno dei fattori fisici considerati. Questi risultati suggeriscono che nell'AMP, laddove lo strato fogliare di *P. oceanica* ha un'architettura minore, l'invasione di *C. racemosa* sarà d'importanza inferiore. Emerge dunque l'importanza di investigare se l'influenza della struttura fogliare interagisca indirettamente con processi predatori.

P5.2 Dallo studio delle macrofite come bioindicatori un importante contributo alle conoscenze sulla biodiversità in Umbria.

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L'introduzione con la Direttiva Quadro per le Acque 2000/60/CE del monitoraggio delle macrofite come indicatori dello stato ecologico dei corpi idrici, ha rappresentato un importante passo in avanti ai fini dell'acquisizione di nuove conoscenze sulle fitocenosi acquatiche presenti nel territorio umbro. L'applicazione della normativa sul controllo della qualità delle acque ha dato avvio infatti, ad un importante processo di cambiamento riguardo all'importanza attribuita allo studio della biodiversità degli ambienti acquatici ed ha determinato la messa in campo di operatori formati, che rilevano sistematicamente, secondo una metodologia condivisa a livello europeo ed in stretta collaborazione con gli specialisti, la composizione e la copertura delle comunità vegetazionali acquatiche. In Umbria il monitoraggio delle macrofite ha permesso fino ad ora la determinazione di 156 taxa di cui: 87 fanerogame, 37 briofite, 28 macroalghe e 4 pteridofite, che caratterizzano gli habitat lotici e lentici presenti in 38 corpi idrici della Rete Regionale di monitoraggio delle acque superficiali. I dati raccolti dal 2008 fino ad oggi, oltre ad essere stati elaborati per il calcolo dell'indice RQE_IBMR, previsto per il processo di classificazione dello stato di qualità dei corpi idrici superficiali, permettono di eseguire considerazioni ecologiche sulla diversificazione delle comunità presenti, sulle specie dominanti, sulla diffusione di specie alloctone invasive, sulle specie minacciate. Le liste floristiche prodotte rappresentano un importante contributo per un aggiornamento delle Check-list delle specie macrofite presenti sul territorio umbro e per la messa in atto di azioni di tutela e protezione della biodiversità degli ecosistemi acquatici indagati.



P6. Ecologia quantitativa

P6.1 Fish condition in natural and artificial habitats: an example from the South European Toothcarp *Aphanius fasciatus*

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The Venice lagoon is characterized by different shallow-water habitats, where salt marshes represent an important feature for many nektonic species. In addition, small lagoon islands show a typical agricultural landscape that still host small ditches, once used in traditional fishery activities. The aim of this study is to determine the ecological value of these habitats for the nektonic community, particularly referred to the small teleost *Aphanius fasciatus*, listed in Annex II of 'Habitat' Directive 92/43/CEE. Fish were sampled from March to August in four sites of the Venice lagoon: two natural salt marshes and two artificial ditches. Five sub-sample of 30 males and 30 females were preserved for laboratory analysis. All specimens were measured (L_S) and weighted (W_T) after evisceration. Separately for the two sexes, condition factor W_R was then calculated for each specimen, according to the relative weight methods, using the length-weight median regression estimated on all the sampled specimens. Comparisons of W_R were carried out by means of quantile regression analyses, considering two different factors: food level (poor-rich) and habitat (natural-artificial). In both sexes, a significant effects of the two factors were found at different quantile levels. Fish from natural salt marshes showed higher W_R values than fish from artificial habitats. Furthermore, in both habitat types a significant effect of habitat trophic richness was found, with higher W_R values in sites with higher environmental basal resources.

P6.2 Seed traits variation and their effects on germination for high altitude mountain species

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Endemic species are a significant feature of high mountain Mediterranean climate which are one of the most threatened systems in the European Union. Seed germination capability of *Adonis distorta*, *Androsace mathildae*, *Aquilegia magellensis* and *Campanula fragilis* subsp. *cavolinii* (endemic species of Central Apennines and included in the Regional Red List) were studied. Pre-treatments to increase germination rate (250, 500 ppm GA3 treatment, cold-wet stratification treatment) were carried out on seeds collected from the wild populations growing at high altitude on Mount Majella (Italy). The results show significant differences in seed traits and germination rate among the species. Germination does not occur in *Ad. distorta* and *An. mathildae* in response to the treatments suggesting that seeds from the highest elevation have a deep physiological dormancy. The treatment with 500 ppm GA3 has a significant effect on germination of *Aq. magellensis*. The cold-wet stratification treatment increases germination in *Aq. magellensis* and decreases it in *C. fragilis*. The observed differences in seed dormancy may be also related to the seed coat thickness which is the largest in *Ad. distorta*, *Aq. magellensis* and *An. mathildae* and the lowest in *C. fragilis*. Our results underline the importance of the selected treatments to favor seed germination of these endemic species and may be used for a protocol in reinforcement projects of the wild populations as a means of reducing the extinction risk.



P6.3 Trees and pollution: joint actions on trees and layout of road space

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The existing transport model is based on the use of fossil fuels. Moreover, freight and passengers mobility is also based on road transport. This model of transport is responsible for 23% of the energy consumed in Europe, whereas about three-quarters of this is used by road transport. The latter causes high emissions of air pollutants: CO₂, particulate matter (PM₁₀ and PM_{2.5}), nitrogen dioxide and sulfur dioxide. We aim to evaluate what contribution is given by the masting road in the reduction of urban pollution and what contribution it could give if it given greater importance to the ability to absorb pollutants in addition to the functional, aesthetic, shape, and biodiversity aspects and in relation to the road and flows types. This assessment is made within the context of researches related to the concepts of traffic reduction and typology of environmental areas. The research has been focussed on one neighbourhood of the urban area of Rome, where there are 92 vehicles per 100 inhabitants vs. the national average of 65 vehicles per 100 inhabitants and the European average of 49 vehicles per 100 inhabitants. In this neighbourhood there were 2176 trees on 5951 available places, including deciduous, evergreen and conifers. Significant values of particulate matter (PM₁₀ between 4.34 and 8.32 t/year, depending to 50% or 4% of re-suspension) have been calculated for the existing masting road. Furthermore we estimated the role of plantation of native plants replacing them in the remaining places along principal roads.



P7. Stress ambientali e servizi ecosistemici

P7.1 A new mortality mass event in the NW Adriatic Sea: do ahermatypic cnidarians will rule the benthic realm?

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Benthic mortalities has become more frequent in the NW Adriatic Sea: on October 2011, five years after the last disease, a mass mortality event occurred at the Conero Promontory, after a long period of high temperatures and calm waters. We compared the values of abundance of some species determined before, during and after the disease. The most damaged species was the sponge *Chondrosia reniformis* that in this area was present also with big individuals, with an average sponge cover of $43.2\% \pm 6.8$. The 70% of the population died and only few small individuals (cover $6.3\% \pm 4.9$) survived. Concerning the cnidarians, polyps of hydroids and stolonifers were no more visible while those of anemones and zoanthids were present but contracted. In November 2011 all the damaged individuals of *C. reniformis* were detached by rough-sea conditions, leaving large bare areas. On the contrary, all the affected cnidarians were in healthy conditions. In June 2013 the specimens of *C. reniformis* did not increase significantly in size while the bare areas were colonized by fast growing species such as the anthozoans *Cornularia cornucopiae* and *Epizoanthus arenaceus*, several hydrozoans, incrusting algae, the polychaete *Spirobranchus triqueter* and the bryozoan *Schizobrachiella sanguinea*. This study put in evidence that in the long-term, environmental stresses could promote a strong reduction of slow-growing sponges, facilitating fast growing organisms, such as the species here reported.

P7.2 Effect of X-rays on morphological and physiological traits in *Lycopersicon esculentum* L.

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Cultivation in Space is a requirement for the realization of long-duration manned missions, since higher plants help regenerating resources in pressurized modules and attenuate conditions of isolation in the crew. Organisms in Space are exposed to a harsh environment characterized by high levels of several types of radiations, which are responsible for genetic, physiological and structural alterations. Plants are quite resistant organisms to radiation and can even profit from irradiation when exposed to specific types and doses of radiation. The aim of this study was to analyze whether there are differential morpho-physiological responses in plants of *Lycopersicon esculentum* L. after irradiation with different doses of X-rays at two phenological phases. Thus, two cultivation trials were performed: the first with plants irradiated at the seed stage (SP-seed phase), the other with plants irradiated at the stage of second true leaf (PP-plant phase). Plant growth and morpho-functional traits were measured during growth up to fruiting in both SP and PP plant groups and compared with not-irradiated control plants. Analyzed features included germination dynamics, leaf development (rate of development and leaf lamina size/shape), above-ground plant architecture, gas exchanges and efficiency of photosystems. Results showed that different doses of X-rays determine differential responses (up to detrimental outcomes) depending on the plant phenological phase at the time of exposure.



P7.3 Servizi ecosistemici della Rete Natura 2000

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I siti della Rete Natura 2000 svolgono numerose funzioni ecologiche e forniscono diversi prodotti, beni e servizi, tra i quali la protezione del suolo dall'erosione, la regolazione dell'acqua, il mantenimento della fertilità del suolo, la fornitura di legname, la sottrazione di anidride carbonica dall'atmosfera. La gestione dei siti della Rete Natura 2000 comporta però oneri in termini di risorse umane ed economiche e spesso la comunità locale non è consapevole del valore di questi servizi ecosistemici. Lo scopo del progetto *LIFE+ 'Making good Natura'* è di evidenziare il valore del capitale naturale e di trovare finanziamenti per la gestione dei siti attraverso la valorizzazione dei servizi ecosistemici. Nell'ambito del progetto vengono analizzati sia la capacità degli ecosistemi di fornire diversi servizi ecosistemici che i potenziali beneficiari, nonché le normative comunitarie, nazionali e regionali per l'individuazione dei possibili finanziamenti. I modelli proposti verranno discussi con gli stakeholder e le istituzioni locali per identificare le attività in grado di creare sinergie gestionali ed economiche a scala locale.

P7.4 Valuation of ecosystem services of the (deep) sea: an overview

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Ecosystem services are of paramount importance for human well-being. Their valuation is seen as a fundamental tool to support decision-making processes in which social, economic and ecological perspectives have to be integrated. In the last two decades an exponential number of published papers on this topic has been undertaken, contributing to significant refining of valuation methods and improvement of our knowledge on the value of natural capital. Within the frame of the project RITMARE, we made an review of the present knowledge on the valuation of marine ecosystem services. We underlined that several shortcomings still remain: (i) studies for marine systems are much less abundant than for terrestrial systems; (ii) valuation studies are patchily distributed worldwide and they rarely take in account spatial and temporal variances of ecological functions, as well as their interactions; (iii) most of investigations pertained to coral reefs and shallow-water ecosystems, with great gaps remaining on open oceans; (iv) use values have been relatively well assessed for provisioning and cultural ecosystem services, whereas deficiencies are critical on both option, quasi-option and non-use values and supporting and regulating services; (v) debates concerning the applicability and reliability of valuation methods are far to be solved. In particular, we highlighted the constraints in valuing ecosystem services provided by the deep-sea ecosystems, the largest and the least known environment on Earth. We stress here the urgent need for developing further investigations enabling the possibility to evaluate the services provided by deep-sea ecosystems.

P7.5 Stress responses of fungal species to vanadium

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Soil is a non-renewable resource for human beings and ecosystems. Fungi have important roles in soil and can survive in high concentrations of toxic elements. The potentially toxic elements (PTEs) pose a significant threat on the human health. We investigated relationships between two fungal species, *Penicillium citrinum* and *Paecilomyces lilacinus*, isolated from soil with high levels of PTEs and vanadium. These species revealed a tolerance to concentrations up to 6 mM, in relation to growth responses, bioaccumulation and mineral transformation. Results were based on growth measurements, (GM), tolerance index (TI), scanning electron microscopy (SEM), energy dispersion X-ray microanalysis (EDXA) and biomass metal concentrations determined by means of inductively coupled plasma mass spectrometry (ICP-MS). Two basidiomycete species, *Trametes hirsuta* and *Fomes fomentarius*, isolated from unpolluted areas, were also tested. They were able to grown up to 12 mM vanadium and accumulate it to high concentrations: more than 4000 µg/g dry weight for *F. fomentarius* and 8000 µg/g for *T. hirsuta*. It was also observed that vanadium had a stimulatory effect on the growth of *F. fomentarius*. One-way analysis of variance (ANOVA) and Pearson's correlation test were used to test the linearity hypothesis for all the interactions. Tolerance mechanisms may explain the occurrence of fungi in metal-polluted habitats and provide opportunities for bioremediation.

P7.6 Risk Monitoring, Modelling and Mitigation of Benthic Harmful Algal Blooms along Mediterranean coasts M3-HABs

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A pan-Mediterranean project in the framework of the ENPI-CBCMED Programme has been proposed and is presently under negotiation regarding monitoring of harmful algal blooms, with particular reference to the benthic dinoflagellate *Ostreopsis* cf. *ovata* (M3-HABs). Along European Mediterranean coasts, *Ostreopsis* blooms have been so far reported in Italy, Spain, France, Croatia and Greece, and *Ostreopsis* occurrence has been reported also in other Mediterranean Countries, such as Tunisia, Algeria, Egypt and Lebanon. The specific objective of the project is to provide a common pan-Mediterranean strategy for monitoring benthic toxic microalgae, through the development of new, more efficient and common procedures and protocols, making the process mostly cost and time effective, allowing for most efficient monitoring designs, increasing the knowledge on environmental drivers affecting *Ostreopsis* blooms and translate this into a forecasting tool, and improving the general awareness of the risks related to *Ostreopsis*. Expected results of the project are: 1) an opto-electronics system and an advanced algorithm coupled with molecular techniques for cell identification and counting; 2) a predictive tool for *Ostreopsis* blooms, on the basis of identified environmental drivers; 3) an improved and common protocol for monitoring *Ostreopsis* abundances and related environmental drivers; 4) set up of common risk detection and management strategies, in order to build awareness in a wide audience.



P7.7 Social-economic assessment of agro-ecosystem service: water consumption in four municipalities neighboring the Circeo National Park.

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In the last years, research frequently refers to water footprint as “virtual water concept” (the volume of water used in the production of a commodity, good or service). The concept of “goods and services” was also formulated by the Millennium Ecosystem Assessment (MA, 2005) as the multiple benefits provided by ecosystems services (ES) to humans. Foods and clean water are classified as provision among ES categories by MA and are regulated by directives in EU Countries (Common Agriculture Practice, CAP, 1991; Water Framework Directive - EU 2000/60/CE) to enhance environmental protection. The aims of this research are to compute an ecological and economic balance related to water consumption for agriculture and animal manure practices in four municipalities of the Latina province (Latium, Italy) for the period from 1982 to 2010. The Latina's lowland surrounds the protected forest areas (EUAP) of the Circeo National Park (CNP). To estimate water consumption in the field of agriculture, evapotranspiration method (ET; Thornthwaite, 1948) was applied, whereas species-specific tabular parameters were used to estimate water consumption for livestock manure. A Life Cycle Assessment eco-accounting (LCA) was performed to estimate the environmental costs of agriculture production of goods and services related to freshwaters. The LCA costs were compared with the freshwater's ES provided by the CNP and negative externalities were highlighted.

P7.8 Struttura, organizzazione trofico-funzionale e tratti biologici della comunità di macroinvertebrati nei pacchi fogliari e in campionamenti bentonici di un fiume appenninico di terzo ordine (Fiume Aterno, Abruzzo, Italia Centrale)

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Le informazioni sulla struttura e sul funzionamento degli ecosistemi fluviali sono essenziali per valutarne l'integrità ecologica. Gli indicatori strutturali sono principalmente basati sull'analisi della ricchezza, diversità e composizione delle comunità biologiche mentre le caratteristiche funzionali dei sistemi lotici restano tuttora più difficili da misurare. Il processo di decomposizione del detrito è considerato un utile descrittore funzionale e la tecnica dei pacchi fogliari è stata spesso utilizzata per valutare tale processo ecosistemico. Tuttavia, gli studi mirati ad evidenziare l'importanza reciproca degli indicatori strutturali e funzionali per una corretta valutazione dello stato di salute dei corsi d'acqua, hanno dato risultati contrastanti. Gli indici funzionali sono stati messi in relazione con la struttura della comunità campionata nel benthos o nei pacchi di foglie, senza nessun confronto diretto tra le due diverse situazioni. Obiettivo principale della ricerca è quello di analizzare l'assetto strutturale e funzionale della comunità macrobentonica di un corso d'acqua appenninico di terzo ordine, campionata in parallelo con la rete di Surber e con la tecnica dei pacchi fogliari. I risultati dimostrano che le due diverse metodologie devono essere considerate complementari in quanto consentono una migliore caratterizzazione dell'intero pool di taxa presenti.



P7.9 Ecosystem services and interaction with fishing: observations from the Mediterranean cold-water coral ecosystem

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Habitat and provisioning services from the Santa Maria Leuca (SML) cold-water coral (cwc) province (Central Mediterranean) as well as fishing interaction with this deep-sea Fisheries Restricted Area (FRA) are reported here. Data were collected and elaborations conducted as part of projects funded by the Italian Government and EU-7FP. The sampling, both inside and outside the coral habitat, was carried out using an experimental trawl net, experimental longline and video systems. The fishing interaction with the SML cwc province was investigated during an observers' program. The habitat service is mainly due to the stony coral *Madrepora oculata*, followed by *Lophelia pertusa*, the black coral *Leiopathes glaberrima*, and several species of massive fan-shaped poriferans. The provisioning service, in terms of food, is provided by several commercial species for which greater abundances and sizes were detected in the coral habitat than in the non coral one. These species provide benefit mostly to trawl fishing the interaction of which with the FRA is greater than that due to longlining. Trawling is generally carried out in the depth range of the highest biomass and sizes of deep-water shrimps, *Aristeus antennatus* and *Aristaeomorpha foliacea*, and hake, *Merluccius merluccius*. It is often carried out very close or even inside the northward limit of the SML coral province with the aim of harvesting greater catches and sizes of fish/crustacean species which find refuge and grow larger in the coral area.

P7.10 Use of GIS technology and free satellite images for the realization of the first land use map of Maldives

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Always considered an undisturbed Eden, Maldives are better known for resorts and uninhabited islands, beautiful seawater and coral reefs. Although, in this paradise of international tourism there are also several islands inhabited by locals. They were highly modified in the last fifteen years and the deepest changes regard the land use. This project is meant to create the first land use map of the Maldives. It will be done using GIS technologies for recovery, storage and processing spatial data. The project will be divided into two steps. During the early one a virtual map and a database, based upon the USGS (NLCD 92) classification, will be created using free satellite images. Lately, there will be a test period on field to verify the geographic and informative aspects of the map. The system will be open and modular, and it will provide a constant upload of data also thanks to the helping of the local population (VGI, volunteered geographic information). Once completed, the map will be published using a WebGis. This will allow it to be fully accessible and approachable to everyone.



P7.11 Imbarcazioni turistiche e rischio di dispersione di specie non-indigene: valutazione della consapevolezza dei diportisti tramite interviste online

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Alcuni vettori di introduzione di specie non indigene (NIS) in ambiente marino sono regolamentati da apposite normative internazionali, ma la navigazione da diporto, responsabile della diffusione secondaria di NIS, in Mediterraneo e ancora priva di controlli. La Commissione Europea suggerisce di intervenire sulla prevenzione e sull'educazione della società civile e sulla divulgazione di buone pratiche di condotta in ambiente nautico. Gli obiettivi di questo lavoro: (i) valutare il grado di consapevolezza dei diportisti riguardo al problema delle invasioni biologiche; (ii) valutare il rischio di dispersione secondaria di NIS dovuto alle pratiche di manutenzione della barca e agli spostamenti abituali; (iii) educare i diportisti alle buone pratiche di condotta in mare, hanno lo scopo di prevenire la dispersione di NIS in ambiente marino e al tempo stesso creare un network tra comunità scientifica e società civile. A tale scopo, è stato elaborato un questionario *online* che raccoglie dati sulle abitudini di pulizia e uso di vernici *antifouling*, sugli spostamenti attuati dalle imbarcazioni e sulla consapevolezza del problema delle invasioni biologiche in Mediterraneo. Il questionario è collegato a un sito web che illustra il progetto di ricerca e fornisce informazioni sulle buone pratiche di manutenzione dei natanti. Il questionario, attivo al sito http://www-3.unipv.it/det/ecologia/progetto_marine.html e diffuso nel web tramite gruppi Facebook, sta tuttora raccogliendo dati.

P7.12 Il Progetto PRIN “TreeCity”: Servizi Ecosistemici offerti dal verde urbano e cambiamento globale nell’area metropolitana romana

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Le foreste urbane rivestono un ruolo di particolare importanza, in quanto forniscono servizi ecosistemici (SE) fondamentali quali il miglioramento della qualità dell'aria tramite la rimozione di inquinanti atmosferici. In diverse aree urbane del mondo, tra cui Roma (Manes et al., 2012), è stato stimato che la riduzione dell'inquinamento atmosferico da parte della vegetazione ha un impatto positivo sulla salute umana (riduzione della mortalità e morbidità). Il mantenimento di questi SE è collegato alla biodiversità funzionale della vegetazione urbana che, a sua volta, risente della presenza di fattori di stress naturali e antropici. “TreeCity - Progettare la città verde nell'era del cambiamento globale: funzioni degli alberi urbani e loro adattabilità nelle future condizioni climatiche” è un progetto interdisciplinare finanziato nell’ambito del PRIN 2010-2011, e vede la partecipazione di 8 unità nazionali, coordinate dal Dipartimento di Coltivazione e Difesa Delle Specie Legnose dell’Università di Pisa. Il Progetto è finalizzato ad aumentare le conoscenze sul ruolo della vegetazione arborea in ambiente urbano, in relazione anche ai previsti cambiamenti climatici. Viene illustrato l’approccio sperimentale utilizzato e i risultati preliminari ottenuti dalla UR UNIROMA nei primi sei mesi di attività progettuale.



P7.13 Coastal dune vegetation: disturbance, recovery and spatial pattern

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The ecological state of sea coasts is often critical worldwide, and in Europe most of the well conserved coastal dune areas are to date under protection. An increasing human impact in the near future along with global climate change could act on sand dune species changing their tolerance to stress factors. Our results give information on the biodiversity of the Tyrrhenian coast developing near Rome. The study underlines that human perturbation have altered the natural vegetation causing the disappearance of the typical dune vegetation bands. The spatial pattern of the species and their adaptive capability is attested by their ability to move back along the gradient from the water-edge toward the inland. Plants colonize the inner patch where microclimate and soil conditions are more favourable. The conservation of coastal areas depends on the maintenance of native species and their ability to compete with alien species. The presence of the most important autoctonous species and their moving ability along the gradient from the fore-dune to the inland can provide information for restoring the perturbed dune areas. In particular, *A. arenaria* could have a positive effect on sand dune stabilization. A sustainable management of the coastal areas under study should emphasized that species recovery capacity depend mostly on the undisturbed sand deposition in the fore-dunes by the limitation of human trampling, use of mechanical means and infrastructure development.

P7.14 Thermal variance affects algal assemblage in rocky pools

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The intertidal rocky pools are habitats that, when disconnected from the sea, become highly stressful for sessile organisms such as algae. Algae experience wide changes of water temperature on short temporal scale (e. g. hour or lower) and their coverage and diversity are expected to depend on thermal variance of small water masses trapped at low tide. Here, we want to investigate the relationship between daily thermal variance and the composition, coverage and diversity of rocky pool's algal community in Western Sicily (Southern MED). We chose 15 intertidal rocky pools and we deployed, in August 2012, thermo-loggers for two days to record temperature changes every 5-min (12 recordings per hour), whilst the algal assemblage was investigated by scraping three quadrats (10 x 10 cm) per pool; samples were brought back to the lab and classified to level of species. Our results show that the larger the thermal daily variance, the lower the number of pool's species and the reduced the coverage. Green algae dominated under the most extreme thermal conditions, while the evenness was higher in those pools closer to the sea. Such an outcome corroborates the hypothesis that extreme thermal variance may affect the structure and composition of ecological communities and pushes towards the identification of approaches to rapidly assess the degree of stress experienced by organisms living on the edge of their physiological tolerance limits.



P7.15 Marine litter on the trawlable seafloor of the Ionian Sea

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Marine litter investigation has been increased over the last two decades as a consequence of its impact on marine ecosystem, human activities and health. In the Mediterranean, most studies regard floating debris or litter along the coast while few data on benthic debris are available in deep waters. Recently, a specific descriptor on marine litter has been included in the Marine Strategy Directive Framework and qualitative and quantitative studies throughout the Mediterranean have been started. Data on the benthic litter composition and distribution collected in the Ionian Sea during an experimental trawl survey conducted in June 2012 as part of the international MEDITS project funded by EU are reported here. The analysis comes from a total of 70 hauls carried out between 10 and 800 m. Litter components were classified in 10 macro-categories (plastic, glass, metallic objects, paper and cardboard, cloth, ceramic, cement, processed wood, fishing gears, others) and different items were identified in some of them. The frequency of occurrence (F%) and a standardized weight per unit area (kg/km^2) for the different items were computed. Processed wood and plastic were most frequently recorded on continental shelf and slope respectively; metallic objects occurred throughout the investigated depth range. Processed wood, cement and metallic objects were the most abundant categories in term of weight. The authors discuss on the geographic and bathymetric distribution of litter items throughout the study area.

P7.16 Effects of dredging and disposal on macrobenthic biodiversity in a leaky lagoon

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Coastal disposal of dredged material is an environmental concern throughout the world. Impacts to the benthos include direct burial by dredged material, reductions in community diversity, and a shift in the dominance patterns within the benthic community. One of the key issues in understanding the ecological significance of dredged material is determining the rate of recovery of the benthos and how physical and biological processes in different locations influence it. We addressed the recovery of benthic infaunal assemblages from dredging and burial by dredged sediments within areas exposed to management interventions in the Sacca di Goro. Experimental treatments were *disposal* (2 sites) and *dredging* (1 site); at each site, a control was placed 100 m apart. Plots were subsequently sampled repeatedly. The disposal of dredged material had an immediate and negative effect on resident fauna, although complete defaunation did not occur. After 10 days, recolonization processes were evident in all the treatment plots. After an initial reduction of the benthic communities, treatments plots in the Sacca followed different recovery pathways, highlighting the importance of site-specific interactions between abiotic and biotic factors influencing succession. The ecological classification of sites showed an improvement in the ecological quality between the first and the second period of sampling, with higher ecological quality at the treated plots after 1 yr from treatment.



P7.17 Effects of global climate change on the marine biodiversity and ecosystem functioning: a multi-species approach

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The increase in atmospheric CO₂ due to anthropogenic activity and pressures results in an acidification of the surface waters in oceans. Under the Intergovernmental Panel on Climate Change (IPCC) emission scenarios, by the end of this century, as the atmospheric CO₂ concentration reaches 800 ppm, the average surface ocean pH could decrease by 0.3–0.4 pH units from the preindustrial values. This rate of increase is at least one order of magnitude faster than has occurred for millions of years. The Mediterranean red coral (*Corallium rubrum*) is expected to be particularly susceptible to acidification effects, due to the elevated solubility of its Mg-calcite skeleton. Recent studies showed that calcification, growth rates and activity of coral polyps are significantly affected by increasing pCO₂. This, together with the large overexploitation of this species describes a bleak future for this organism. Experimental exposures of organisms OA conditions indicate a high level of intra- and interspecific variation in species' ability to accommodate these alterations. However, so far most studies investigated the effects of OA on biological and ecological processes of single species. In the framework of DEVOTES project manipulative experiments will be conducted to investigate the potential consequences of OA at levels predicted for 2100 on the whole coralligenous assemblage and on the single species *C. rubrum* to investigate the impact a single versus multi specific level, including the impact on prokaryotes and viruses. The results of the present study will allow us to point out the presence of facilitation processes and understanding the effect of biodiversity loss on the response of marine organisms to OA.

P7.18 Possible effects of pebble beach nourishment on benthic assemblages

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The nourishment of sandy beaches to counteract coastal erosion and the loss of economic value is a very common practice. The alterations of benthic assemblages at different spatial scales caused by massive interventions have been well studied and, although several authors have proposed guidelines for good practices, there is a general consensus among scientist on their negative effects. Despite all this, the possible effects of small nourishment projects on pebble beaches have not been well studied. The pebbles nourishment intervention realized in Portonovo (Ancona, IT) in June 2011 offered the opportunity to study these possible effects. Along a small stretch of coastline have been reserved 2 control areas in which the intervention was not carried out. The benthic assemblages were investigated with photographic sampling twice a year in the 2 control areas and in 2 areas subjected to nourishment. Preliminary results indicate a modest alteration of the local assemblages. Among the different species, only the abundance the marine anemones *Anemonia viridis* shows clear effects within the first 2 year after the intervention. Counteract the natural evolution of the coast is a losing battle from the start. Despite this, short-term local economic interests tend to prevaricate management decisions. A proper integrated coastal zone management should be forward-looking and based on solid knowledge of the possible effects of each kind of intervention, both on short- and long-term.



P7.19 Stable Isotope signatures of selected benthos at natural carbon dioxide vents: preliminary results on macrophytes

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There is a growing evidence that macrophytes undergo the effects of ocean acidification (OA) with consequences on the community composition of the associated organisms and trophic webs. Underwater volcanic CO₂ vents can provide valuable information on the marine community's changes to low pH conditions and represent useful natural laboratories for *in situ* observations along natural pH gradients. This study is part of a larger project on the diet of target polychaetes in the shallow CO₂ vent system off Ischia (Tyrrhenian Sea) and it investigates on the effect of volcanic CO₂ on δ¹³C of macrophytes through the analysis of carbon stable isotopes. Collection of samples, took place in two acidified stations (Castello Aragonese North and South sides) and two control areas in May-June 2012, and included macrophytes species present in every station (*C. prolifera*, *Dyctiota spp.*, *F. petiolata*, *H. scoparia*, *P. oceanica*) or punctual (*A. armata*, *S. vulgare*). Results suggest an effect of the increase of volcanic CO₂ on the macrophytes. Infact, a recurring ¹³C depletion can be observed in most species, especially in the Castello Aragonese South side station and this could be due to the exploitation of volcanic-derived DIC that is more ¹³C-depleted than marine one and to increased availability of CO₂. Macrophytes represent a food source for many grazers, and, being their signatures well diverged between stations, it is possible to follow their transfer into the food web.

P7.20 Applicazione del modello di fragilità a supporto della gestione di aree protette

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In un contesto antropizzato come quello europeo, le aree protette devono essere concepite come paesaggi multifunzionali dove l'uomo è parte interagente ed integrante. La sfida per i gestori è quella di assicurare la sostenibilità a lungo termine del sito preservando i valori ecologici e culturali dell'area da stress antropici, ed allo stesso tempo garantendo la fruizione dell'area ed il godimento delle risorse ambientali. In tale contesto questo studio mira a sviluppare un utile supporto ai gestori delle aree protette identificando le priorità gestionali sia nel tempo che nello spazio. A tale scopo è stato utilizzato come punto di partenza il modello lineare di fragilità sviluppato da Zurlini e colleghi nel 1999. Tale modello è stato popolato in ambiente ArcGIS 10.1 da fattori di sensibilità e pressioni considerando tre assi portanti: la prevenzione del rischio incendi, il turismo e l'attività agricola e la valorizzazione degli aspetti naturalistici e culturali dell'area. L'applicazione del modello ha consentito di individuare le aree a diverso grado di fragilità, attraverso una ranghizzazione su una scala quali-quantitativa dei diversi fattori di sensibilità e pressione. Tale modello è stato applicato nella Riserva Naturale Statale di Torre Guaceto nell'ambito dell'aggiornamento del piano AIB, ed ha fornito un utile supporto ai gestori dell'area protetta per l'individuazione delle aree prioritarie di intervento e nella scelta delle migliori strategie di conservazione.



P7.21 Foreste urbane e servizi ecosistemici: abbattimento del particolato aerodisperso (PM10) in un contesto urbano e periurbano nell'area metropolitana di Roma

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Il particolato atmosferico (PM) rappresenta uno degli inquinanti di maggior rilievo, dotato di elevato impatto tossicologico su ambiente e salute umana (Pope et al, 2004). La concentrazione di PM10 risulta legata a molteplici e complessi fattori, quali tipologia e distanza delle sorgenti emmissive, conformazione ed uso del territorio, condizioni microclimatiche, ma anche e soprattutto struttura e tipologia della vegetazione presente. Differenti e numerosi studi hanno confermato l'azione positiva del verde sulla qualità dell'aria e sulla salute psico-fisica dei cittadini (BES, Istat 2013) in particolar modo nelle aree metropolitane, evidenziando l'effetto di abbattimento su particolato e altri inquinanti gassosi e l'importanza dei Servizi Ecosistemici derivanti (Manes et al, 2012). Questo studio presenta alcuni risultati di un progetto volto a caratterizzare l'effetto della vegetazione sulla distribuzione e la concentrazione del particolato, in un parco storico (Villa Ada) e nella Foresta Mediterranea della Tenuta Presidenziale di Castelporziano nell'area metropolitana di Roma. I risultati hanno permesso di caratterizzare la risposta delle tre tipologie di vegetazione (latifoglie sempreverdi, latifoglie caducifoglie e conifere) nei 2 anni considerati (2011 e 2012) alle diverse condizioni climatiche, evidenziando l'importanza della biodiversità funzionale per il mantenimento dei Servizi Ecosistemici forniti dal verde nell'abbattere le concentrazioni di particolato aerodisperso.

P7.22 Caratterizzazione del servizio ecosistemico come zona nursery di una laguna del delta del Po per l'introduzione di misure di tutela

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I popolamenti ittici delle lagune del nord Adriatico costituiscono un'importante componente della biodiversità. La risorsa biologica a cui si fa riferimento è il novellame di specie ittiche eurialine che trovano in questi ambienti le condizioni trofiche ottimali per la migrazione "montata" e la crescita. L'oggetto di questo studio è la definizione di una gestione migliorativa, condivisa da Istituzioni e stakeholders, di una particolare tecnica di pesca, in un comprensorio particolarmente importante come nursery. L'ambiente è la laguna Fattibello-Spavola, sita lungo la costa a nord delle Valli di Comacchio, di cui è volano idraulico e biologico. Lo studio ha previsto due fasi, di messa a punto metodologica (2009-10) e di sperimentazione, nel biennio 2011-12, in cui i dati sono stati raccolti con cadenza mensile e nell'arco delle 12 ore. I risultati hanno evidenziato la rimonta di novellame principalmente delle seguenti specie: *Liza ramada*, *L. aurata*, *L. saliens*, *Sparus aurata*, *Anguilla anguilla* e *Platycthis flesus*. Altro dato di interesse è che i giovanili hanno rappresentato la quasi totalità delle catture, in tutto l'anno. Tra le specie di interesse conservazionistico sono state evidenziate *Pomatoschistus canestrini* e *Knipowitschia panizzae*. La discussione è incentrata sul valore della funzione ecosistemica di questa importante nursery nel comprensorio più ampio delle Valli di Comacchio e sulle misure di protezione introdotte per la sua tutela.



P7.23 Analisi delle diatomee di corsi d'acqua dell'isola di Cipro: la qualità biologica di siti fluviali mediterranei sottoposti a gradiente di stress ambientale

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La Repubblica di Cipro, stato membro dell'Unione Europea, ha l'obbligo di implementare la Direttiva Quadro sulle Acque. In questo contesto, il presente lavoro ha previsto lo studio dell'elemento di qualità biologica "Flora Acquatica" (fitobenthos) in fiumi ciprioti. A tale scopo sono stati esaminati 186 campioni di diatomee, raccolti tra il 2005 e il 2012, secondo il metodo standard UNI EN 13946 in acque correnti perenni e temporanee della rete di monitoraggio nazionale. Per ogni campione processato, fissato, identificato e conteggiato (UNI EN 14407), sono stati calcolati i valori diversi indici utilizzando OMNIDIA 4.2, tra cui l'IPS, metodo nazionale per la definizione della qualità ecologica. I siti investigati, che coprono un ampio gradiente ambientale, sono soggetti sia agli effetti della variabilità naturale tipica dei corsi d'acqua mediterranei, sia, in alcuni casi, a pressioni antropiche dovute ad attività agricola e urbanizzazione. I valori degli indici e i giudizi di qualità sono stati messi in relazione con i dati chimico-fisici, idromorfologici e di habitat disponibili per ogni campione, consentendo di valutare la risposta delle comunità alle condizioni di stress ambientale. Le identificazioni sono state eseguite con la maggior risoluzione tassonomica possibile, utilizzando la letteratura più recente. Si sono così potute evidenziare numerose peculiarità di un'area mediterranea poco studiata come quella di Cipro.

P7.24 Physiological and morphological acclimation of *Cistus salvifolius* L. winter leaves to elevated temperatures

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Plants of Mediterranean ecosystems rely on both morphological and physiological adaptations to cope with Mediterranean environmental constraints. In such ecosystems, vegetation is composed by perennial, summer deciduous, or seasonally dimorphic species. Plants of *Cistus* spp. adopt seasonal dimorphic *habitus* with mesic winter and xeric summer leaves and represent an effective model to study temperature acclimation. This work aimed to evaluate the eco-physiological response of *Cistus salvifolius* L. winter leaves (WL) to high temperatures since in a climate change scenario, winter temperature is expected to increase of 5°C in the Mediterranean Basin. Plants grown outdoor at winter temperature (hardened) were transferred at +10 °C in a greenhouse to induce the de-hardening. Photosynthetic fast-response curves to light, CO₂ and temperature as well as fast light fluorescence curves were performed on: WL grown outdoor (WLO); WL grown outdoor and moved indoor for 15 days (WLI_15); WL developed indoor (WLI). SLA and LDMC were also determined. WLO showed lower photosynthetic rate, apparent carboxylation efficiency and mesophyll conductance than WLI. In these leaves an higher partitioning of absorbed light in photochemistry than in thermal dissipation was also measured together with lower SLA and higher LDMC values. The growth of WL at higher temperatures determines a rise of photosynthesis and an increase of light utilization in dissipative processes together with SLA reduction.



P7.25 Impact of ocean acidification on microbial loop and biogeochemical cycling in coastal sediments (Mediterranean Sea)

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Anthropogenic emissions of CO₂ are causing a global reduction in ocean pH, and alteration of carbonate chemistry, at a rate faster than has been observed in the past 20 million years. Our understanding of the ecosystem response to ocean acidification is very limited as almost all studies have involved short-term perturbation experiments on single specific components of the ecosystem. In situ observational studies, exploiting natural pH gradients, can help to understand the ecosystem level effects of ocean acidification by seeing how species, communities and ecosystems react in a natural environment. In the framework of the DEVOTES project, we investigated the effects of ocean acidification on the structure and functioning of benthic microbial food webs and biogeochemical cycling in two coastal areas of the Mediterranean Sea, characterized by naturally low pH (values from 8.0 to 6.0 in the sediments): the Presidiana Harbor (Sicily), a basin characterized by a natural acidification due to acid freshwater input from inland and Island of Ischia (Naples), a shallow coastal site, in which the acidification is caused by underwater emissions of volcanic CO₂. Our results show that a reduction of seawater pH may cause changes in the microbial processes, increasing extracellular enzymatic activities of prokaryotes and thus the rates of remineralization processes of organic matter. Moreover acidification seems to promote the viral production and viral-mediated prokaryotic mortality. The enhanced viral lysis of microbial cells in response to acidification may increase the transfer of microbial biomass into the pool of dissolved organic matter (DOM), subsequently affecting the organic matter flows within benthic food webs.

P7.26 Uso del suolo e comunità macrobentonica in fiumi mediterranei: un semplice approccio per monitoraggi a scala di tratto

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La 2000/60/EC chiede di quantificare le pressioni per impostare i piani di bacino, per valutare il rischio di fallimento degli obiettivi ambientali e per interpretare i dati biologici. Tra le pressioni antropiche importanti da quantificare c'è da considerare l'uso del territorio. In questo contesto, la Commissione Europea ha cofinanziato il progetto LIFE+ INHABIT (ENV/IT/000413), il cui obiettivo, tra gli altri, è quello di definire la relazione tra invertebrati fluviali e descrittori di pressione antropica. Nel nostro studio è descritto il Land Use Index (LUIr), che quantifica le modificazioni di uso del territorio a scala di tratto fluviale. Il LUIr è stato sviluppato sulla base dei dati raccolti con il metodo CARAVAGGIO. L'efficacia del LUIr nel descrivere i gradienti ambientali è stata valutata congiuntamente ad una serie di descrittori ambientali. Sono stati studiati 40 siti fluviali a Cipro. Le analisi hanno mostrato che il LUIr è risultato essere il fattore più significativo nello spiegare la variabilità osservata nelle metriche biologiche testate. I nostri risultati supportano la conclusione che il LUIr possa essere uno strumento efficace per interpretare la variazione della comunità di invertebrati. Peraltro, il LUIr si è rilevato un indice chiave nell'ambito del progetto LIFE+ INHABIT. Infine, il LUIr potrebbe essere utilizzato per impostare le misure per il miglioramento degli ecosistemi acquatici, in particolare per i corsi d'acqua mediterranei.



P7.27 $\delta^{15}\text{N}$ variations in macroalgae to detect the origin of Nitrogen in coastal waters

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Understanding the fate and processing of anthropogenic discharges in the coastal and transitional waters is crucial to understand their level of selfpurification capacity and to address the management of coastal zones. Standard physical-chemical analyses have been used systematically in monitoring programs to track the nutrient in the water column and eutrophication. However these methods were ineffective since nutrient load is rapidly diluted by hydrodynamic forces and/or removed by microbial and plant uptake. The ratio of stable nitrogen isotope ($\delta^{15}\text{N}$) in bioindicators is increasingly employed to identify the origin of nitrogen inputs in aquatic ecosystems. The biological characteristics (short turnover time) of macroalgae make this kind of organism an appropriate probe to detect the presence and origin of nitrogen pollutants. The present research was performed in two coastal areas, Circeo and Gaeta Gulf, differing in anthropogenic pressure, and three coastal lakes near Circeo, differing for land use. In order to assess the origin of N inputs in study areas, we assessed $\delta^{15}\text{N}$ signal variations in the green macroalga *Ulva lactuca*. Preliminary results emphasized the heterogeneity spatial distribution of $\delta^{15}\text{N}$ in the coastal sea as revealed by algal-probe. Spatial dependency of the $\Delta \delta^{15}\text{N}$ (between control and experiment) suggested both agricultural and farming derived N in the Gaeta gulf, and predominantly farming derived N in the water of the coastal lakes, with differences in $\Delta \delta^{15}\text{N}$ observed between lakes.

P7.28 Trophic evolution of Lake Garda in the last 200 years as outlined by paleolimnological studies

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Lake sediments of Lake Garda have been studied within the EU EuLakes project (Nr. 2CE243P3). The results are being used to determine the lake reference conditions before stronger human impact. The deepest lake basin (350 m depth) is less impacted by human activities and is suitable for reconstruction of long term environmental (and climatic) variability and its effects on lake ecology. The shallower basin (81 m) is strongly affected by tourism and agriculture, and thus is more suitable for studies on lake eutrophication. The aim of this contribution is to evaluate the vulnerability of Lake Garda respect to specific human stressors (e.g. nutrients, hydroelectrical exploitation) in a climate change scenario. The palaeolimnological approach adopted focusses on changes in sub-fossil diatoms in two pelagic sediment cores and on diatom-based TP reconstruction. The core collected at 350 m shows two discontinuities. The deepest one dates in the 1940s and consists in a decrease in benthic taxa, which may be related to the hydroelectric exploitation of the catchment area. The second discontinuity in early 1960s coincides with the increase in Fragilariaceae respect to centric taxa, as a result of nutrient enrichment. The core from the shallower basin does not show discontinuities, though sub-fossil diatoms show a decrease in both mesotrophic Fragilariaceae and Cyclotella spp. since the 1960s. Reconstructed lake TP concentrations confirms the trends in decadal limnological data.

P7.29 Progetto SIGNAL: gradienti europei di resilienza rispetto ad eventi climatici estremi

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I prati e i pascolieuropeiforniscono importanti servizi ecosistemici ed hanno un influsso determinante sulla qualità della vita. Tuttavia, l'aumento di eventi meteorologici estremi e la diffusione di specie invasive possono minacciare la biodiversità, la resilienza e la stabilità di tali sistemi semi-naturali. I potenziali meccanismi di stabilizzazione sono rappresentati dalla ricchezza di specie, dalla presenza di specie chiave (leguminose) e dalla diversità genetica intraspecifica. In questo contesto si inserisce il progetto SIGNAL (BiodivERSA), che prevede di approfondire i meccanismi di resilienza dei pascoli europei, a seguito di eventi climatici estremi, per identificare eventuali segnali premonitori del cambiamento delle comunità vegetali. Si sono attivati esperimenti in grado di simulare eventi climatici estremi di aridità, in otto diversi siti europei (Belgio, Bulgaria, Francia, Germania, Ungheria, Italia, Svizzera e Turchia). Per quanto riguarda l'Italia, l'esperimento è seguito dall'Università di Camerino presso le strutture dell'Arboretum appenninicum. Più in dettaglio, SIGNAL indagherà sull'interazione di tre tematiche di ricerca che non sono ancora state mai combinate, ossia: esperimenti sulla biodiversità, ricerca sull'impatto dei cambiamenti climatici e la ricerca sulla invasività di specie esotiche. Il progetto mira a rispondere come eventi estremi siccitosi possano influire sulla biodiversità e sulla fornitura di servizi eco-sistemici.

P7.30 Identifying priority areas for conservation of critical habitats in the Mediterranean Sea using conservation planning tools

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Several efforts have been carried out in the Mediterranean Sea to identify priority sites for conservation/management. However, systematic approaches for spatial optimization have never been used at basin scale. Based on a collection of georeferenced data, we developed a spatial conservation planning for Mediterranean priority habitats (*Posidonia* meadows, coralligenous) and essential fish habitats (i.e. nurseries, spawning grounds) using the software Marxan. Deep-sea habitats (canyons, banks, sea mounts) were also included in the analyses. Conservation targets have been set according to EU commitments. Existing Marine Protected Areas, Fisheries Restricted Areas and Natura 2000 sites have been also included to make sure that the new scenarios will not disregard the currently applied conservation efforts. Results show that, at present, only the 4% of *Posidonia* and the 8% of coralligenous are protected within the already established MPAs. Considering the whole dataset, conservation targets were achieved by all analyses. The North Adriatic Sea, the Otranto Channel, the north Tyrrhenian, the Sicily Channel, the North Aegean Sea emerged as candidate areas for conservation/management actions. However, results are largely driven by data availability. The eastern Mediterranean is still underrepresented due to lack of georeferenced data. Habitat distribution and extent are still severely underestimated limiting the potential of effectively use spatial optimization tools at basin scale.



P8. Educazione ambientale e didattica nell'ecologia

P8.1 A Life+ Nature project for the enhancement of structural heterogeneity in priority habitat (9210* and 9220*) Apennine beech forests

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The Apennine beech Natura 2000 priority habitats 9210* 9220*, i.e. beech forests where European yew (*Taxus baccata*), European holly (*Ilex aquifolium*), and silver fir (*Abies alba*) occur, are remnants of ancient, more extensive forests. Nowadays, this habitat has been extensively altered and reduced in extension due to traditional forestry practices that transformed these into pure beech stands, with cascading effects on the diversity of other taxonomic groups, e.g. saproxylic fungi and beetles. The Life+ project (2012-2016) "FAGUS - Forests of the Apennines: Good practices to conjugate Use and Sustainability" aims at ensuring long term conservation of these priority habitats in two Italian National Parks: Cilento Vallo di Diano and Alburni, Gran Sasso and Laga Mounts. The Focus of the project is to test experimental harvesting practices aimed at enhancing forest structural heterogeneity, as a way to accelerate the development of old-growth attributes and, accordingly, to increase diversity levels for focus taxa. The project will contribute to the development of Sustainable Management Strategies for the habitats 9210* and 9220*, and to disseminate the advantages of the experimented approach to local stakeholders as well as to a wider public. According to the eligibility criteria, awareness-raising campaigns and special training for agents involved in forest harvesting are fundamental steps of Life+ projects implementation. The Life FAGUS involves many other dissemination actions: website, educational projects, consultation with relevant stakeholders, courses for local harvesters, conferences, seminars and workshops. Here we discuss the principal results and ongoing actions of the awareness-raising campaign.

P8.2 PROGETTO GIOVIALI! – GIOVani idee per la Valorizzazione degli Ambienti fluviali

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Lo stato di degradazione degli ambienti fluviali è principalmente dovuto allo sviluppo delle popolazioni umane e alla mancanza di attenzione per i fattori ambientali. La voglia di integrare educazione e scienze ambientali e quello di divulgare la conoscenza dell'ecologia fluviale ha portato a creare il progetto Gioviali!, rivolto a più di 500 giovani. Il suo obiettivo è quello di valorizzare gli ambienti fluviali e creare delle linee guide per la loro tutela. La partecipazione è stata usata come strumento per creare una strategia di educazione ambientale in cui è stato promosso l'interesse dei partecipanti per l'ecologia e sono stati forniti gli strumenti per valutare l'integrità degli ecosistemi fluviali. Dalla conoscenza possono scaturire azioni concrete e responsabili a favore del ambiente. Nelle diverse fasi del progetto si è cercato di unire conoscenza di concetti, metodi e valori mediante un approccio teorico e, soprattutto, pratico con attività sia in campo che in laboratorio. Per questo, sono stati creati percorsi di ecologia fluviale per le scuole superiori e un corso di formazione per neolaureati e laureati sul metodo CARAVAGGIO. Inoltre, grazie alla caratterizzazione di 5 fiumi (in Lombardia e in Val d'Aosta) è stato possibile scrivere delle linee guida per la tutela e valorizzazione dei corsi d'acqua. Infine è stato creato un sito web per promuovere e valorizzare il patrimonio fluviale e sono stati realizzati 5 eventi di sensibilizzazione rivolti alla cittadinanza.



P8.3 Reef Check Italia onlus, a network to improve civil participation in marine environment assessment

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The involvement of "citizens" (whether members of the general public or dedicated volunteers) to undertake data collection for regional-scale scientific studies is a key tool to achieve shared decisions in the field of biological conservation. Reef Check Italia onlus is applying fast and effective protocols since 2008 involving both young students and recreational divers, to collect data on abundance and distribution of target species, along beaches and underwater. These activities are mainly developed within schools and MPAs. Regarding beach surveys, in the Ligurian Sea a recent experience involved more than 700 volunteers by a "vertical" project. Students from secondary schools were trained to collect data on beached organisms and litter. They, on their side, trained students coming from the primary schools, together with their parents. Students, being sensitive and participatory collectors, represent an essential vehicle to create a general ecological awareness towards both their peers and adults. Regarding the underwater protocol, volunteers (more than 1000) are allowing to map the distribution of several species, including some listed in the Habitat Directive and Barcelona Convention protocols. According to the European Marine Strategy, each Member State must reach a "good environmental status" at regional level and establish clear environmental targets and monitoring programmes by 2020. These data are an important contribution to this objective.

P8.4 La didattica delle discipline scientifiche nella scuola secondaria superiore in alunni con disturbi cognitivi: un esempio di educazione ambientale

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Spesso si pensa che i ragazzi con disturbi cognitivi gravi nella scuola superiore debbano essere esclusi dall'apprendimento di determinate discipline scientifiche: in realtà il disturbo non sempre dipende da tutti i diversi aspetti dell'intelligenza, ma l'alterazione di una o più funzioni produce un effetto a cascata sulle altre, anche su quelle adeguate, alterandole. Dal punto di vista verbale spesso la comprensione è più sviluppata della produzione, orale e scritta, e questo può far apparire lo sviluppo cognitivo più compromesso di quanto sia in realtà, mentre il soggetto è comunque in possesso di conoscenze derivate dalla sua esperienza personale. Le esperienze proposte in questo lavoro rappresentano una parte di un percorso di chimica rivolto a ragazzi con disturbo cognitivo medio-grave, con l'obiettivo di fare acquisire loro consapevolezza sulle caratteristiche della materia, gli stati della materia e i cambiamenti di stato. Sono state realizzate varie attività sull'acqua, presente in natura in tutti e tre gli stati di aggregazione, utilizzando immagini, semplici esperimenti pratici per esplorare le sue caratteristiche chimico-fisiche e i suoi passaggi di stato e uscite sul campo, con l'obiettivo di sensibilizzare anche questi studenti all'uso razionale delle risorse, in particolare dell'acqua. I ragazzi coinvolti hanno manifestato curiosità e interesse e hanno dimostrato di aver compreso sufficientemente le attività svolte.



P8.5 Quanta biodiversità nella mia giornata?

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Scopo del presente lavoro è dare un contributo ai mediatori della cultura ecologica che operano nella scuola primaria, con la descrizione di una esperienza di didattica dell'Ecologia che dal punto di vista metodologico si è basata sull'uso della rappresentazione teatrale e del lavoro di gruppo. L'esperienza didattica, rivolta a bambini dagli 8 agli 11 anni e della durata di 1h e 30', è stata progettata per stimolare la riflessione sull'importanza della conservazione della biodiversità sia per il pianeta sia per la vita di ogni singola persona. Durante la rappresentazione il bambino, protagonista della storia, intercetta implicitamente il concetto della biodiversità ed è compito degli "spettatori-alunni", attraverso un gioco a squadre, individuare quando e come questo accade. Dalla valutazione dell'esperienza emergono i seguenti punti di forza e di debolezza. Le metodologie didattiche scelte, ben descritte nella letteratura pedagogica, hanno mostrato l'efficacia attesa poiché consentono di mantenere alto il coinvolgimento emotivo e cognitivo, soprattutto in situazioni logistiche difficili in cui il pubblico è costituito da un alto numero di bambini con età differenti. Tuttavia, è importante che i mediatori siano attenti a evitare problemi sia di tipo educativo-epistemologico, come la presentazione della biodiversità come risorsa importante solamente per l'uomo, sia di tipo educativo-gestionale, come l'emergere di una eccessiva competizione tra le squadre.



P9. Tema libero

P9.1 Effects of vineyard management on diversity and abundance of Ground-dwelling spiders and carabids

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One of the main threats to the diversity and abundance of species associated with farmland is the intensification and expansion of modern agriculture occurred over the last 50 years. The dramatic decline of many species led to growing concern over the sustainability of current intensive farming practices. We studied the effect of different farming practices on ground beetle and spider abundance, species richness and community composition in vineyards (Piedmont, Italy). Six organic and six conventional vineyards were compared. Sampling transects were carried out using pitfall traps between late May and early July 2009. A total of 1963 individuals belonging to 49 species of ground beetle and 1206 individuals belonging to 97 species of spiders were identified. Both abundance and species richness of ground beetles and spiders increased in organic vineyards. Concerning ground beetles, we show that Brachypterous ground beetles are more sensitive to the farming management practice than Macropterous. Canonical correspondence analysis highlights those Ground beetle species which avoid conventional farms. When considering spider functional groups, ground hunters are particularly linked to organic farming, as confirmed by the indicator value analysis (Indval). We conclude that compared to conventional ones, organic vineyards benefits farmland spiders and carabids supporting their diversity and abundance, with a possible effect on ecosystem functions and services such as pest control.

P9.2 Potential dietary influence on the fatty acid composition of mauve stinger *Pelagia noctiluca* (Forskal, 1775) in the Strait of Messina (Sicily).

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The outbreaks of gelatinous zooplankton in the marine environment are recurring as regular events, whose impact on pelagic food webs is still poorly understood. Biochemical tracers, such as stable isotopes and fatty acids, offer several advantages because they differentiate between what is assimilated and what is simply ingested, and may be useful for identifying contributions from sources. In particular, lipid biomarkers are known to be source-specific biosynthetic compounds; therefore, they represent a powerful tool to trace organic carbon cycling in food webs. Here we report on the analysis of the fatty acids composition of the mauve stinger *Pelagia noctiluca* (Forskal, 1775), known as a major outbreak-forming jellyfish in Mediterranean and Eastern Atlantic. Tissues of *Pelagia noctiluca* display a 16:1(w7)/16:0 ratio revealing diatom FA signatures, together with high EPA and DHA w3 values, markers of a major carnivore diet. Throughout the year, an overall PUFA/SFA ratio remains high but with seasonal fluctuations, corresponding to changes in main prey items. A higher PUFA content in female gonads can be positively related to a higher reproductive success. Finally, a large fraction of FA, composed by 22:4, 22:5, 24:4, 24:5 (w6) molecules, may originate from high-level animal sources, such as fish larvae. These results corroborate the hypothesis of *Pelagia noctiluca* jellyfish as both competitors and predators of fish larvae.

P9.3 Struttura genetica di popolazioni di Barbo nel fiume Adda sub-lacuale: valutazioni ecologiche e geografiche

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Il genere *Barbus* è costituito da specie ittiche primarie distinte in due gruppi monofiletici contraddistinti da diversa vocazione ecologica: specie reofile e fluvio-lacustrine. Nota l'elevata plasticità del genere, sono probabili fenomeni di ibridazione nelle zone di sutura lungo il tratto fluviale. In questo studio è stato indagato il mescolamento genetico tra specie reofile (*B. caninus*) e fluviolacustrine (*B. plebejus* e *B. barbus*) presenti nel distretto ittiogeografico Padano-Veneto. È stato effettuato un campionamento di 4 popolazioni nell'Adda sub-lacuale. Attraverso il sequenziamento di marcatori nucleari (Gh e S7) e mitocondriale (cytb) è stata ricostruita la struttura filogenetica, nella quale è stata confermata la dicotomia ecologica. L'analisi della variabilità genetica stimata per ciascun marcatore nucleare, in cui sono inclusi SNPs e indels, ha evidenziato omogenei livelli di polimorfismo in termini di diversità nucleotidica ($0.004 < \pi < 0.013$) e di diversità aplo-tipica ($0.067 < Hd < 0.92$). Le popolazioni di barbo risultano caratterizzate da una debole struttura genetica contraddistinta da tre pool genici; infine è stato confermato un buon livello di introgressione tra le tre specie considerate, in particolare tra *B. plebejus* e *B. barbus*.

P9.4 Modelling geographic distribution and detecting conservation gaps in Italy for the threatened beetle *Rosalia alpina*

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Presence-only models can aid conservation and management of threatened, elusive species. We developed a Maxent model for the rare cerambycid beetle *Rosalia longicorn* *Rosalia alpina* L. in Italy and neighbouring regions and identified the variables best explaining the species' occurrence on a large scale. Once successfully validated, we used the model to (a) evaluate the current degree of fragmentation of *R. alpina* range in Italy; and (b) quantify the amount of the Italian territory with the highest probability of beetle presence within the existing national conservation areas (Natura 2000 network, parks and reserves). Low (<0.5) probability scores of *R. alpina* presence corresponded to 89% of the total area considered, whereas high scores (>0.9) covered only 2.5%. *R. alpina* was predicted to occur mostly in broadleaved deciduous forest at 1000–1700m a.s.l. with warm maximum spring temperatures and May and November precipitation >80mm. We found a high degree of fragmentation; gaps were mainly covered with farmland or other unsuitable habitat. Over 52% of potential habitat is unprotected. While the Natura 2000 network protects 42% of potential habitat, parks and reserve covers less than 29%. To preserve *R. alpina*, we urge to create, or restore, forest corridors to bridge the otherwise impermeable gaps our model detected and grant protection to the still largely unprotected area of the Italian territory e.g. by including it in further Natura 2000 sites. Models such as ours may also help focus field surveys in selected areas to save resources and increase survey success.



P9.5 Effetti dell'implementazione della Piattaforma Regionale di Simbiosi Industriale in Sicilia: linee di indirizzo e prime osservazioni sul territorio

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Nella Green Economy assume centralità il concetto di capitale naturale, metafora economica che indica le risorse fisiche e biologiche che si trovano sulla terra e la capacità degli ecosistemi di fornire servizi. Uno degli obiettivi della Green Economy è, infatti, il decoupling tra crescita economica e consumo delle risorse, attraverso una riconversione dell'attuale sistema produttivo verso processi e prodotti sostenibili. In questo quadro si muove il progetto "Eco-Innovazione Sicilia" che l'Unità Tecnica Tecnologia Ambientale (UTTAMB) dell'ENEA sta portando avanti dal 2011. Il presente lavoro, inserito nell'ambito del dottorato di ricerca in "Economia e Territorio" (28° ciclo) dell'Università degli Studi della Tuscia (DEIm) di Viterbo in partnership con l'ENEA, riguarda in particolare gli effetti "territoriali" derivanti dallo sviluppo e dalla implementazione della Piattaforma Regionale di Simbiosi Industriale che l'ENEA sta realizzando nell'ambito del citato progetto. Attraverso l'utilizzo di vari strumenti (public hearing, questionari, interviste, workshop e seminari) si intendono valutare le ricadute che detta Piattaforma, attraverso la creazione di sinergie tra imprese di diversa natura, potrà generare nel territorio in termini economici, ambientali e sociali. Il presente lavoro mostra le principali linee del progetto di ricerca nonché l'analisi preliminare degli effetti delle iniziative svolte, ad oggi, dall'ENEA per l'implementazione della Piattaforma.

P9.6 Colony persistence of the invasive hydrozoan *Clytia hummelincki* and comparison of methods for the study of its populations in the Northern Ionian Sea

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The mechanisms of persistence through adverse conditions of twenty-four colonies of the invasive hydrozoan *Clytia hummelincki* were assessed in two localities in the Northern Ionian Sea from October 2012 to May 2013. For each colony, size (cm²) and polyp density (hydrothecae/cm²) were monitored on a monthly basis by in situ visual census. Both size and polyp density decreased gradually until disappearance of the polyps in December; followed by their reappearance in May. During winter, the hydrorhiza of the colonies remained on the substrate, and the persistence of the colonies is attributed to the survival of these resting structures. Previously, two sampling methods (in situ visual census and underwater photography) for the evaluation of colony size and polyp density in the population had been tested and their outcomes were contrasted against the estimates deriving from the observation of collected colonies, the optimal sampling method being identified by a cost-benefit analysis. The methods did not show significant differences in the estimation of polyp density, whereas the in situ visual census was more effective in the assessment of colony size. For ecological purposes of the monitoring of the dynamics of this species, sampling based on in situ visual census was considered an appropriate experimental design to get a statistically robust representation of the population. However, variation in depth and exposure may require different sampling approaches in other areas.

P9.7 Modelli distribuzionali come strumento per delineare i limiti tassonomici: il caso di studio di *Squamarina cartilaginea* in Italia

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I modelli di distribuzione spaziale (SDM) vengono usati per diversi scopi, tra i quali anche la delimitazione di entità tassonomiche, integrando risultati ottenuti con altre metodiche, come analisi genetica, chimica e morfologica. In questo lavoro è stata analizzata la distribuzione delle due varietà (var. *cartilaginea* e var. *pseudocrassa*) del lichene *Squamarina cartilaginea* in Italia. I dati sono stati ottenuti geo-referenziando a posteriori 125 campioni, identificati con la reazione medullare alla p-fenilendiammina. Entrambe le varietà sono presenti dal mare alla fascia montana, con la var. *cartilaginea* (la più comune, 76% dei campioni) che raggiunge altitudini maggiori. La distribuzione spaziale è stata analizzata usando Random Forest (RF) e Generalised Linear Model (GLM). La suitability area (SA) è stata ottenuta con il criterio del 0% di omissione d'errore. RF ha un minor errore di predizione rispetto a GLM, che tende a sovrastimare la distribuzione spaziale potenziale. Il test statistico tau di Kendall indica che le due varietà tendono a separarsi ecologicamente, con la var. *pseudocrassa* più diffusa nella regione Mediterranea, nelle aree costiere e collinari secche, e la var. *cartilaginea* più abbondante nelle aree temperate e montane. La distribuzione delle due varietà è determinata dallo stesso gruppo di variabili ambientali. Questo risultato da nuove ipotesi sulla storia evolutiva del *taxon*, e dimostra l'efficacia dell'uso degli SDM in combinazione con altre tecniche.

P9.8 Analisi paleolimnologiche del Lago di Levico (Trentino) – primi risultati

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Il Lago di Levico (Trentino sudoccidentale) si trova a 440 m s.l.m., ha una superficie di 1.16 Km², profondità massima di 38 m, e un volume di 12.9 10⁶ m³. Il lago riveste una grande importanza socio-economica quale terzo sito ricreativo estivo trentino dopo i laghi di Garda e Caldonazzo), ma primo sviluppo della conca di Levico come centro termale risale già ai primi del '900. La porzione orientale del lago è tutelata come SIC per la vegetazione e l'avifauna acquatica. Lo studio dei sedimenti profondi del Lago di Levico ha lo scopo di: i) determinare le condizioni ecologiche di riferimento del lago antecedenti l'impatto antropico più intenso; ii) compensare la frammentarietà dei dati limnologici per determinare la vulnerabilità del lago rispetto al crescente impatto antropico in un contesto di cambiamento climatico; iii) affinare gli obiettivi di qualità futuri e promuovere azioni a favore di misure per un uso sostenibile del lago. Vengono qui presentati i primi risultati dello studio di una carota di sedimento di 96 cm prelevata nel 2009 dal punto più profondo del lago. La carota è stata datata (210Pb e 137Cs) ed analizzata per una serie di parametri geo-chimici (densità, contenuto acquoso e organico, Spheroidal Carbonaceous Particles, C/N) e biologici (pigmenti algali e diatomee). I primi risultati confermano l'aumento di trofia del lago riportato in letteratura a partire dagli anni '50, ma indicano una prima evidente discontinuità già durante gli anni '20 del XX secolo.



P9.9 First assessment of the growth rate of stylasterid corals by means of coral transplantation method

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Styasterids are calcified azooxanthellate hydroids that are an important component of shallow and deep reefs. For the first time we have applied to these cnidarians the method of transplantation of whole coral colonies. In February 2012 six colonies of *Distichopora* sp. have been collected from 7-18 m deep in front of the Coral Eye research outpost in Indonesia. Each colony base has been cemented and then transplanted on a fixed underwater structure placed in the same locality at a depth of 11 m. Three colonies survived and did not show any sign of suffering. Frontal photographs of them have been taken monthly from February to August 2012 and their height has been assessed analysing the pictures by the software ImageJ. The results indicate an average growth rate of 1.5 ± 0.3 cm in height during six months. Moreover the analysis of covariance (ANCOVA) of the relationships between the height vs time has shown an homogeneity of the slopes ($F=0.216$; $P=0.807$) indicating that the colonies have the same growth pattern. The available data on the growth rate of hard corals mainly concern shallow and deep scleractinians and zooxanthellate milleporid hydroids. The present investigation represents the first assessment of the stylasterid growth rate. Our results suggest that stylasterids have a growth rate similar not only to that reported for milleporids but also for zooxanthellate scleractinians as already observed for other azooxanthellate corals.

P9.10 Sovrapposizione alimentare e predazione tra il ghiozzo di ruscello *Padogobius nigricans* (Canestrini, 1867) e il ghiozzo padano *Padogobius bonelli* (Bonaparte, 1846) nel bacino del Tevere (Umbria)

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Il ghiozzo di ruscello *Padogobius nigricans* è un endemismo dei sistemi idrografici tirrenici di Toscana, Umbria e Lazio. È una specie sensibile alle alterazioni della qualità ambientale e il suo areale risulta frammentato a causa delle modificazioni dell'habitat e della competizione con il ghiozzo padano *Padogobius bonelli*, endemismo del distretto padano-veneto. Mentre sono noti i meccanismi di competizione territoriale tra le due specie per l'occupazione dei siti riproduttivi, poco è ancora conosciuto sulla composizione dello spettro trofico e non ci sono informazioni tali da far ipotizzare la presenza di competizione alimentare. Scopo del presente lavoro è approfondire le conoscenze sull'alimentazione delle due specie nel bacino del Tevere e di stabilire il grado di sovrapposizione tra le loro diete. Sono stati analizzati i contenuti stomacali di 299 *P. nigricans* e 189 *P. bonelli*: le percentuali di stomaci risultati vuoti sono rispettivamente il 16.7% e il 18.0%. Viene confermata la dieta prevalentemente invertivora, con una rilevante presenza di pesci, la maggior parte dei quali ascrivibili allo stesso genere *Padogobius*. Le prime osservazioni sulla dieta, unitamente alle analisi relative ad alcuni aspetti della biologia di *P. nigricans* in situazioni di sintopia e allotopia con *P. bonelli*, suggeriscono l'esistenza di altre possibili interazioni fra le due specie oltre alla semplice competizione, tra le quali l'antagonismo mutuo, che si tradurrebbe in una reciproca predazione.



P9.11 Test of strobilation inducers in *Aurelia* spp.: toward a validated protocol

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Medusa production in the class Scyphozoa is by the production of discs by transverse fissions of the polyp body column until young medusae (ephyrae) are released in the water. This asexual reproduction (strobilation) was investigated in three populations of the moon jellyfish *Aurelia* sp. from the Adriatic coast: Piran, Mljet and Varano. Natural (decrease in temperature) and artificial inducers (hydrogen peroxide and indomethacin) of strobilation were tested on well-fed polyps held at 21°C and checked for 117 days. Hydrogen peroxide did not induce strobilation in any of the populations tested. The effects of the other inducers differed by population. For the indomethacin treatment, higher percentages of polyps strobilated in the lowest concentration for Piran and Mljet populations, but Varano polyps responded conversely. Higher indomethacin concentration (20 µm) also reduced the survival rate of polyps. Decreased temperature induced a higher percentage of Piran polyps to strobilate than Varano polyps, but no effect was observed for Mljet polyps. Although the most ephyrae/polyp were released in all populations with the natural inducer, we finally demonstrated that indomethacin was the best inducer to obtain high percentages of strobilating polyps (75%) quickly (10 days) to obtain ephyrae. This work would represent the first step in the research of possible triggers and pathways involved in the strobilation of *Aurelia* spp. polyps.



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