S.It.E. - Società Italiana di Ecologia

SItE 2017

XXVII Congresso Nazionale della Società Italiana di Ecologia

La ricerca ecologica in un mondo che cambia

Libro degli Abstract

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Università degli Studi della Campania *Luigi Vanvitelli*

S.It.E. - Società Italiana di Ecologia
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XXVII S.It.E. Atti

RELAZIONI AD INVITO

RELAZIONI AD INVITO

CLIMATE EXTREMES AND ECOLOGICAL SYSTEMS: IMPACTS AND FEEDBACKS "A TREE-RING PERSPECTIVE THROUGHOUT TIME"

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In this "overview" talk, I will review the wealth of recent, cross-disciplinary advancements within the emerging field of tree-ring research, including wood anatomy. In so doing, I will describe how novel data, innovative methods and cutting-edge perspectives are now more and more used to define, shift and overcome intellectual boundaries in our conceptual way of thinking.
Ranging from the cell to the globe and from the present to the early Holocene, the various topics that I will briefly introduce, jointly underline the relevance of annually resolved and absolutely dated tree-ring chronologies for providing a unique temporal dimension and dating accuracy to a wide range of ecological studies.
More specifically, I will navigate through some of the most influential dendroecological and paleoclimatological achievements of the last decade. Furthermore, I will provide several examples of how dendroecological approaches might indeed be able to contribute towards crossing research frontiers, not only within the vast field of natural sciences but also towards the humanities.
While presenting an array of timely case studies, with all of them being centred on either tree-ring data or associated techniques, this talk will comprise multiple aspects of archaeology, astronomy, biology, ecology, epidemiology, history, mycology and volcanology. Finally, I hope to stimulate discussion on both, the potentials as well as the limitations of state-of-the-art tree-ring research to help answering ecological questions.

BIOLOGICAL INVASIONS: IMPACTS AND FEEDBACKS

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Invasive alien species are a major driver of biodiversity loss globally, also causing serious socio-economic impacts. European and global data on the temporal trends of invasions show that the number of alien species is increasing in all regions and in every environment, with no sign of a saturation effect, stressing the urgency to develop effective responses to this threat. Responding to biological invasions clearly requires a prioritisation of action, based on the identification of the most impacting species and also forecasting possible emerging invasives. For this aim, it is essential to categorize the different types of impact and to develop metrics of the effects caused by invasive species. Indeed this is a complex challenge, as invasive species can have different effects, varying from changes in native species extinction probabilities, to genetic composition of native populations, behaviour patterns, species richness and abundance, ecosystem productivity, nutrient cycling, hydrology, habitat structure, etc. In the last years, there have been significant progresses in the development of formal categorisation of these impacts and of a metric of these impacts; similar efforts are now being applied also to improve our understanding of the socio-economic impacts of invasive species.
These efforts are being used to develop decision support tools for policy making, in particular to identify priority species to be regulated or controlled. The progresses in invasion biology have been pivotal to the development of policies on invasive species in several regions of the world including Europe, with the adoption of a European Union regulation specifically focused on this threat. The enforcement of these policies could significantly reduce the impacts of invasive species in the future, but for this aim it is essential that the link between science and decision making is maintained and strengthened.

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COMUNICAZIONI ORALI

THE HYDROMORPHOLOGICAL WAY TO THE EVALUATION OF E-FLOWS

Bussettini M.[1,2], Rinaldi M. [2], Vezza P.[3], Belletti B.[4], Zolezzi G.[5], Comiti F.[6], Carola M.[5], Lastoria B.[1], Bruno M.C.[7], Braca G.[1]

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River hydromorphological processes have been severely altered by human pressures, with subsequent impacts in river ecological status. Such impacts could be mitigated implementing functional water (and sediment) flows regimes, i.e. environmental flows (E-flows). E-flows are determined by various methods and approaches, and their range in time reflects the degree of knowledge achieved in the field of river sciences, and in particular in the domain of eco-hydro-geomorphology. A first paradigm shift in the late 90's recognized that not only the magnitude but also all the components of flow regime are crucial for ecosystems functioning. This means that minimum flow strategy cannot be effective measure to restore some ecological processes. Recently, that paradigm was better reformulated to stress the necessity of considering sediment dynamics in the specification of environmental flows. Hydrological and geomorphological processes are indeed coupled over a wide range of spatial and temporal scales and any change in one affects the other, resulting in alteration of riverine habitats. In spite of those evident linkages in space and time, current restoration approaches, such as minimum flows (e.g. DMV in Italy), typically focus only on changes on hydrological regime as a means promoting ecological enhancements. Neglecting the multispectral nature of flows and their interaction with sediment transport in shaping riverine habitats is likely to results not only in minor or no enhancements in the ecology, but may also increase the costs of water use. Therefore, a multi scale, process based diagnostic and prognostic framework has to be adopted in order to diagnose the mechanisms of alteration and the possible rehabilitation actions. Here we present, in particular, a methodology for the estimation of environmental flows, based on the implementation of such an analysis.

THE POTENTIAL OF PLANT ASSEMBLAGES AS INDICATORS FOR ASSESSING THE CONSERVATION STATUS OF NATURA 2000 HABITATS

Angelini P.[1], Casella L.[1], Chiarucci A.[2], Nascimbene J.[2], Cerabolini B.E.L.[3], Dalle Fratte M.[3], Genovesi P.[1]

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The current approach for assessing the conservation status (CS) of Natura 2000 habitats is mainly related to the recording of the occurrence of a pool of indicator species that are supposed to be typical of a given habitat. However, this approach may miss to incorporate the evaluation of ecosystem functioning and this weakens the consistence of the current monitoring programs with the EU policies. In this perspective, the analysis of plant assemblages, both in terms of taxonomical and functional composition, would provide new tools for developing more effective indicators of the CS of Natura 2000 habitat types. On these basis, it would be possible to develop a practical "Vegetation Functional Index (VFI)" that estimates the deviance of a given patch of habitat type from a reference standard of the same habitat type, also accounting for its functional features. Therefore, further effort will be devoted to the computation of the VFI and to the definition of reference conditions against which each Natura 2000 habitat type should be evaluated. This would strengthen the national monitoring program, fully accomplishing the EU guidelines.

MONITORING BIODIVERSITY UNDER HABITATS DIRECTIVE TO ENHANCE AN ECOSYSTEM APPROACH TO CONSERVATION

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ISPRA - Istituto Superiore per la Protezione e la Ricerca Ambientale

Monitoring is the fundamental tool to detect trends of biodiversity, to identify emerging threats and to enhance efficient conservation actions. It requires standardized survey methodologies and organization and circulation of data. Monitoring activities are needful also to implement European strategies and directives for biodiversity conservation. Habitats Directive requests surveillance and reporting on the conservation status of habitat and species of Community interest aiming to assess the results of its application and to set nature conservation priorities. Despite the Directive fixes the reporting parameters and rules in order to allow data aggregations and assessments at a European scale, it doesn't bind on how Member States should carry out monitoring. In this perspective, nation wide shared monitoring protocols for the Italian habitat and species protected under the Habitats Directive (Annexes I, II, IV, V) have been identified and published (available online: http://www.isprambiente.gov.it/it/servizi-per-lambiente/direttiva_habitat/) thanks to an Italian project, based on a collaboration network between Ministry of the environment, ISPRA, regions and scientific societies. The high number of Italian fauna and flora species of Community interest (113 plant species and 225 animal species reported in 2013), showing a wide range of different distribution patterns and ecological requirements, reflects the particularly rich biodiversity of Italy and determines a great responsibility in terms of conservation, both at national and regional level. A survey on plant species is presented. A great work was done to identify the most adequate field survey methods to monitor population size and ecological requirements of Italian species of Community interest, with the aim to enhance an ecosystem approach to conservation and support the setting of long-term monitoring schemes and priorities.

SHRINKING STREAMS THREATEN DIATOM BIODIVERSITY

Falasco E.[1], Piano E.[1], Fenoglio S.[2], Doretto A.[1], Bona F.[1]

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The Mediterranean basin is one of the most important biodiversity hotspot on Earth, resulting from unique combination of geography, geology and climate. Unfortunately, this area is also one of the most threatened by climate change and habitat loss. In particular, the maintenance of the hydrological stability represents an important requirement for biodiversity conservation of lotic systems. However, over the last decades, both global and local pressures have been heavily threatening Mediterranean aquatic ecosystems causing water scarcity and habitat fragmentation, with significant consequences on benthic communities. In this research, we analyse the response of the benthic diatom communities to summer droughts in terms of benthic primary production, taxonomic and functional community composition, with a particular attention to the presence of threatened or allochthonous taxa. Sampling campaigns were carried out from spring to early autumn to track the community changes throughout the different phases of the drought. We performed an experimental sampling methodology aimed at exploring peculiar microhabitats, usually excluded from the standardized sampling protocols. While we observed no variation on the total benthic chlorophyll a content, we detected a general decrease in the diatom chlorophyll a from spring to late summer, when the drought impact was at its maximum. Moreover, the analysis of microhabitats during the base flow revealed the presence of endangered diatoms, which are usually underestimated by the traditional sampling methodology. We showed that the hydrologic disturbance threatened these taxa, favouring at the same time the diffusion of allochthonous species. In particular, our results confirmed that a perceptible flow is a crucial factor for the conservation of endangered species. In conclusion, diatoms can provide useful guidance for the improvement of the river management practices in a context of increasing water scarcity.

MACRO- AND MICRO-DRIVERS OF MACROPHYTE DISTRIBUTION IN LOWLAND RIVERS: LESSONS FROM A HIGHLY MODIFIED WATERCOURSE OF NORTH ITALY (OGLIO RIVER)

Bolpagni R., Racchetti E., Laini A.

Università di Parma

Multiple drivers regulate the distribution of macrophytes in rivers. Anyway, a central role has always been ascribed to the nutrient stoichiometry, emphasizing the contribution of pollutants to primary production shifts. A classical paradigm in this sense is represented by the progressive replacement of complex, anchored vascular plants by algae (including filamentous macro-algae and/or phytoplankton) in response to increasing nutrient availability. However, recently a new awareness has emerged on the non-negligible role played by hydrogeomorphic forces in driving local representativeness of macrophytes, as well as the importance of the contribution of groundwater supply during summer. Additionally, this could explain the fact that often it is not possible to find significant relations between macrophytes and physical and chemical determinants, weakening the effectiveness of biomonitoring approaches. Based on 6-years monitoring project (2009-2015) focused on the evaluation of the Minimum Vital Flow of the Oglio River (North Italy), we collected data on the role of damming and groundwater resurgence on macrophyte distribution, diversity, dominance, and river ecological status classification. A clear habitat filtering and niche differentiation effects were recognized, especially in terms of life forms and relative cover-abundance values with relevant implications for river quality assessment.

PHYLOGENY AND MORPHO-MOLECULAR DIVERSITY OF THE FAMILIES SPHAEROCORYNIDAE AND CLADOCORYNIDAE (HYDROZOA, CAPITATA)

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Marche Center, Università degli Studi di Milano Bicocca

Hydrozoans belonging to the families Cladocorynidae and Sphaerocorynidae have, in most cases, confusing taxonomic histories. The family Cladocorynidae traditionally comprehend two genera, the octocoral-associated Pteroclava and the generalist Cladocoryne. Pteroclava harbour a high genetic diversity despite a conserved morphology. In particular, according to molecular phylogenetics and DNA taxonomy analyses, several clade ascribable to as many cryptic species can be identified. Each clade is specifically associated with a different octocoral family, and the distribution of some lineages seems to be restricted to certain geographical regions and/or depths. Cladocoryne includes five nominal species, of which three were almost never recorded after their description. The most recorded species in literature is *C. floccosa*, which can be found from the Western Atlantic Ocean to the eastern Pacific in both tropical and temperate waters. Preliminary results suggest that also this species may harbour a cryptic diversity or at least a strong genetic structure. Finally, a new genus is included in the family and is represented by a species previously ascribed to the genus Zanclea. The family Sphaerocorynidae is composed of five valid species currently subdivided into two genera. Molecular analyses of three of these species plus other new taxa allowed a phylogenetic reconstruction of the family and revealed the polyphyly of one genus, as well as the presence of new species and new genera. Moreover, the morphology of polyps is reanalysed and new polyp-based descriptions are provided, in order to clarify the morphological diversity of this group, and to find a solution to the previous common misidentifications.

HIGH-THROUGHPUT SEQUENCING REVEALS HIGH CYANOBACTERIAL DIVERSITY IN A LARGE PERIALPINE LAKE

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The study of phytoplankton and cyanobacterial diversity in aquatic environments has been traditionally limited mostly to the microscopic examination of samples and to the use of molecular techniques based on culture-dependent approaches. In the case of cyanobacteria, a correct identification of individuals is of paramount importance, due to the ability of these organisms to produce a wide variety of toxic compounds. Nevertheless, owing to the limitations of the traditional approaches, the number of cyanobacterial taxa can be severely underestimated and identifications affected by taxonomic ambiguities. This is especially true in the detection of rarest and/or smaller individuals. In this study, we evaluated the use of high-throughput sequencing (HTS; Illumina MiSeq) as a tool for the study of cyanobacterial diversity in a large lake south of the Alps (Lake Garda). Results obtained from two years of monthly samplings allowed discovering a wide diversity. The most abundant operational taxonomic units recovered coincided with the most abundant taxa identified using traditional microscopic and molecular approaches (e.g. Tychonema, Planktothrix, Dolichospermum, Microcystis). Conversely, HTS allowed identifying many other small abundant Synechococcales and Chroococcales, as well as other rare large Nostocales never identified so far. The concurrent metabolomic profiling provided results consistent with the production of anatoxins and microcystins by the most abundant taxa. Though HTS enables increasing the knowledge of microbial complexity in response to environmental changes, its use in the evaluation of the specific diversity of target groups is not free of complications, e.g. due to the short length of 16S rRNA sequences.

MICROZOOPLANKTON COMPOSITION AND HORIZONTAL DISTRIBUTION IN THE WESTERN MEDITERRANEAN SEA

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In this study microzooplanktonic abundance, biomass, and taxonomical compositions were analysed and the community structures were discussed on the base of abiotic variables measured during the summer 2015 in the Western Mediterranean Sea. The purpose was to highlight a connection between population composition and the hydrology that characterizes the specific basins, contributing to the understanding of the phenomena that make the Mediterranean area a hotspot of variability and diversity. A significant effect of the interaction between Transect and Depth factors, were detected. Total MCZ community abundance and number of taxa decreased from the surface to the 500m depth. Furthermore, PERMANOVA results showed a significant effect of the variable depth in the community structures and abundances, this variable explain 28.6% of the total variance recorded in our sampling units. A significant effect is also highlighted for the variable Transect accounting for 11.6 % of the total variance; conversely the Site variable resulted not significant. The value of similarity recorded between the community of the transects analyzed in this study appeared closely related to the circulation that characterizes the Western Mediterranean basin highlighting that the water masses modifications in salinity along the Mediterranean circulation could play a significant role in shaping the protis assemblages.

TEMPORAL PATTERNS AND FUNCTIONAL DIVERSITY OF PHYTOPLANKTON ASSOCIATIONS AT A COASTAL LTER MEDITERRANEAN SITE

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Coastal phytoplankton composition is characterised by a remarkable variability at small temporal and spatial scales, which is the consequence of complex relationships with hydrological parameters at the land-sea interface. Nevertheless, the identification of successional patterns and rules of assembly, as well as of their driving factors, is imposed by the pivotal role of species-specific properties in controlling ecosystem functions and at times posing human health risks. Based on light microscopy analysis of surface samples collected in 1984-2010, we addressed species associations and their seasonal and interannual distribution at the coastal station LTER-MC (Gulf of Naples, Mediterranean Sea), with the aim of assessing the extent of their regularity and robustness. Using an r-mode clustering analysis on a reduced dataset of 80 species, we identified seven main groups of species. Five of them were recurrent over the years in early spring, spring, early summer, autumn and winter, respectively. One association showed two peaks of occurrence, whereas one did not show any clear seasonality. With the exception of the winter group, which mainly included coccolithophores and silicoflagellates, diatoms were present in all associations. The occurrence of the different associations was mainly driven by the season (i.e., temperature), whereas parameters related to the coastal nature of the site (i.e., nutrients and salinity) showed to be important for associations with no clear seasonality. Finally, we addressed the variations of morphological features that define ecological traits, with the aim of assessing the degree of functional diversity within the individual association. A seasonal trend in functional diversity was evident, the maximum corresponding to the early spring association and the minimum to the winter one, which indicates a change in the rule of assembly of phytoplankton communities along the year.

A NEW METHOD TO IDENTIFY POSSIBLE SHIFTS IN WEIGHT-LENGTH RELATIONSHIPS

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The exponential function W=aLb is commonly used to describe the weight(W)-length(L) relationship (WLR) of fish. A known issue that affects its fitting performance is that small/young specimens may present different WLR from the larger/older ones introducing errors in the WLR of the total population. This difference may appear with a breakpoint only in the log-WLR plots and it has been attributed either to biological factors or to errors in the sampling procedure.
The aim of the study is: to propose a flexible bilinear model (LinBiExp), to use the breakpoint of LinBiExp as a method to improve the fitting performance of W=aLb and to provide a statistical procedure, which examines the robustness of the breakpoint. The analysis was performed using as test case a large dataset of W-L measurements (2627 specimens) of European eel (Anguilla anguilla L.) and highlighted the ability of LinBiExp function to capture the breakpoint and to describe the two linear log-WLR segments. The breakpoint was used to divide the data into two parts that were further analyzed separately using the typical exponential function, which showed improved fitting performance. A bootstrap procedure was used to assess the robustness of breakpoint's coordinates and the ratio of slopes of the two linear segments using the 95% intervals of the highest posterior density distribution. The estimated breakpoint for the specific dataset was justified by a) the regulation of metabolic activity to achieve higher elongation rates at the young age classes and b) ontogenetic diet shift, which was verified by gut content analysis.

DRIVERS AND PATTERNS OF POST-DROUGHT DIATOM RECOLONIZATION OF THE RIVERBED

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Over the last decades, the extent and frequency of droughts in Mediterranean streams have been intensified due to both local impacts and global climate changes. This hydrological intermittency has important chain effects on both structure and functioning of the aquatic ecosystem and the consequences on the biological communities are significant, especially on benthic primary producers. The survival of benthic organisms in intermittent streams is mainly due to resistance mechanisms (e.g. the exploitation of refuges during the dry periods or the production of resistance forms) and resilience (their ability to re-colonize riverbeds). The aim of this research was to study the recolonization patterns of benthic diatom communities after droughts in three Mediterranean intermittent streams, which differed in terms of surrounding land use. A manipulative experiment was carried out to evaluate the recovery pattern of adapted and non-adapted diatom communities, after different drought modes (abrupt vs gradual). As response metrics, we evaluated benthic chlorophyll a and taxonomic composition. Our results demonstrated that: i) diatom communities adapted to seasonal droughts recover faster than non-adapted ones during recolonization phase; ii) compared to gradual water recession, abrupt droughts exerted a stronger impact on biofilm recovery both in terms of primary production and community biodiversity; iii) consequences are more severe for pristine streams. Diatoms resulted as the most sensitive group within biofilm and the effects of short- and long-term droughts on diatom recovery patterns are, in both cases, significantly visible. The impact of droughts can be detected in terms of both primary production and community composition, with significant loss of endangered species.

COMMUNITY RESPONSE TO HYDROLOGICAL INTERMITTENCE IN ALPINE RIVERS: PRIN NOACQUA PRELIMINARY RESULTS

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Italian alpine rivers have always been typically perennial systems, in which the presence of water was continuous along the year. However, over the last decades they have been affected by a conspicuous increase in frequency and intensity of drought periods, mainly caused by global climate change and human impacts (agricultural and hydroelectric uses). In intermittent lotic environments benthic communities have evolved adaptations and strategies to survive the dry period. Biological and ecological recovery after seasonal droughts are here relatively rapid, because aquatic organisms have adopted over-summering refuges and life-cycle strategies. For these reasons, communities in intermittent streams show high resistance and strong resilience to seasonal droughts, but almost nothing is known about the biotic responses to droughts in previously perennial Alpine streams. The study we present here is part of the MIUR PRIN NOACQUA, in which we are responsible of the Alpine area, together with the University of Parma for the Apenninic systems and the University of Ferrara for lowland rivers. In 15 alpine rivers, we have identified a 'perennial' reach (called M) that permanently maintains the surface running water and an 'intermittent' section (called V), subject to water withdrawals. Quantitative samplings of benthic communities (diatoms and macroinvertebrates) were performed in each of these sections. In addition, both allochthonous (CPOM amounts) and autochthonous (benthic chlorophyll-a estimated with the Benthotorch) energy inputs were estimated. Regarding macroinvertebrates, we found that M-communities are on average richer and more diversified than V-communities. Moreover, while M-communities are highly heterogeneous, V communities are much less differentiated. We suppose that hydrological intermittence act as a filter that selects, also from different communities, species sharing the same life-history traits adapted to overcome the drought periods.

MANAGING SQUIRRELS TO PREVENT LOSS OF BIODIVERSITY IN THE APENNINES: NEW CHALLENGES AND OPPORTUNITIES

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The grey squirrel (*Sciurus carolinensis*) is one of the world worst invasive alien species. Following its introduction in Umbria, Italy, in 2000, it occupied a range of about 50 km2, replacing the native red squirrel (*Sciurus vulgaris*). Spatially explicit population models show that the alien species can easily expand in Central Italy in the near future, threatening the biodiversity of Apennines forests in general. Following the new European Regulation No. 1143/2014, the LIFE U-SAVEREDS Projects now aims at the eradication of the Umbrian population. The distribution of grey squirrel in Umbria largely overlaps the urban and suburban areas of Perugia, and the Project faces oppositions by citizens. Eradicating the grey squirrel from Umbria is thus both an opportunity and a challenge, because effective management policies must be developed taking into account social issues. A successful eradication could positively impact for the conservation of the red squirrel and of the endemic *Sciurus meridionalis*. In this context, the LIFE U-SAVEREDS Project developed a management strategy involving direct (capture and euthanasia) and indirect (capture and surgical sterilization) removal of the animals. A Decision Support System including the evaluation of social issues was specifically developed. It identified spatial intervention priorities and it allowed the start-up of grey squirrel management in areas where the overall social context was favourable. At the same time, a targeted information campaign was implemented to actively involve citizens in the Project. Following the intervention in different management units, we now evaluate the outcome of Project activities. Quantitative data on the assessment of grey squirrel populations before and after the implementation of control activities are used to evaluate the future evolution of grey and red squirrels according to scenarios differing in terms of accessibility to private areas and control strategies.

BIRDS AS SENTINELS OF GLOBAL WARMING: A PHYLOGENETIC META-ANALYSIS OF CIRCANNUAL PHENOLOGY AT THE WORLDWIDE LEVEL

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Over the past century, global temperatures have increased unprecedentedly, and are projected to increase at an even steeper rate in the next decades. Such a dramatic increase have already impacted on biodiversity at all levels of organization, and climate change is expected to become the greatest global threat to biodiversity over the next few decades. However, organisms have already provided adaptive phenotypic responses to ongoing climate change. Among them, one of the most widespread response is the adjustment of timing of their circannual life cycle to match climate-driven shifts in the phenology of the organisms to which they are ecologically linked. This aspect has been particularly studied in birds. In the present study, we summarized the temporal variation in phenology of bird species breeding in all the continents by using a meta-analytic approach. We collected from the published literature more than 5000 historical series of phenological changes (e.g. the slope of the linear regression between phenology and year) of 650 different species (ca. 7% of the totality of the described bird species), concerning three distinct phases of their circannual activities: migration towards breeding grounds, breeding and migration towards wintering grounds. By accounting for the effect of phylogenetic legacy among different species, we estimated variation in phenology among continents and latitudes, and according to several life-history traits (e.g. migration strategy, breeding habitat, trophic level) of any bird species included in the database. On the whole, this study represents the largest attempt to summarize the effects on climate changes on phenology of birds to date. We provided information at a very large spatial scale about the vulnerability of different ecological guilds and/or phyletic lineages of birds to climate change, identifying not only single species, but also groups of species which can become the priority for future conservation strategies.

THE EVOLUTIONARY ECOLOGY OF SOLDANELLA (PRIMULACEAE) IN THE SOUTHERN APENNINES (ITALY)

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Soldanella (Primulaceae) is a small genus of orophytes represented in the southern Apennines (Italy) by three metapopulations on some of the highest peaks of the area (Gelbison, Sila and Aspromonte massifs). Their disjointed and fragmented distribution poses intriguing questions about their phylogeny, evolutionary ecology and biogeography, here investigated through a comparative approach based on the study of molecular, morphological and ecological characteristics of 8, 5 and 2 populations on the Gelbison, Sila and Aspromonte massifs, respectively. Specifically, their phylogeny, based on nuclear (total ITS) and plastid (rbcL and trnL) markers, was derived using maximum likelihood and Bayesian techniques, their glandular hair and leaf morphometry was analysed, and their environment was characterised for altitude, forest canopy composition and soil pH, C, N and organic matter. The availability of ITS sequences for the almost entirety of Soldanella species allowed also to delineate the evolution of the genus in Europe, with a special focus on the early diversification events and on the evolution of the southern Apennines populations. According to our multispecies coalescent model, the Soldanella lineage of southern Italy diverged from the Carpathians one during the early diversification of the genus in the Middle Pleistocene, and underwent an evolutionary radiation during the Late Pleistocene. The populations of the Sila and Aspromonte massifs diverged from those of the Gelbison massif around 380000 years ago, likely through vicariance, with shifts in morphology and ecological niche, and are probably undergoing a differentiation due to their isolation. The unique molecular, morphological and ecological traits of the metapopulation of Soldanella on the Gelbison massif clearly demonstrate its belonging to a new taxonomic unit at the species level, which we named Soldanella sacra A. & L. Bellino from the name of the massif on which it was discovered, the “Holy Mountain”.

RIPARIAN VEGETATION CLEAR CUTTING: EFFECTS ON VEGETATION BIODIVERSITY AND COMPOSITION

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Riparian vegetation can include trees, shrubs, grasses and vines in a complex structure of groundcovers, understorey and canopy. Native riparian vegetation forms an important part of a healthy functioning ecosystem and has many important ecological benefits. Although there is abundant literature confirming that riparian vegetation affects flood hydrology by attenuating the flood wave, enhancing deposition and reducing bank erosion, in some countries like Italy it is still considered one of the main causes of flood risk so without any local scientific evidences. In August 2014, a stretch of riparian forest of the Savena river included in the SIC IT4050012 (near Pianoro Vecchio (BO)) was subject to clear cutting with the declared aim to avoid any risks arising from possible floods. While the potential benefits of this intervention are still the subject of lively discussion, its impact on the vegetation has been strong . In order to feed into future policy making, a monitoring campaigns was carring on verifying the resilience, the variations of structure and phytodiversity, as well as the turn-over of plant species. In the surrounding area there are 2 main types of wood: the first one, is characterized by Alnus glutinosa, Salix alba and other species of damp habitats; the second, dominated by the Blacj Poplar and Ostrya carpinifolia is less hydrophilus. The first results show that one year after cutting show an increase of plant diversity was detected, mainly due to a massive invasion of Heliophilus and termo-xerophilous herbs with nitrophilous and riderals ones with the reduction of nemoral species. So this high turn-over of species caused a considerable variation on the vegetation composition.

CONSERVATION OF MULTISPECIES HOTSPOTS OF INTRA-SPECIFIC BIODIVERSITY IN THE ITALIAN PENINSULA: COMBINING POPULATION GENETICS, SPECIES DISTRIBUTION MODELS AND GAP ANALYSIS

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Most conservation planning exercises, as well as classical gap analyses, only consider species diversity which, at most, provides a single static snapshot of biodiversity patterns. As an alternative, conservation of intra-specific diversity hotspots represents one of the few options available to ensure long-term preservation of biodiversity, yet only a handful of studies have focused systematic conservation planning exercises on this component of biological diversity until now. Here, we provide for the first time in the Italian peninsula a framework aimed at identifying priority areas for the conservation of genetic diversity.Considering 23 lineages of terrestrial vertebrates endemic of the Italian peninsula, we developed four main steps: 1) using species distribution models in an ensemble forecasting approach, we mapped current and future geographic distributions for each lineage; 2) considering different genetic markers, we mapped hotspots of intra-specific genetic diversity for each lineage; 3) we combined single lineages results and identified those areas came to light to be multispecies hotspots of diversity; 4) we tested the extent to which the existing networks of Protected Areas (PAs) and Natura 2000 areas covers these hotspots now and in a near future (2100, under several global circulation models and emission scenarios). We identified areas of outstanding importance as hotspots of genetic diversity,located in the Calabria region and the Ligurian Apennine. Furthermore, our results clearly show that the existing PAs plus the Natura 2000 network do not guarantee an effective protection of this basal component of biological diversity,and that they will be even less effective in this respect under future scenarios of climate change.

A LONG-LIVED SEAGRASS UNDER MULTIPLE ANTHROPOGENIC DISTURBANCES: SYNERGIES, EARLY WARNINGS, AND CONSERVATION TIPS

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Seagrasses are globally declining and often their loss is due to synergies among stressors. We investigated the interactive effects of eutrophication and burial on the Mediterranean seagrass, *Posidonia oceanica*. A field experiment was conducted to estimate whether shoot survival depends on the interactive effects of three levels of intensity of both stressors and to identify early changes in plants (*i.e.* morphological, physiological, and expression of stress-related genes) that may serve to detect signals of imminent shoot density collapse. Sediment burial and nutrient enrichment produced interactive effects on *P. oceanica* shoot survival, as high nutrient levels had the potential to accelerate the regression of the seagrass exposed to high burial (HB). After 11 weeks, HB in combination with either high or medium nutrient enrichment, caused a shoot loss of about 60%. Changes in morphology were poor predictors of the seagrass decline. Likewise, few biochemical variables were associated to *P. oceanica* survival (the phenolics, ORAC and leaf $\delta^{34}S$). By contrast, the expression of target genes had the highest correlation with plant survival: photosynthetic genes (ATPa, PsbD and PsbA) were upregulated in response to high burial, while carbon metabolism genes (CA-chl, PGK and GADPH) were down-regulated. Therefore, die-offs due to high sedimentation rate in eutrophic areas can only be anticipated by altered expression of stress-related genes that may warn the imminent seagrass collapse. Management of local stressors, such as nutrient pollution, may enhance seagrass resilience in the face of the intensification of extreme climate events, such as floods.

BATS FORAGING OVER FREE-RANGING CATTLE – COMMENSALISM OR MUTUALISM? IMPLICATIONS FOR BAT CONSERVATION AND LIVESTOCK MANAGEMENT

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Traditional agropastoralism increases biodiversity by maintaining habitats whose existence depends on human practices as well as by providing wildlife, including bats, with key spatial and trophic resources. Bats in farmland are crucial predators of crop pests, thus offering an economically important ecosystem service. It seems possible that bats also may provide services by feeding on insects associated with livestock. We tested whether bats associate with cattle in a traditionally managed pastoral area of central Italy, i.e. setting the bases for providing pest control services. We found that small bats (mostly Pipistrellus spp.) foraged preferentially over livestock, and that their activity increased, but then reached a plateau or slightly decreased, for progressively larger herds. Landscape complexity also led to an increase in bat activity over livestock. Since insects attracted to cattle at night typically include flies such as mosquitoes (Culicidae) and biting midges (Ceratopogonidae), which are potentially harmful to cattle and may carry serious diseases, and that bats such as Pipistrellus spp. are important predators of such flies, we argue that bats may play a valuable pest-suppression role. In this case, both bats and livestock would benefit from this trophic interaction, which would thus represent a case of mutualism rather than commensalism.

RESTORATION ACTIONS IN MARINE ECOSYSTEMS: A GLOBAL ANALYSIS

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The conservation of nature and the management of human activities are considered effective approaches to limit the degradation of marine ecosystems and the services they provide. Current practices are clearly inadequate to reverse present trajectories of change. Marine restoration is still at its infancy, due to many gaps among current implementation methods and a substantial inconsistency in the evaluation of restoration strategies. The MERCES scientific community made a review of studies on restoration published in the last 25 years at global scale, including from very shallow to deep sea habitats, to assess how, where, at which spatial and temporal scales restoration was carried out and with what outcomes. A total of 573 studies were analysed. Despite the increasing recognition that active restoration can have a critical role in the recovery of disturbed systems, results highlight the heterogeneity of targets, implementation methods, approaches and standards across habitats. With the exception of wetlands, most restoration projects cover too small areas (< 1 ha) to match the scale of human disturbance. In addition, short project duration (one - two years), frequent lack of consideration of control areas and knowledge of baselines, largely impair the potential for showing robust success stories. The response variables used for assessing restoration effects (e.g. survival rates, mortality, growth, propagule production, biomass partitioning) change among studies and in many cases are only vaguely reported. Despite some success stories are described, most studies report high costs, also in terms of labour, and idiosyncratic outcomes. Our results show the importance for the identification of protocols, appropriate monitoring approaches and case studies for developing marine restoration and the need of applying best practices at appropriate spatial and temporal scales to make restoration a sound perspective for future management of marine ecosystems.

ADDRESSING COMPLEX CONSERVATION CHALLENGES THROUGH MARINE SPATIAL PRIORITIZATION

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The Adriatic and Ionian Region (AIR) is a strategic area for sustainable Blue Growth in the European Union. In the AIR, the governance framework is complicated by stratified legal frameworks operating at multiple scales under responsibility of both EU and non-EU countries. This semi-enclosed marine region will benefit from collaboration between countries, which has proven to deliver cost-efficient solutions for conserving biodiversity through cost-sharing across the Mediterranean Sea. Yet operationalizing collaboration is a major challenge and no formal framework exists in the AIR. We address this challenge by pre-emptively investigating the value of spatial conservation prioritization at multiple scales within the AIR. Using the decision support tool Marxan, we identify priority areas for marine conservation across the AIR. We evaluate 4 planning scenarios at multiple scales with respect to the equitable distribution of 1) conservation areas across AIR countries, 2) the impacts on maritime industries. Results show that planning at the regional scale without considering impacts to countries or industries produced the most inefficient plans of all scenarios. On the other hand, approaching priority setting through spatial prioritization, where biodiversity targets are explicitly set according to the domain of each country in the AIR, produced far more cost-efficient plans for a minimal reduction in our equality metrics used. Our objective is to illustrate the value of using spatial prioritization as tool to facilitate simplifying complex conservation challenges for ocean governance. The analysis supports the identification of priority areas across the AIR for conservation, strategic areas for cooperation between specific countries, and how spatial prioritization can deliver better outcomes for biodiversity and maritime industries.

RE-ESTABLISHMENT OF THE RIBBED LIMPET (*PATELLA FERRUGINEA*) IN LIGURIAN MPAS BY RESTOCKING AND CONTROLLED REPRODUCTION – RELIFE PROJECT

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Patella ferruginea, an endemic proterandric gastropod mollusc from the Western Mediterranean, is one of the most endangered invertebrates of the entire basin, as reported by SPAMI and Bern Convention and the Habitats Directive (ECD 92/43/EEC, 1992). In addition, *P. ferruginea* is considered a target species to evaluate the good marine environmental status (GES), according to the Italian Marine Strategy, thus requiring protection regimes both within and outside Natura 2000 sites. Historically, this species was present along the Ligurian coasts in the upper intertidal and lower subtidal, habitat strongly threatened by seawater pollution and by human harvesting for food and baits. Exploitation may exert further detrimental effects decreasing the reproductive output of the species, because larger size specimens, with higher fecundity, are the preferentially collected ones. All these aspects contributed to the disappearance of the species from the Ligurian coast, as well as from many other Mediterranean areas. The project RE-LIFE, funded by the LIFE Programme (EC), aims at reintroducing *P. ferruginea* within the Portofino MPA and in the other Ligurian MPAs (Natura 2000 sites), where extinction causes have been eliminated and appropriate protection is assured. Two main actions will be implemented: (i) the re-introduction of *P. ferruginea*, by transferring adult specimens from the Tavolara MPA (Northern Sardinia), where a rich population in good health is still present; (ii) the production of new specimens in hatchery, adopting specifically targeted culturing protocols, to extend the repopulation process and replicate it in other MPAs. As expected results, *P. ferruginea* population will be reintroduced in Ligurian MPAs, the original population in Tavolara MPA will be restored by transferring reared specimens and an optimized rearing process will be setup to replicate active reintroduction and restocking in other MPAs.

EXPLORING THE FEEDING ECOLOGY OF THE CORALLIVOROUS STARFISH CULCITA SPP. IN THE REPUBLIC OF MALDIVES

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The study of the role of corallivore starfish in reef ecology and integrity has become increasingly important, especially in this era of continuous and dramatic global change. However, to date only the impact of predation by the Crown of Thorns Starfish (COTS) Acanthaster planci has been largely investigated, focusing the main efforts on understanding the devastating effects of their outbreaks and invasions. In this scenario, other species of coral-eating starfish have been neglected, probably due to their apparent inability to cause population outbreaks and to represent an immediate and macroscopic risk source for the reef integrity. The Pincushion starfish Culcita spp. is a genus of starfish that occurs in many tropical reef areas and represents one of the most common genera of Asteroidea in the Republic of Maldives, where, in normal condition, is commoner than A. planci. This study was conducted in different reef areas of Faafu Atoll (Maldives) between 2015 and 2017, with the aim of investigating the main ecological features of Culcita spp. focusing in particular on its feeding preferences and behaviour, scarcely analysed until now. Our results showed that these organisms could significantly affect the community structure of coral recruits of the genus Acropora spp. and Pocillopora spp. Moreover, they showed a surprisingly high feeding activity and impact on adult specimens with a diameter between 10 and 20 cm, which in the most of the cases were totally consumed. Furthermore, for the first time, the genus Pavona spp. was found to be prayed in a large number of cases and not only occasionally. Giving new insights about the ecological traits of these coral-consumers animals could be of great importance in understanding the possible effects of corallivory in an already stressed environment and in a poorly studied site, such as the Republic of Maldives.

HANDLING LONG TERM ECOLOGICAL MARINE DATA: AN OPEN SCIENCE APPROACH

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The Open Science approach is the route towards a democratic way of making freely available, for every researcher or stakeholder, scientific ideas, data, metadata, tools and outcomes of the research itself. Actually, the H2020 European Union's guidelines sustain and claim that research must be "F.A.I.R.", that is: "Findable, Accessible, Interoperable and Reusable". This requirement implies the openness not only of data or results, but also of the entire scientific process, from design to implementation. In this note, we explore the possibilities provided by the application of the Open Science and the Open Access principles to Long Term Ecological Research (LTER), focusing on the Northern Adriatic Sea, one of the LTER-Italy network sites, and on the LTER data on plankton and related abiotic factors there produced in 50 years of oceanographic cruises. The process involved both LTER and data management researchers in a joint partnership, in order to take into account and give value to the different point of views and expertise and include, as essential parts and outcomes of the process itself, also the cultural and practical resistances and challenges.
We focused on each of the different steps needed for "opening science": research ideas statement; raw data collection; data interoperability (structural, syntactic and semantic); ancillary data collection/recovery and metadatation; data, software, tools, and result publication and eventually data citation. Our final goal is to demonstrate that a change of vision is possible, leading from "publishing ASAP" to "sharing data and information and collaborating ASAP".

CONSERVATION AND HUMAN WELL-BEING: MAPPING ECOSYSTEM SERVICES IN PROTECTED AREAS TOWARDS A NEW PARADIGM

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During the last decades, the number of conservation initiatives exponentially increased around the globe with the aim to protect species, habitats and traditional landscapes. This resulted in an increase of Protected Areas (PA) under the governance of national and local administrative bodies and NGOs. Recently, together with the arise of the Ecosystem Services (ESs) concept among scientists and decision makers, PAs are claimed to be managed as fundamental providers of services to support human well-being. In order to meet this target and to address future measures, the assessment of the effectiveness of PAs in maintaining and promoting ESs is fundamental. The present study aims to map the spatio-temporal changes of ESs in different case studies to describe the effectiveness of PAs from a new perspective. The analysis were performed through differ methods that link land use/land cover changes with ESs provision. The results showed that the mere protection is not effective in maintaining ESs provision, as regional drivers were not tackled properly at local scale. Moreover, some methodological concerns raised when mapping ESs in PAs: i) the lack of ecological data, particularly for historical ones, is the main limitation for spatio-temporal analysis and ii) the method to be used for mapping ESs must be selected according to the availability of such data. Further investigations are needed to assess the role of PAs as providers of ESs and to identify proper strategies that harmonize biodiversity conservation and human well-being.

CAN MPAS PROTECT SEA URCHIN STOCKS?

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Sea urchins have long attracted attention from scientists worldwide for their ecological role in coastal areas. Entire communities structures associated to kelp beds and related ecosystem functions were found to strictly depend on grazing by urchins. Sea urchins, in addition, have been used as a food resource by humans since prehistory, and presently they are one of the important sea food (both exploited from the wild and in part obtained from aquaculture) consumed in many regions, but also exported-imported through the world. In the Mediterranean sea, the purple sea urchin *Paracentrotus lividus* (Lamarck) exerts a key ecological as a main regulator of the structure of coastal communities. At the same time *P. lividus* is recreationally and commercially exploited in many Mediterranean areas, as both male and female gonads are considered a delicacy in several countries. In the past, this species was locally fished and consumed. Presently the market of this sea food is expanding, and therefore major concern should be devoted to avoid overexploitation and possible community-wide effects of overfishing. The goal of the study is to figure out if well-enforced marine reserves can increase density, size and reproductive potential (gonad weight) of *P. lividus*, often important for the local economy. We examined the effects of *P. lividus* recreational harvesting on the species itself on rocky substrates of Ustica Island MPA. We compared the average density, size structure and gonad weight of *P. lividus* recorded at protected (no take zone) and fished sites (take zone C) in summer 2015 and 2016. *P. lividus* was always larger and more abundant at the protected sites than the fished ones. Results suggest that stronger management measures should be adopted by managers of MPAs to accomplish conservation of wild P. lividus populations also in the take zones.

RUN TO THE HILLS: EXOTIC FISH AND WATER QUALITY DRIVE NATIVE FISH TO HIGHER ALTITUDES

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While the significance of anthropogenic pressures in shaping species distributions and abundances is undeniable, some ambiguity still remains on their relative magnitude and interplay with natural environmental factors. In our study, we examined 91 late-invasion-stage river locations in Northern Italy using ordination methods and variance partitioning (partial-CCA), as well as an assessment of environmental thresholds (TITAN), to attempt to disentangle the effects of eutrophication and exotic species on native species. We found that exotic species, jointly with water quality and geomorphology, are the main driver of the distribution of native species and that native species suffer more joint effects than exotic species. We also found that water temperature, rather than altitude, clearly separates species distribution and that some native species, like Italian bleak (Alburnus alborella) and Italian rudd (Scardinius hesperidicus), seem to be the most resilient to exotic fish species. We also analyzed the dataset for nestedness (BINMATNEST) to identify priority targets of conservation. As a result, we confirmed that altitude correlated negatively with eutrophication and nestedness of exotic species and positively with native species. Overall, our analysis was able to detect the effects of species invasions even at a late invasion stage, although reciprocal effects seemed comparable at this stage. Exotic species have pushed most native species on the edge of local extinction in several sites and displaced most of them on the rim of their natural distribution. Any potential site- and species-specific conservation action aimed at improving this situation could benefit from a carefully considered prioritization to yield the highest results-per-effort and success rate.

COLLABORATIVE FISHERY RESEARCH AND SHORT-TERM MARINE NO-TAKE AREAS BOOST RESILIENCE OF EUROPEAN SPINY LOBSTERS TO OVERFISHING

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Declining fishery resources and relative services are a matter of fact, what is still under debate is if this trend can be reversed or not. Many Small-scale fisheries (SSF) from coastal areas showing declining catches and the absence of any- time soon possible recovery and, thus, do have a track record of being unsustainable. The fishery of the European spiny lobster Palinurus elephas (Fabr. 1787) has severely declined in the last 50 years in both the Mediterranean Sea and Atlantic Ocean. In European seas, current management options of this species include fishery effort restrictions and size limits on catches. Nevertheless, problems with compliance still persist, locally enhanced black market, as side effect. Outcomes from marine reserves establishment emphasized decadal recovery periods, with often hardly detectable fishery spillover benefits, partly ascribable to improper reserve enforcement or design. Using data collected through a Collaborative Fishery Research (CFR) project, we investigated variations in Catch-Per-Unit-Effort (CPUE) of European spiny lobster stocks both outside and inside three no-take areas established around Sardinia (Tyrrhenian Sea) lasting five years and assisted by wild below-legal size juveniles restocking. We show that CPUE inside no-take areas increased significantly just after 2 years since their establishment, with two- to four-times higher CPUE. Moreover, we show also that a considerable fishery spillover effect ranging from >30% to >80% occurred after two / three years since no-take areas were established, which suggests the efficacy of reserves in promoting resilience of overfished lobster stocks in surrounding fishing grounds. We conclude that combining CFR with the establishment of no take areas and the use of active restocking practices (using wild below-legal size juveniles) represents a reliable, highly efficient and dynamic short-term tool for boosting European spiny lobster resilience to local overfishing.

IMPLEMENTATION OF MOLECULAR METHODS IN HAB (HARMFUL ALGAL BLOOM) DINOFLAGELLATE RESTING CYSTS MONITORING

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Many toxic dinoflagellates produce resistant resting cysts as part of their life cycle, depositing in the bottom sediments. It is known that these resting stages play an important role in bloom initiation as the seed population can persist for long time in the sea floor. Therefore, monitoring of cyst densities in the coastal areas prior to an outbreak is important, so that damages by potential toxic blooms can be forecasted and minimized. Cysts identification and counting are essential in blooms prediction and in toxic dinoflagellate species dispersal by both natural or human mediated ways. In this context, ballast waters represent a major vector for marine HAB species introduction and dispersal as resting stages can survive in ballast waters that are loaded at source port, transported over long distances and discharged at destination port. The aim of this study was to develop and apply a rapid, specific and sensitive molecular assay based on the qPCR for the detection and enumeration of toxic dinoflagellate cysts in sediment samples collected from harbour mud during the survey activity in the Adriatic ports within the EU Interreg Project BALMAS. One of the main goals of this project was to detect and control the discharge of non-indigenous and noxious organisms through ballast waters of ship cargos. The qPCR cyst quantification was also compared with the traditional microscopy determinations. The molecular standard curves of various target species allowed obtaining the rDNA copy number per cyst. The analytical sensitivity was set at 2 or 10 rDNA copy number per reaction. The molecular method also allowed detecting cyst abundance at concentrations that are higher or not detectable by light microscopy. This qPCR method revealed a powerful tool for the accurate quantification of toxic cysts in sediment samples of Adriatic ports.

INLAND FISHERY ADAPTATION TO CLIMATE CHANGE: THE CASE OF THE LAKE GARDA

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The whitefish Coregonus lavaretus is a freshwater fish species inhabiting many European lakes, that has been introduced at the end of the 19th / beginning of the 20th century in Italy, where in some lakes formed well structured populations. As it is a coldwater species, the increasing water temperature could negatively affect the populations and as a consequence also the local fisheries. In this study, carried out within the H2020 project ClimeFish, we aimed to assess the effects of climate change on the population of whitefish of the Lake Garda, considering the potential consequences for the commercial and recreational fishery, largely based on this species. Downscaling from global circulation models at the lake level the RCP4.5 and the 8.5 IPCC scenarios and using an Individual Based Model, developed on the basis of a temperature-dependent growth model, we projected the potential population response to climate change for the Lake Garda. One key point of the ClimeFish approach is to involve the stakeholders since the beginning of the process of studying the potential effects on fish population and searching for suitable management strategies. Indeed, preliminary modelling results will be shared with a panel of stakeholders, to ensure that the main features of the problem are included in the case study and to develop together a set of management guidelines, to anticipate and to be ready to cope with the effects of climate change. Our main results suggest that in the Lake Garda a moderate temperature increase in the next decades could still stimulate the whitefish growth and increase the total production, but a more severe temperature raise could change the population structure, leading to a decrease in the biomass yield and the size of the catches. These preliminary results could help in building management guidelines that could be considered in future management plans of the exploited resources.

TRAIT-BASED AQUATIC ECOLOGY: THE KEY ROLE OF SEMANTIC RESOURCES FOR DATA INTEGRATION AND INTEROPERABILITY

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Functional trait-based approaches have experienced an extraordinary expansion in ecology. A large quantity of relevant data has been produced on this issue; however, they are quite heterogeneous and require to be harmonized in order to be shared and re-used. In this respect, semantic harmonization, achieved with the construction and use of thesauri, represents an essential precondition. Actually, a thesaurus is a controlled and structured vocabulary in which concepts are represented by terms, organised so that relationships between concepts are made explicit. Thesauri collectively constructed bypass ambiguities in natural language, facilitating the identification and integration of the information available in multiple data sources and allowing both people and machines to interpret it. The E-Biodiversity Research Institute of LifeWatch-Italy developed thesauri, all available online (http://www.servicecentrelifewatch.eu/catalogue-of-services), on most morphological traits of several groups of aquatic organisms: phytoplankton, zooplankton, macrozoobenthos and fish. They were implemented in Simple Knowledge Organization System (SKOS) and Resource Description Framework (RDF), using TemaTres (http://www.vocabularyserver.com), an open-source web-based platform for the collaborative management of thesauri, as well as a Linked Data interface and an RDF query language (SPARQL) endpoint. The developments of LifeWatch thesauri is the result of an interdisciplinary collaboration of experts from both the functional domains and information and communication technologies. In this context, experts in the specific domain had a central role in the different phases of thesauri implementation, allowing to produce shared and stable versions of thesauri and to extend the range of covered concepts. LifeWatch thesauri are available as a web service for ecological community in order to make data interoperable between different research groups.

FUNCTIONAL INDICATORS OF RESPONSE MECHANISMS TO NITROGEN DEPOSITION, OZONE AND THEIR INTERACTION IN TWO MEDITERRANEAN TREE SPECIES

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The effects of nitrogen (N) deposition, tropospheric ozone (O3) and their interaction were studied on two Mediterranean tree species with different leaf habit and resource use strategy, Fraxinus ornus L. and Quercus ilex L. An experiment in controlled condition was conducted to analyze how N deposition can affect ecophysiological, structural and biochemical traits and to explore how the N-induced changes would influence the response to O3. After 14 kg N ha-1 yr-1 only structural traits were affected by N in Q. ilex (an increase of basal diameter and number of new shoots flush), whereas nitrogen content at leaf level did not change in both species. At the end of the experiment (20 kg N ha-1 yr-1), higher nitrogen was measured at leaf level on F. ornus, whereas a slight increase was detected on Q. ilex that however showed a higher nitrogen use efficiency and Rubisco activity. In F. ornus, O3 affected functional parameters (reduction of assimilation and accelerated senescence-related processes). Q. ilex instead developed an avoidance mechanism to cope with O3, confirming a substantial tolerance to O3 for this species. Nitrogen seemed to ameliorate the harmful O3 effect in F. ornus: the hypothesized mechanism of action involved the production of nitrogen oxide as first antioxidant barrier upstream from the enzymatic antioxidant response. The interaction was not detected in Q. ilex, but in this species nitrogen might stimulate an alternative antioxidant response such as Volatile Organic Compound: enzyme activity was lower in the experimental set threaten with both O3 and N even if the reactive oxygen species production was the same between treatments. Understanding the mechanisms with which functional traits shift under multi-stress environment could better sustain the models able to forecast the vegetation's response to global change in Mediterranean area and to address biodiversity conservation in the next future.

TWO-YEARS MONITORING OF AN ACANTHASTER PLANCI OUTBREAK IN THE CENTRAL MALDIVES

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Acanthaster planci, the Crown-of-Thorns seastar (COTs), is a specialized coral-feeder widespread throughout the Indo-Pacific region. In the last decades it has been identified as one of the major disturbances on tropical coral reefs due to the ability to cause wide population outbreaks. During these events the abundance can exceed 1000 starfish ha-1 and the consequent impact on coral reefs can be dramatic. However COTs outbreaks are well described along the distribution, little is known about small and dislocated reefs such as those that are present in the Republic of Maldives where no information are available except for few short reports. The purpose of this study is to investigate the abundance, the population size structure and feeding preferences of A. planci. Surveys were conducted in Ari Atoll, Republic of Maldives, between March 2015 and December 2016. The preliminary results showed that coral cover decreased extensively due to the predatory activity observed mainly on scleractinian corals. Significant variation has been documented between different Reef Zones and Depth Ranges indicating a structured distribution of COTs in the coral reef. A total of 1521 individuals were measured during the study period. The overall size distribution had a mean of 25.96±0.12 cm with population size ranged from 7 to 50 cm including four different age classes varying from less than 2 years old to more than 5 years old starfish. COTs showed a high corallivore preference for massive corals, in particular belonging to the genus Porites, followed by corals belonging to the genus Pocillopora and Acropora. The feeding preferences were probably related to the particular structure of the coral cover that we have found during the study period. This is the first overview of an outbreak with the description of abundance, population structure and feeding preferences of Crown-of-thorns starfish in the Republic of Maldives. These information are useful to extend the knowledge of these corallivorous echinoderms and to plan active conservation strategies in order to protect the Maldivian coral reefs. Finally, we strongly suggest to extend the survey on a national scale and over a long period of time to understand the long-term variation in abundance and the causes triggering the outbreaks.

PHYTONUMBERS: A TOOL TO SUPPORT MICROSCOPE COUNTS OF PHYTOPLANKTON BY UTHERMÖL METHOD

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The Utermöhl method (1958), using inverted light microscope and standard settling technique, is the most worldwide used to determine biodiversity of phytoplankton assemblages and their relative abundance. Phytoplankton is recognized as biological quality element or biological descriptor respectively by WFD to MSFD. European directives and national laws have created a need for a uniform procedure to determine phytoplankton abundance and taxonomic composition. The Uthermöl method has been standardized in UNI EN 15204. It aims to provide guidance on microscopical algae analysis and to provide statistical procedures for the design, optimization and validation of method and protocols. Nevertheless, method is time consuming and labor intensive. We developed a tool for microscopic analysis (counting) of phytoplankton samples (PhytoNumb?rs) designed to make easier to calculate cell density and encompass qualitative and quantitative aspects for data precision, bias and method sensitivity. In particular, it allows to estimate the performance characteristics such uncertainty and detection limit. PhytoNumb?rs is a user friendly computing system based on Excel spreadsheets. It allows to count phytoplankton cells at different magnifications and counting strategies and to obtain a referred florist list with relative cell density, uncertainty and detection limit for each taxon. PhytoNumb?rs represents an useful tool at different hierarchical levels: 1. From harmonization and standardization issue of phytoplankton data in order to increase the quality, comparability and accessibility of intra and inter laboratories data over time; 2. To laboratory level since it allows to calculate the performance characteristics associated with analytical results according to UNI EN 15204 needed for quality control procedures; 3. To individual level because it makes the analyst comfortable to adopt the more suitable counting strategies in the mean time is running the analysis.

SOIL QUALITY OF TWO MEDITERRANEAN AREAS AFFECTED BY DIFFERENT HUMAN MANAGEMENTS

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Natural and anthropogenic disturbances play an important role in Mediterranean ecosystems and contribute to create a mosaic vegetation with gaps breaking up the shrub cover. Besides, they affect the ecosystem structure and productivity and can potentially reduce the soil quality. The aim of the study was to evaluate, through a numerical index, the soil quality of two Mediterranean areas characterized by different human managements such as pollution, waste accumulation and fires. The investigated areas were an urban park (Quarto-NA) located near Fusaro Lake and Tyrennian Sea, and a natural reserve (Castel Volturno-CE) located on a flat costal area. Both the areas were characterized by similar vegetation cover (shrubs and clearings) and micro-climatic conditions. To reach the aim, soils (0-10 cm) were sampled and physical, chemical and biological indicators were evaluated. For both the sites, higher values of C:N ratio and fungal biomass were detected in soils under shrubs, whereas soil organic matter, microbial biomass and activity were affected differently by vegetation cover. Besides, the soils sampled at the natural reserve showed higher Cr content; on contrary, those sampled at the urban park showed higher Cu and Pb contents with values that exceeded the threshold values of Pb fixed by the Italian law for urban soils. At the urban park the highest amount of soil organic matter, microbial biomass and activity were detected. The soil quality index was statistically lower at the natural reserve than the urban park. This result together with the statistically highest values of metabolic quotient, fungal biomass and mineralization coefficient suggested a stress condition for soil microbial community of the natural reserve likely due not only to waste accumulation but also to frequent fires.

STRUCTURAL AND FUNCTIONAL RECOVERY OF FISH COMMUNITIES DURING SEAGRASS HABITAT RESTORATION

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The full success of habitat restoration programs is reached when the recovery of the habitat structure is coupled to the functional recovery of the system. This includes the re-establishment of the faunal community with a stable trophic structure. Recently, the analysis of trophic structure and trophic niche by means of carbon and nitrogen stable isotopes has been widely used to quantitatively describe communities, integrating information provided by species composition and abundance. In the present study, we used community-wide isotopic metrics as descriptors to assess temporal variations of the trophic niche of fish communities associated to a habitat subjected to seagrass restoration in the Venice Lagoon (Project SeResto, Life12 NAT/IT/000331). In particular, fish community was monitored for three years since the beginning of seagrass restoration, and compared to a reference community associated to a stable seagrass meadow in the study area. Results showed that fish community of the restoration site was featured by lower species diversity but similar density as the reference site. Descriptors of the trophic niche revealed a slight increase of the isotopic niche width and trophic diversity and a reduced trophic redundancy across time, suggesting the initial trophic recovery of the fish community. Despite the ecological status and structural complexity of the seagrasses improved during the first three years, longer time is needed for the fish community to restore structurally and functionally. Overall, this study emphasizes the importance of considering the recovery of habitat function, other than structure, among the criteria to assess the success of restoration programs.

MAPPING THE CONSERVATION: EVIDENCE OF THE EFFECTIVENESS OF SPATIAL MANAGEMENT MEASURES IN PROTECTING THE MEDITERRANEAN MARINE BIODIVERSITY

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Since both the scientific community and the public opinion have started to perceive the global decline of marine biodiversity and the need to protect marine ecosystems from irreparable alterations of functioning and associated services, an extensive range of Spatial Management Measures - SMMs, have been deployed and enforced. The design of marine SMMs can represents a complex process often involving the integration of both conservation objectives and socio-economic priorities and the resultant trade-offs are highly dependent on the management regime in place. In the next future, marine management plans and measures are called to involve a greater use of different forms and levels of protection, particularly for sites where there are multiple competing demands and uses. Evaluations of the characteristics enabling forms of SMMs to successfully achieve their objectives are crucial to inform future conservation networks. We carried out a systematic graphical analysis of the current literature to: (i) provide a summary of the SMMs in force in the Mediterranean Sea, (ii) assess and compare the biological effects of different forms of SMMs to provide additional guidelines, (iii) describe the best known affected components on which the biggest monitoring efforts have been focused, (iv) strength the science-policy nexus by offering a credible, salient and legitimate knowledge baseline. To identify and collate evidence to address these questions a comprehensive systematic map process of peer-reviewed scientific literature and grey literature was undertaken. Sources were examined for relevance and critically appraised. The map exercise highlights the knowledge gaps and gluts. Gaps that need to be filled in and took into due consideration before addressing future transnational and cross-border monitoring and management plans and activities. Gluts, or rather, habitat and ecosystems on which the biggest efforts of evidences on conservation status has been produced historically.

COASTAL HYDRODYNAMISM SHAPES SEA URCHIN POPULATION DISTRIBUTION ALONG THE SINS PENINSULA (SARDINIA ISLAND)

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In Sardinia sustainable fishing of the sea urchin Paracentrotus lividus have become a necessity. Specifically populations in the middle West Coast (Peninsula of Sinis) suffer a high human pressure from a few decades. Even the harvesting is more restrictive inside the Marine Protected Areas of Sinis-Maldiventre, density of recruit in this area is lower than in the nearest high take-zone. Changes in sea urchin population density are mainly driven by variability in recruitment and the majority of populations are demographically open, since their replenishment is largely and sometimes exclusively dependent on a supply of larvae from the plankton. Thus, local oceanographic conditions determine physical barriers, ecological corridors and hot spots of recruitment strictly related with the coastal morphology. In this study a collection of four hydrodynamism variables (wave height, temperature, current speed and Eulerian trapping index of water masses), as descriptors of the transport dynamic of sea surface, together with the specific adult density, as stimulator of the larvae settlement, are selected as possible determinants of differences in local densities of recruits in shallow rocky bottom. Dataset of variables considered for the model represent conditions in the first half of the year, from the time of spawning to the peak of recruitment. Recruit density increases with low current speed and high Eulerian trapping index. These hydrodynamism conditions are associated to two convective cells generated by the main wind regime (Mistral wind) and located in the shallow water areas Norther to the MPA where probably larvae tend to accumulate. Possibilities to predict recruitment in this stretch of coast are discussed together with the implications for a systematic conservation management to optimize the local harvesting.

MALACOFAUNA ASSOCIATED WITH THREE CYSTOSEIRA ASSEMBLAGES IN THE GULF OF NAPLES

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The brown macroalgae of the genus Cystoseira are important habitat forming species along the rocky coasts all over the Mediterranean Sea. However their decline at basin and local scale is being described in many studies. Malacofauna associated with Cystoseira amentacea, C. compressa and C. crinita along the coasts of Ischia Island, in the Gulf of Naples, have been characterized. Samples were collected by snorkeling in the infralittoral belt. The surface within 20 x 20 cm frames was scraped off by hand and collected in three replicates each sites. The coverage, the height and the dry biomass of macroalgae were assessed. The molluscs were quantified according to: abundance, frequency and dominance index. The diversity and structure of community were described by: number of species, the exponential Shannon and the reciprocal Simpson's index of diversity. The k-dominance curves were performed to extract information on pattern of relative species abundance. The patterns of diversity at spatial scale were assessed by alpha, beta and gamma diversity and visualized by nMDS. A total of 53 species of molluscs were identified in those associations. Gastropoda were the most species-rich class followed by Bivalvia and Polyplacophora. Bivalves were dominant in terms of number of individuals because of the mussel Mytilus galloprovincialis. The species M. galloprovincialis was the most frequent and top dominant one inhabiting Cystoseira associations along the coasts of Ischia Island (96.6 % of the total abundance of all the individuals). Most of the identified molluscs species belonged to two main feeding guilds: micrograzers (29 species) and filter feeders (13 species). Only juveniles were found providing the importance of Cystoseira associations as nursery for molluscs recruitment. Differences in composition, structure and abundance of molluscs assemblages were found within the three algal associations and seem to correspond both to different morphology and habitat in which these algal species live.

CHALLENGES AND PERSPECTIVES FOR AN INCLUSIVE CONSERVATION OF THE MEDITERRANEAN SEA USING SEASCAPE CONNECTIVITY ANALYSIS

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The implementation of networks of MPAs is increasingly advocated as an effective conservation tool. However, most proposals have been implemented without using explicit criteria for the design (size and spacing), efficiency (maximizing the gain for a given cost) and effectiveness (ensuring that targets and objectives are met). In addition, data and criteria on how to implement effective networks of MPAs are often lacking and quantitative information on the potential connections of the nodes of the networks are largely missing or confined to few species. Here, we use site selection algorithms for marine reserve design (MARXAN) in the Mediterranean Sea, considering 1- a refined information on the distribution of habitat typologies, human pressures and present conservation measures for both coastal and high seas (http://www.coconet-fp7.eu/); 2- an eulerian simulation of dispersal to individuate those sites, both coastal and in the high sea, that should be considered essential to be included in a scenario of protection based on connectivity. The final aim is 1- to complement a static prioritization approach with a connectivity-based regionalization method (Berline et al. 2014), 2- compare outputs with different spatial configurations including the consideration of potential connections, to analyse where and how it makes a difference. Three scenarios of protection produced by MARXAN and selected since similar for criteria such as costs, compactness and conservation targets, were analysed in terms of connectivity analyses (Treml et al. 2008). Despite the similarity of the three scenarios, their different spatial configuration (i.e. geographical position and dimension of protected sites) has critical consequences in terms of number of potential connections among the nodes of the networks. We demonstrate the effects of including dispersal simulation information into MARXAN to properly individuate nodes and informing about their function and role in the network.

CLIMATIC CONNECTIONS AMONG BREEDING AND NON-BREEDING AREAS IN LONG DISTANCE MIGRATORY BIRDS

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Long-distance migratory birds move seasonally for thousands of kilometers tracking seasonally varying environmental conditions. The migratory process is influenced by several variables and interactions, among which climate is one of the major driver. Contrary to the common wisdom, in his work we show that some species of long distance migratory birds may have developed the ability of predicting climate conditions in the breeding areas while they are still in their wintering grounds. Using long-term atmospheric reanalysis (ERA20C) data, we reconstructed the 30-year time series of daily mean temperatures in the breeding and non-breeding locations of individual barn swallows (Hirundo rustica) and analyzed possible correlations among them in the periods immediately before departure from the wintering locations and upon arrival to the breeding grounds. We found that correlations at actual locations were stronger than those measured at random locations in Africa, both at local (within the winter foraging range of barn swallows) and continental (whole Africa) scale. These 'climatic connections' may be used by barn swallows for forecasting temperature conditions they will experience weeks/month and thousands of kilometers ahead. Long distance migrators may thus have evolved the ability to exploit inter-continental climatic connectivity to optimize the timing of departure for spring migration. Geographical patterns of climatic connectivity may thus have shaped the wintering distribution of long-distance migrators and have contributed to the development of migratory systems. We close the discussion by testing whether these analyses can be applied to other species and to which extent.

USING COMMERCIAL DRONE FOR MAPPING ECOLOGICAL PHASE SHIFTS ON THE CORAL REEFS OF SOUTHERN FAAFU ATOLL, REPUBLIC OF THE MALDIVES

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The Republic of the Maldives is a Small Island Developing States with a unique geographic configuration: an archipelago composed of more than 1100 islands surrounded by coral reefs, grouped into a chain of atolls in the Indian Ocean. The one-meter elevation of most of the atolls' islands makes the Maldives one of the countries highly vulnerable to the impacts of climate change. Maldivian islands are carbonate landforms, totally composed of biogenic sediments produced by the surrounding coral reef. Healthy coral reefs are thus essential for the survival of the Maldivian islands due to their capacity to keep-up with the rising sea-level. Nevertheless, the Maldivian coral reefs are threatened by anthropic and climatic issues and during April and May 2016 they faced a massive coral bleaching followed by extremely high rates of mortality. In our study, we collected high resolution images using a commercial drone (DJI Phantom 4) along different sector of reefs surrounding inhabited, uninhabited and resort islands of the Southern Faafu Atoll. The acquired data were processed in order to map the extension and the composition of shallow lagoons habitat, from the beach to the reef crest. Comparing these new results with habitat maps realized using satellite images databases from 2011 to 2016 (RapidEye, Sentinel 2 and LandSat8) and field data (snorkelling and diving transects), we were able to realize habitat change maps and correlate these changes to environmental disturbances. In addition, high resolution images (1,5 cm/pixel) were collected in situ, at selected locations, in order to realize a 3D model of shallow reef communities using structure from motion photogrammetry technologies. These 3D optical models will be used as the first step of a 3 years monitoring campaign addressed to observe the 3D structural complexity changes of the reef after the 2016 bleaching event. The whole study will focus on the integration of multi-scale maps to investigate, on a multi-temporal scale, ecological and geomorphological shifts in the study area and to figure out relationships with human activities (agriculture, land reclamation, new infrastructure) and pressures related to global climate changes.

SUSTAINABLE MARINE AQUACULTURE EXPANSION UNDER EU POLICIES

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Coastal ecosystems generate goods and services with a high economic value, but anthropogenic activities can produce negative impacts, compromising the benefits provided. Maintaining and expanding these activities, and preserving the ecological status represent a challenging task. In response, the European Union has implemented two Directives: the Water Framework Directive (WFD) and the Marine Strategy Framework Directive (MSFD). The MSFD requires member states to apply an Ecosystem Approach to the management of human activities with the aim of achieving Good Environmental Status (GES) by 2020. In the meantime, the European Commission emphasizes the contribution of marine areas to economic [Blue] Growth, with the expansion of human activities such as aquaculture. A tool to further these objectives, by integrating human activities and manage their effects, is the Maritime Spatial Planning (MSP). Aquaculture is not specifically mentioned as a pressure in the WFD, nor in the MSFD. However, the indicators for its assessments under both directives are relevant to benthic impacts and nutrient enrichment due to aquaculture. The present study focuses on evaluating the potential for expansion of finfish aquaculture along the Italian coast and, in the meantime, attempts to predict the pressure on the seabed environment associated to this activity. An integrated model predicting fish growth and biogeochemical fluxes across the fish cage was applied, with the aim of identifying the most suitable areas. The analysis took advantage of open source remote sensing and cartographic data, combining the use of numerical models with habitat mapping. Results are discussed in relation to the implementation of MSP, as a tool for regulating marine activities and their associated pressures, in order to achieve and/or maintain GES. The application showed the power of open data for addressing future Ecosystem Based Management plans.

IMPACT OF THE NEIGHBORING CITYSCAPE ON COLLEMBOLA BIODIVERSITY: A MEDITERRANEAN CASE STUDY

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Urbanization threatens biodiversity, increasing landscape patchiness and habitat loss. In order to turn urban parks into healthy ecosystems, deeper knowledge on their biodiversity and the processes driving species assemblages is required, especially for soil communities to which scarce attention has been paid so far. This study, conducted in public parks in Montpellier (Southern France), is the first one examining the impact of neighboring landscape patterns on collembolan species communities. Moreover, soil abiotic properties were analyzed to examine how local factors drive species assemblages within homogeneous landscape groups. Different neighboring landscape patterns were associated with specific communities, differing in their structure. Specifically, late successional stage communities were found within the most diverse neighboring landscapes, mainly composed of woody patches. By contrast, communities of pioneer stages were observed in neighboring landscapes with wide turf patches surrounded by other green habitats. Finally, biotic homogenization was evident when considering communities of small and isolated turf patches. This work corroborates the hypothesis that urban parks with more complex plant communities would host more diverse animal communities as well. With an urban park landscaping perspective, limiting fragmentation and preserving landscape diversity, as well as presence of woody vegetation, are the priorities to ensure the development of diverse and structured Collembola communities, indicators of the overall soil quality.

INTRODUCING CLIMATE CHANGE CONSIDERATIONS IN THE SPATIAL PLANNING FOR AQUACULTURE: MODEL PREDICTIONS AND ASSOCIATED UNCERTAINTIES

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In the broader context of Marine Spatial Planning, the allocation of areas to aquaculture must take into account production, ecological and social carrying capacity, and the conflicting uses of the marine space. Forecasted long-term trends in environmental parameters induced by climate changes should also be considered in this context, in order to plan adaptation strategies aimed at guaranteeing a sound future management of the aquaculture areas. The present work, carried out within the H2020 projects Aquaspace and Climefish, focuses on the selection of areas to be allocated to shellfish farming along the North Western Adriatic coast. Shellfish site suitability was assessed by means of a methodology of Spatial Multi-Criteria Evaluation, which provided the framework to combine mathematical models (individual-based and deposition models), with operational oceanography, and remote sensing products. Three classes of criteria were included in the analysis: 1) optimal growth conditions; 2) environmental interactions; 3) socio-economic evaluation. The growth-potential criteria was mapped by performing model simulations under current conditions and under future scenarios of climate change. This was carried out by considering 2 scenarios RCP, 45 and 85, of EURO-CORDEX CMIP5 (2015-16 versus 2049-50). Uncertainty was assessed by means of a Monte-Carlo approach, which considered farming practices and environmental conditions as input factors of the analysis. Values obtained for the Suitability Index (SI) confirmed that the growth potential in this area is high, and the socio-economic is the most restrictive class of criteria. Differences in the growth-potential under current conditions and under climate change scenarios reflected on changes in the map of most suitable areas for aquaculture. The analysis performed allowed to map the contribution of different factors to the uncertainty of the prediction, allowing to identify further research needs.

LONG AND SHORT-TERM PAH POLLUTION FOOTPRINTS EVALUATED BY *HYPNUM CUPRESSIFORME* MOSS BAGS AND ROBINIA PSEUDACACIA LEAVES

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Polycyclic Aromatic Hydrocarbons (PAHs) are listed among the contaminants of emerging environmental concern. These compounds consist of two to seven condensed aromatic rings; they can be of anthropogenic origin (mainly from fossil fuels burning), but they can also originate from natural sources as volcanic eruptions and wild fires. The transport pathways of PAHs in the atmosphere depend on their physical-chemical properties; low molecular weight PAHs (LMW) remain in gaseous phase after their emission and can be long range transported, while high molecular weight ones (HMW) are adsorbed on solid particulate matter and generally deposited nearer to their emission sources. Besides, environmental conditions such as temperature, UV radiation and wind dispersion can also affect their transport and persistence in the ambient air. Few studies have addressed the correlations between the concentrations of PAHs in mosses and other bioindicator plant species with biomonitoring aims. This study was carried out to investigate the potential of the joint use of devitalized *H. cupressiforme* transplants and *R. pseudoacacia* leaves as cost effective biomonitors for the assessment of PAHs in the air. The test was performed in a land of Campania region (southern Italy) historically devoted to agriculture, where recurrent waste burnings randomly occur, especially during the summer season. *R. pseudoacacia* accumulated both LMW and HMW PAHs, while moss prevalently collected the latter. As evidenced by specific diagnostic ratios, *R. pseudoacacia* combined chronic pyrogenic and petrogenic PAH inputs along its vegetative growth, while moss exposed in bags reflected PAH depositions from recent pyrogenic events occurred during the exposure time. The joint use of autochthonous trees and moss bags is useful to obtain a more complete environmental information, especially when native mosses are lacking in the areas under investigation.

MICROBIAL COMMUNITIES IN BIOREMEDIATION OF SOILS CONTAMINATED BY POLYCYCLIC AROMATIC HYDROCARBONS

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Polycyclic aromatic hydrocarbons (PAHs) are produced by incomplete combustion of organic matter and hydrocarbon fuels, but also by natural processes. PAHs are released to the environment causing the contamination of soil with subsequent risks for humans and ecosystems. Soil PAH degradation depends on biotic and abiotic factors and the composition and structure of microbial community also play a fundamental role. Synergy between microbial groups can result in a complete PAH mineralization. Enhancement of this process is the basis of bioremediation of PAH contaminated soils. Indeed, soil bioremediation can be accelerated by the addition of fungal species, able to metabolize recalcitrant organic compounds, and of compost, rich in microbial species. In this frame, the aim of this research was to study the role of microorganisms in soil PAH degradation and to assess the structural and functional changes in microbial community along the time. A mesocosm study was set-up by incubating an industrial soil spiked with benzo[a]pyrene and anthracene (150 mg/Kg, each) in three different treatments: 1) addition of compost; 2) addition of four fungal species; 3) no addition. The mesocosms were incubated in controlled conditions of temperature and humidity along 273 days, during which PAH concentrations, biomass and structure of microbial community, through PLFA profile, were monitored. The native soil microbial community was able to reduce anthracene (96%) and benzo[a]pyrene (52%), although both the two PAHs were degraded quickly in treated soil respect to untreated. The addition of compost improved mainly benzo[a]pyrene degradation, increasing it by 8%. Along the time, Gram-positive bacteria and actinomycetes remained constant, whereas Gram-negative bacteria and fungus decreased. The metabolic activity of Gram-negative bacteria was predominant compared to the other microbial groups. Soil compost addition effectively improves bioremediation, increasing PAH degradation.

ATMOSPHERIC TRACE ELEMENT MONITORING INTO THE DISTRICT OF STRONGOLI MARINA (KR)

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The district of Strongoli Marina is an highly agriculture oriented area where arable, olive growing and viticulture are all practiced. The main road is the SS 106 located close to the coast while the only significant industrial activity is due to the biomass power plant managed by “Biomasse Italia” Society, one with the highest energy potential in Europe (360 GWh on a year ground). The levels of atmospheric trace elements were monitored by means thalli of the lichen Pseudevernia furfuracea (L.) Zopf transplanted from a pristine area into 28 stations of the study area for 3 months. At the end of the exposure period the lichens were retrieved and analyzed for the concentrations of Al, As, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Sb, Sn, Ti, V, Zn as well as the ecophysiological parameters: total peroxidation, dehydrogenase activity, pigments (chlorophyll a, chlorophyll b, xanthophylls + carotenoids) and phaeophytization coefficient. Use of a univariate – multivariate approach detected clear spatial trends for both trace element contamination and physiological changes of P. furfuracea transplants. Biomass power plant, by means quantitative relationships with local winds, showed to contribute to atmospheric enrichment in Cu and Mn, variation of traffic intensity associated with that of concentrations of Sb and Sn, agricultural use of land did not correlate with any lichen parameters. Processes of both increase and decrease in pigment values compared to pre-exposure levels were detected at the end of transplantation. Spatial variation of total peroxidation amounts resulted in a sub area (15% of study area) with a mean value significantly higher than that of lichen origin area and was associated with biomass power plant (again by means quantitative relations with local winds) and spatial variation of copper concentrations. Such a result supports the hypothesis that biomass power plant contributes to local atmospheric contamination and biological stress of lichens.

EFFECTS OF ELECTROMAGNETIC FIELD EXPOSURE ON SPROUTS OF *PHASEOLUS VULGARIS* L: I: ASSESSMENT OF PHOTOCHEMICAL AND PHOTOSYNTHETIC ACTIVITY OF ADULTS PLANTS

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The expanding use of electronic devices as cellular phones, television/radio communications and wireless devices arise in the scientific community as well as also in the public opinion important and basic questions about safety for people and living organisms of natural ecosystems exposed to electromagnetic fields (EMF). Plants are an outstanding model to assess the effects of EMF exposure on living organisms because they are sessile organisms keeping a constant orientation to an EMF source. In this work sprouts of *Phaseolus vulgaris* L. were exposed to 2,45 GHz electromagnetic field at 40 mW/g SAR level for 24 hours to assess the influence on the photochemical and photosynthetic leaf activity of adult plants. Moreover appropriate experimental treatments of sprouts were performed in order to separate any possible indirect thermal effect of EMF exposure from the direct effect of applied EMF. On leaves of adult plants the photochemical and photosynthetic activity were evaluated for 3 weeks. An increase of CO_2 uptake was evident in plants obtained from exposed sprouts compared to the control.

EFFECTS OF ELECTROMAGNETIC FIELD EXPOSURE ON SPROUTS OF *PHASEOLUS VULGARIS* L.: II: ANALYSIS OF PLANT GROWTH

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In the literature studies investigating the effects of EMF exposure on natural and crop plant species are still controversial. The main causes of this heterogeneity are the different frequency, intensity and duration of EMF applied that do not facilitate well defined results. EMF exposure to different organs (seed, sprout, seedling, adult plant) or developmental processes (germination, early growth, vegetative development, reproductive phase) may affect qualitatively and quantitatively the responses of plants. Here we report some results of the growth analysis in plants developed from sprouts exposed to 2,45 GHz electromagnetic field, a widespread frequency in everyday life through wireless internet connection devices or microwave ovens. The growth plant analysis was performed during the whole life cycle from the sowing of the sprouts in the soil up to fruiting. An increase of biomass production as a higher number in leaves, a greater leaf expansion and a stimulation of flowering and fruiting were evident in plants obtained from exposed sprouts compared to control condition.

THE CYTO-GENOTOXIC RESPONSE OF SEA URCHIN PARACENTROTUS LIVIDUS (ADULTS, EMBRYOS AND GAMETES) EXPOSED TO NANOZNO

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Zinc oxide nanoparticles (nZnO) are increasingly used in several personal care products, with high potential of being released directly into marine environment and consequent adverse impact on marine biota. Once in marine environment nZnO tend also to form complex with organic matter, becoming available as food particles to grazer organisms, like sea urchins. Therefore sea urchin adults are mainly exposed to nZnO via contaminated food while, their swimming planktonic larvae are principally exposed to direct action of released NPs. The exposure routes, developmental stage and ZnO physicochemical available form can provoke different toxic effects for sea urchins. To understand the possible action of nZnO upon sea urchins during their lifetime, we evaluated and discussed effects on adults, embryos and gametes. In particular we assessed cytogenetic parameters and toxic effects upon Paracentrotus lividus embryos and gametes exposed to ZnO (Bulk >100 nm, NP 100 nm and 14 nm) and, on adults exposed through the diet, we evaluated the adverse effects upon immune and reproductive systems. The embryos exposure to nZnO affected the mitotic activity inducing chromosomal aberrations that resulted in the larval development block (EC50=0.46 [0.30-0.63] µM Zn) while, the exposure of male gametes provoked DNA damages that resulted in offspring morphological alterations (EC50=0.81 [0.31-3.17] µM Zn). In P. lividus adults, via food exposure induced damages to immune cells (decrease of vitality, DNA damage increase) and, transmissible effects to offspring due to genotoxic damages in sperm cells. However, after 3 weeks of exposure a recovery of standard coelomocytes condition was observed. P. lividus embryos and gametes were more sensitive to nZnO directly released in seawater, while in adults fed with contaminated food, the first damages were observed in immune cells. Nevertheless the immune system recovery over time, an evident transmissible effect was still observed in offspring quality.

THE INTERPLAY OF CARBON BASED NANOMATERIALS WITH BENZO(α)PYRENE IN THE AQUATIC ENVIRONMENT: FROM CHEMICO-PHYSICAL INTERACTIONS TO TOXIC EFFECTS ON ZEBRAFISH EMBRYOS

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This study investigates a key feature of nanomaterials ecotoxicity, such as their interaction with environmental pollutants. To this aim the potential role of two carbon-based nanomaterials (CNMs), namely Carbon nanopowder (CNPW) and fullerene (C60), as carrier for Benzo(α)pyrene B(α)P was evaluated in zebrafish embryos. CNMs were contaminated with B(α)P, and the effective sorption of the hydrocarbon on CNMs was quantified. Embryos were exposed to CNPW, C60 and B(α)P alone and to CNPW and C60 doped with B(α)P. The uptake of CNMs and B(α)P and their tissue and intra-cellular localization were investigated by immunofluorescence and electron microscopy. To evaluate the toxic effects due to CNMs interaction with B(α)P, biomarkers of cyto/genotoxicity and oxidative stress were applied. The application of proteomics analysis allowed also the identification of molecular events involved in the responses to pollutants alone and in co-exposure. The adsorption on CNPW modified the accumulation of B(α)P, which is forced to follow the distribution of the physical pollutant instead of its natural bioaccumulation. On the contrary the co-exposure with C60 did not affect the uptake/distribution of B(α)P, however C60 doped with B(α)P is more prone to sedimentation and less bioavailable for the embryos respect to C60 alone. The integrated results from biomarkers and functional proteomics showed that different stress response pathways are induced by the pollutants alone respect to their combination, generating different toxic effects. In particular CNPW doped with B(α)P mainly mirrors the effects shown by the physical contaminant rather than by the hydrocarbon, while C60 doped with B(α)P seems to induce a cellular response similar to B(α)P. Our results highlight that, in the ternary system represented by CNMs and environmental contaminants and the organism, complex chemico-physical-biological interactions arise, which could determine unexpected ecotoxicological consequences.

DO MICROPLASTICS INDUCE ADVERSE EFFECTS ON FRESHWATER INVERTEBRATE SPECIES?

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Microplastics (MPs), plastic fragment smaller than 5 mm, are considered from scientific community an emerging global issue. In fact, because of the large production of plastic materials worldwide and the inability of Wastewater Treatment Plants (WWTPs) to remove them from treated effluents, MPs were widely found in both marine and freshwater environments. However, few studies about their toxicity, especially on freshwater species, have been conducted. The aim of this research was the evaluation of chronic toxicity induced during 7 exposure days by polystyrene microparticles (among the most common MPs found in environment), on zebra mussel (Dreissena polymorpha). In particular, considering the large amount of MPs released every day from WWTPs, we tested the effects of two MP mixtures (MIXs): the first one contained 2x106 of 1µm size MPs/L and 2x106 of 10 µm size MPs/L, while the second one contained 5x105 of 1µm size MPs/L and 5x105 of 10 µm size MPs/L. Chronic toxicity was evaluated through a multi-biomarker approach. As biochemical biomarkers we evaluated, in the soft tissues of mussels, the activity of antioxidant/detoxifying enzymes superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx) and glutathione-S-transferase (GST). To assess oxidative damage we monitored the levels of lipid peroxidation (LPO) and protein carbonylation (PC). In addition, to evaluate MPs genotoxicity we measured the frequency of micronuclei (MN test) in mussel hemocytes. The uptake of MPs in the exposed organisms was investigated through confocal microscopy. The obtained results showed that polystyrene microparticles do not induced significant alterations in both oxidative status and genetic damage, despite found in the zebra mussel tissues. Therefore, further research are needed in order to better investigate the adverse effects of MPs on freshwater organisms, by considering for example other endpoints (such as neurotoxicity) and increasing the duration of the exposure.

CONTAMINANTS IN ITALIAN ALPINE GLACIERS: A NEVER-ENDING STORY?

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Atmospheric transport has been recognized as a major pathway for the distribution of anthropogenic contaminants. Concern over the long range atmospheric transport (LRAT) of Persistent Organic Pollutants (POPs) and their detrimental effects in cold ecosystems began in 1960s after the detection of organochlorinated insecticides in the Arctic. High mountains interfere with the LRAT and global cycle of POPS, favouring their accumulation in glaciers. The effectiveness of mountains as cold condensers is dependent on several factors, such as meteorological conditions, orography, presence of vegetation and post-depositional processes. In addition, mountains are in close proximity to emission sources; this favours regional atmospheric transport (MRAT: Medium Range Atmospheric Transport) of contaminants towards glaciers. For instance, the Italian Alps lie close to anthropized areas, which represent significant emission sources increasing the role of MRAT. Nonetheless, the importance of MRAT in the contamination of glaciers has been underestimated in the past, as the attention was on the LRAT of POPs. In the last years, various international treaties have led to a strong decline in POPs emissions, with a reduction of their accumulation in glaciers. On the other hand, there is increasing evidence of the presence of emerging contaminants (ECs), in Alpine glaciers. These pollutants are less persistent than POPs but sufficiently enough to reach alpine environments through the MRAT. In this study old and new data on contaminants in the Italian glaciers are reviewed. Our results suggest a decline of POPs, but also an increased presence of ECs, highlighting that anthropogenic impact on the health of remote area is a “never-ending story”.

NANOPARTICLES ACTIVITY DISTURB XENOPUS LAEVIS EMBRYOGENESIS

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Nanoparticles (NPs) have extensive industrial, biotechnological, and biomedical/pharmaceutical applications, leading to concerns over health risks to humans and biota. Because of their properties NPs are attractive for basic science also. Size, surface charge, geometry, and its modifications contribute to NPs toxicity. The aquatic environment is at risk of exposure to NPs, as it acts as a sink for environmental contaminants. There are insufficient evidence for environmental concentrations and derived harms for almost all NPs. This finding requires more standardised approaches for NPs hazard identification. The possibility to relate the data obtained in Xenopus laevis with higher vertebrates, including humans, makes it a convincing study model. Our aim is to evaluate the activity of three different commercial NPs: AgNPs, AuNPs and SiO2NPs, 20nm sized, on the embryogenesis of X. laevis. These commercial NPs were used as model to understand the possible consequences of similar NPs utilized in medicine. DLS and TEM was performed to characterize these NPs. The embryos were reared starting from st4/8 in FETAX containing 0.01, 1 and 5 mg/L NPs. All embryos were harvested at st46/47. The mortality, morphology, length, heartbeat and pigment distribution were statistically analyzed. Real Time-PCR were carried out from embryos st.46 to verify gene expression. Our data showed that all NPs, that we tested, aggregate in FETAX and do not cause mortality. Embryos treated with AuNPs are longer and bradycardic compared with control, whereas those treated with AgNPs or SiO2NPs are shorter and tachycardic (AgNPs).The pigment distribution and gene expressions are altered. In conclusion our studies indicate that the NPs that we tested affect embryonic development impairing the expression of genes involved in the early embryogenesis.

PREDICTING CHEMICAL BIOAVAILABLE CONCENTRATIONS IN FRESHWATER ECOSYSTEMS FOR FIVE EUROPEAN ENVIRONMENTAL SCENARIOS

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Environmental risk assessment (ERA) implies the estimation of chemical concentrations in the environment (i.e., exposure) and the expected effects. However, the environmental realism of the currently used approaches have been questioned for years. For example, in aquatic environments, exposure is generally modeled using steady-state models and static scenarios, neglecting the potential role of emission, environmental, biomass and organic carbon dynamics in affecting bioavailable concentrations. In this work, an improved dynamic multimedia model (ChimERA fate), including a phytoplankton compartment and equations to calculate phytoplankton, detritus and dissolved organic matter variations in time, was developed. The model was parameterized to simulate five dynamic scenarios for shallow meso-eutrophic phytoplankton-dominated water bodies based on a latitudinal gradient (in Europe); such scenarios include seasonal profiles of water temperature, autochthonous phytoplankton biomass, detritus, and dissolved organic matter. Model runs were performed for each scenario and eight polychlorinated biphenyl congeners, with the aim of investigating the influence of scenario characteristics and compound properties on bioavailable concentrations. The key processes were adsorption/uptake by phytoplankton and deposition to sediment of detritus-bound chemicals. The northern scenarios ("Scandinavia" and "UK") showed the highest bioavailable concentrations and seasonal variability (up to a factor of 25); in contrast, maximum concentrations in the southern scenarios ("Northern Italy" and "Mediterranean") were lower by a factor of 2 to 9 with respect to the northern ones (due to the generally higher biomass and carbon levels), and showed only limited seasonal variability (up to a factor of 4). These results highlight the importance of including biomass and organic carbon dynamics in both models and scenarios for the evaluation of exposure concentrations in aquatic environments.

ROLE OF RHIZOREMEDIATION IN MODELLING PCB FATE IN AN ITALIAN CONTAMINATED SITE

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In the last two decades, there has been a growing interest in bioremediation technologies which use plants and microorganisms to reduce contaminant concentration in soil. More specifically, plants can help to stimulate bacteria activity, which subsequently results in more efficient degradation of organic contaminants (rhizoremediation). Different studies have been conducted to investigate the potential of plant-microbe interactions in the remediation of organic chemical contaminated soils with respect to baseline biodegradation, providing useful data such as chemical degradation rate (kDeg) or half-lives (HL). Such type of data can be used to predict soil concentration temporal trend, as well as the time needed to achieve regulatory thresholds when using plants and their associated rhizosphere microbe to remediate contaminated sites. In the present work, rhizoremediation experiment derived HL for Polychlorinated Biphenyls (PCBs) were used as input parameters in a modified version of a dynamic air-plant-litter-soil fugacity based model (SoilPlusVeg) to estimate PCB concentration temporal trend in the soil of a National Relevance Site (SIN) for remediation located in Northern Italy (SIN-Brescia Caffaro). A number of long term simulations were run for 7 PCB congeners (PCB 28, 52, 101, 138, 153, 180, and 209) to 1) compare the influence of baseline biodegradation vs. plant/microbe interactions on soil concentration reduction, 2) investigate input/loss processes in soil and plant compartments and 3) evaluate the effectiveness of rhizoremediation when a complex contamination gradient is present. Simulation results showed that 1) remediation time could be halved when considering rhizoremediation HL, 2) PCB volatilization from soil is an important source for air and therefore leaves and 3) rhizoremediation could be a suitable strategy for about 70% of the contaminated site, while more contaminated points have to be treated in a different way.

SPATIAL AND TEMPORAL TRENDS OF TOXIC AND PERSISTENT MICROPOLLUTANTS IN SEDIMENTS OF PRINCIPAL TRIBUTARIES OF LAKE MAGGIORE (ITALY)

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Lake Maggiore is a large and deep perialpine lake located in a widespread industrial area of northern Italy, and represents an aquatic environment highly contaminated by persistent organic pollutants (POPs) and trace elements such as heavy metals. In this study we focused on time and spatial trend analysis of the contamination of sediments collected from the main tributaries of the Lake (Tresa, Bardello, Boesio, Margorabbia, Toce) and Ticino emissary, in order to detect potential contamination sources and to compare concentrations with existing Quality Standards (EQS) for both organic (DDx, PCBs, PBDEs, PAHs) and inorganic (As, Cd, Ni, Pb, Cu, Hg) pollutants. Sampling campaign of river sediments was carried out every year, in different seasons, from 2001 to 2015. The analysis of organic micropollutants was made for all collected samples, after a step of extraction and purification, using a GC coupled to a mass spectrometer (ThermoFisher - Ion-trap Polaris Q). Instead, trace elements were analyzed only for the sediment samples collected in the period 2008-2015; Hg concentrations were measured using the AMA254 tool (FKV - Automated Mercury Analyzer), while concentrations of the other trace metals were measured by graphite furnace atomic absorption spettroscopy (Perkin Elmer - GF-AAS). The results show a statistically significant decrease of total DDx concentrations in sediments sampled in the Toce river during the considered period; in the same river we found a temporal decrease of Cd, Pb and Cu. Furthermore, other negative trends was observed for PCB (Margorabbia and Ticino emissary), As (Margorabbia), Cu (Tresa) and Hg (Bardello). Moreover, the potential biological toxicity of the pollutant's mixture in the considered sediments was investigated by calculating the mean Probable Effect Concentration Quotient (mPECQ), an index based on International Sediment Quality Guidelines values.

DETERMINATION OF PERFLUOROALKYL ACIDS PRECURSORS IN SURFACE WATER AND GROUNDWATER BY AN OXIDATIVE METHOD

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Identification and quantification of PFAA precursors is a key issue to determine the risk assessment. It is problematic to detect these difficult-to-measure compounds because of few previous studies and the lack of availability analytical standards and sensitive techniques. In the most of cases the limits of detection are too high to be applied to field samples, unless for specific events of industrial pollution. In order to assess the total amount of "potential" PFAA (these one already present in the aqueous sample and that can be formed in more by oxidation) a method for the quantification of the total amount of PFAA precursors in natural waters, after a persulphate oxidation of the sample, has been tested. The method, modified from a literature one, has been applied on surface waters and groundwater samples, both in field and pilot scale tests. The compatibility of the literature method with the on-line-SPE-UHPLC-MS/MS method has been evaluated by studying the matrix effects and method repeatability. Furthermore conversion efficiency of selected precursors and stability of main perfluoroalkyl acids under the oxidation conditions have been evaluated in order to assess its applicability in experimental tests and even in field studies. The method for the estimation of PFAA precursors was applied to the discharges of factories that produce or used fluorochemicals, which represent the most significant sources of PFAS for the Italian river basins. The method demonstrated to be very effective also in assessing the actual risk for the ecosystem caused by discharges of fluorochemical plants. This risk sometimes can be underestimated because industrial discharges can include a significant amount of precursors that can be in vivo transformed in PFAAs contributing to their environmental occurrence and bioaccumulation in the organisms.

COMPARISON OF THE BEHAVIOURAL EFFECTS OF PHARMACEUTICALS AND PESTICIDES ON *DIAMESA ZERNY* LARVAE (CHIRONOMID)

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In past years, several studies indicated the presence of contaminants in Alpine aquatic ecosystems. Even if measured levels are far below of acute effects, the exposure to sub-lethal concentrations may cause detrimental effects on macroinvertebrates, leading to cascading indirect effects at higher levels of the ecological hierarchy. To improve the determination of ecologically relevant risk endpoints, behavioral alterations in organisms due to pollutants are increasingly studied in ecotoxicology. In fact, behavior links physiological function with ecological processes and can be very sensitive towards chemical exposure. Unfortunately, no studies on behavioral alteration in species belonging to Alpine aquatic communities are available in literature. In this study, a video tracking system was standardized and utilized to identify the contaminant-induced behavioral alterations in *Diamesa zernyi* larvae (Diptera Chironomidae). This organism is considered a keystone species in the Italian alpine aquatic ecosystems. *D. zernyi* larvae, collected in an Italian alpine stream (Rio Presena, Trentino Region), were acclimated for 24 hrs and successively exposed to several aquatic contaminants (pesticides and pharmaceuticals), at concentrations corresponding to their NOEC. After 24, 48, 72 and 96 hrs of exposure, changes in the moved distance, average speed and frequency of body bends were considered to highlight contaminant- and time- dependent effects on larval behavior. In general, metolachlor, captan, and trimethoprim reduced all the considered endpoints, whereas chlorpyrifos, boscalid, ibuprofen and furosemide increased the moved distance of larvae; this could be related to the different mechanisms of action. Independently from the contaminant, after 72 hrs a general slowing down of all behavioral activities was observed. Finally, in order to compare the overall behavioral effects induced by different contaminants, a Behavioral Stress Indicator (BSI) is proposed and applied.

ECOTOXICOLOGICAL STUDY OF *CARETTA CARETTA* (LINNAEUS, 1758) IN THE MEDITERRANEAN SEA: A NON-INVASIVE PROTOCOL BASED ON BIOMARKER RESPONSES AND CONTAMINANT LEVELS

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The loggerhead sea turtle (*Caretta caretta*) is a long lived (up to 70-80 years) carnivorous reptile included in the IUCN Red List. As regards to Mediterranean sea, major threats for this species are fishing, pathogens, pollution and nesting beaches degradation. The main aim of our study was the development and validation of a non-invasive protocol, integrating biomarker responses and contaminant analysis, for the ecotoxicological study of this protected species. The study was conducted in the Mediterranean area: seventy-five loggerhead turtles were sampled in Italian marine rescue centers or free-ranging along the Spanish coasts. We developed and applied a non-invasive sampling methodology for blood, skin biopsy and carapace, and a set of ecotoxicological biomarkers to explore different levels of interaction between contaminants and the target organism. We focused on biomarkers of exposure to lipophilic contaminants (induction of CYP1A in skin biopsies), biomarkers of indirect and direct effects investigating neurotoxic (esterases inhibition) and estrogenic (vitellogenin) effects, lipid peroxidation, genotoxicity (Comet and ENA assays) and liver damage (y-GT). The possible relation between biomarkers and contaminant levels in blood (PAHs, OCs, trace elements) was investigated and data elaboration was performed taking into consideration also different size classes of the specimens. We also analysed two specimens sampled immediately after an oil spill. Amongst the main results obtained we would underline the significantly highest levels of carcinogenic PAHs and ENA assay in the older animals (class 3), the significant correlation between carcinogenic PAHs and Comet assay, and between Comet assay and micronuclei, the inhibition of esterases in class 1 with respect to class 3 and the correlation between y-GT and cadmium. The protocol was successfully validated and can be proposed as a sensitive tool to study not only *C. caretta* but also other species of sea turtles.

FROM IN FIELD TO IN VITRO: RESPONSE TO HEAVY METAL ENVIRONMENTAL POLLUTION IN *LEPTODYCTIUM RIPARIUM*

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This study evaluated the biological effects of heavy metal pollution of the heavily contaminated channels Regi Lagni, running through the so-called “terra dei fuochi” (South Italy), using the aquatic moss *L. riparium*. This species is a efficient bioindicator of heavy metal pollution, accumulating different heavy metals taken from the aquatic environment (Basile et al, .2011). Biological effects of heavy metal pollution were assessed by studying metal bioaccumulation, ultrastructural damage, oxidative stress, and stress gene expression. Experiments were performed both on samples exposed in field in moss bags and in vitro-cultured in conditions reproducing the heavy metal pollution. Three sites were chosen as representative of the extreme polluted conditions. In vitro samples were exposed to the same HM concentrations as measured in the 3 sites. The results showed severe ultrastructural damage, increase of ROS production, induction of antioxidant enzymes and expression of stress gene. Those changes were observed both in the samples collected from the polluted sites and in those in vitro treated with the same heavy metal concentrations as in the field. In the in vitro test all the considered parameters were severely affected, although at a lower extent in comparison with the field experiment. The results showed that in vitro studies are useful indicators of the role exerted by the different stressors in environmental conditions. In addition, these results suggest *L. riparium* as a model organism in biomonitoring projects and the ultrastructural, enzymatic and genetic responses as promising biomarkers of heavy metal toxicity.

BIOCHAR AMENDMENT IN GREENHOUSE: EFFECTS ON SOIL AND CROP

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The greenhouse crops, widely spread in the Mediterranean Basin, may cause a reduction in soil organic carbon content because of both the removal of crop residues and the high decomposition rate due to the optimal temperature and water conditions. Among agricultural practices increasing soil organic C pool, the addition of biochar (*i.e.*, a product of low-temperature pyrolysis of organic wastes) has been recently proposed. Due to its physical and chemical characteristics (stability to microbial degradation, high surface area and charge), the biochar may increase soil organic matter, nutrient and water content, so improving soil quality and crop productivity, also reducing CO_2 emissions in the atmosphere. Aim of this study was to evaluate the effect of biochar amendment in greenhouse on soil properties and crop yield of a Southern Italy farm. Three biochar (from coniferous pruning wastes) treatments (0, 10 or 20 t ha-1), 3 replicates each, were applied immediately before planting young plants (1-week old) of pepper (*Capsicum annuum* L.). On soil samples, collected one hour after biochar addition (before the cultivation began) and 6 months later (following pepper harvest) we determined: pH, electrical conductivity, contents of total organic carbon, extractable carbon, mineral nitrogen, total microbial biomass, fungal mycelium, soil potential respiration, nitrogen mineralization, nitrification, soil suppressiveness to *Rhizoctonia solani*. The results showed that this first biochar application did not improve crop yield neither soil suppressiveness to *R. solani*, but it positively affected soil potential respiration, nitrogen mineralization and nitrification 6 months after its application. These preliminary results suggest that the biochar may be considered a promising amendment in greenhouse crops, however, further studies need to define the suitable dose that could improve both crop productivity and soil fertility.

PHYTOTOXIC EXTRACTS AS POSSIBLE ADDITIVE IN SUBSURFACE IRRIGATION DRIP FOR ORGANIC AGRICULTURE

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The subsurface drip irrigation (SDI) systems is a micro-irrigation technique applied below the soil surface through drip lines buried at a depth depending on the characteristics of the soil and the plants to be irrigated. SDI distributes precise amounts of water directly to the root area, with the possibility of leaving dry the soil surface and less subject to weeds. From there, it would have less use of water, herbicides, environmental pollution and less containers that are usually abandoned when empty. Furthemore, with subsurface irrigation it would be possible to use of urban wastewater, advantageous from the environmental point of view since it reduces the consumption of ground water and energy costs required for its pumping, moreover it reduces the use of chemical fertilizers through the enhancement of organic fertilizer content in the waste. However there are issues related to the use of SDI system, such as the elimination or reduction of roots that wrap the dripper therefore block the water outlet. It has been hypothesized that it would be useful to add a pure or blended phytotoxic mixture to plastic during the production of drippers, whose herbicidal action dissolves gradually with the passage of water. Five species of plants have been selected in this study: *Vetch villosa*, *Brassica juncea*, *Secale cereale*, *Juncus effusus* and *Vallisneria natans*. The phytotoxicity has been tested in vivo on *Lactuca sativa*, *Lycopersicon esculentum*, and *Allium cepa*. The plants show the same behaviour but the aerial biomass of *V. natans* results the most active ones. The phytotoxicity of the hydroalcoholic extract of each plant was evaluated on the same test organisms, with peak inhibitions up to 60, 70 and 80% at concentrations ranging between 10-4 to 10-7 M. Generally, the most active hydroalcoholic infusion was that of *V. villosa*. In the end, after some chromatographic steps and LC/GC-MS analyses, the most abundant metabolites of the hydroalcoholic extracts were identified.

EVALUATION OF NEW STRATEGIES TO REDUCE THE TOTAL CONTENT OF ALFA-SOLANINE AND ALFA-CHACONINE IN POTATOES

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Potatoes are a staple food for over a billion people worldwide, a primary dietary source of carbohydrates and a vital crop to the agricultural economy of South America, Africa, East and Central Asia. Potatoes contain secondary metabolites that are potentially toxic and dangerous to human health, such as the glycoalkaloids α-solanine and α-chaconine. α-Solanine and α-chaconine represent an effective chemical defence against animals, insects, fungi, worms and bacteria, adverse environmental conditions and pollution. Many stress factors occur before and after harvest, and any stress factor could cause a rapid increase of α-solanine and α-chaconine concentration in potatoes. For example, their total concentrations were negatively related to atmospheric CO_2 enrichment. Small sized and immature tubers were often associated with high glycoalkaloids levels, and in fact, the levels decrease with growth and maturation of the plant. Even post-harvest conditions, such as exposure to light, heat and storage times, are able to influence the glycoalkaloids levels.

This study describes new methods for α-solanine and α-chaconine reduction in the potato. The potatoes were incubated at room temperature in the dark for 24 hours, in 10 different conditions, to minimize the stress that the potatoes are subjected to between harvesting and marketing, assessing, for example, the effect of sodium and fluorescent lamps. In addition, it has been proposed to store them in an inert atmosphere with nitrogen, or to wash them in the presence of phytotoxic substances or substances which somewhat mimic the soil conditions in which they grew. The lower content of α-solanine and α-chaconine were achieved with NaOH solution at pH 12 or with HCl solution at pH 3. In the assayed samples, α-solanine and α-chaconine reduction was 43% and 27% respectively. The process proposed allows to minimize the total content of glycoalkaloids, with respect to mode of collection, storage and cleaning of potatoes.

AN EPIDEMIOLOGICAL MODEL FOR BROWN ROT BUILD UP IN STONE FRUIT ORCHARDS

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Brown rot, caused by Monilinia spp., is a major disease of stone fruits and, in the absence of chemical treatments and favorable environmental conditions, it causes important economic losses. We developed an epidemic model of Monilinia spp. infection of fruits by modifying classical SEI models for plant diseases to account for peculiarities of brown-rot diffusion. We parametrized the model by using field data from a peach Prunus persica orchard infected by M. Laxa and M. fructicola in Avignon (southern France). The model well reproduces temporal evolution of fruit abundance in the different epidemiological compartments (i.e. Susceptible, Exposed and Infected). The model permits us to highlight crucial mechanisms undergoing brown rot build up and to evaluate the consequences of different agricultural practices on the quantity and quality of the yield. We found that winter sanitation practices, which decreases the initial fraction of exposed and infected fruits, and the control of the fruit load, which decreases host density and increases fruit growth rate that is responsible for cuticle cracks, can be effective in controlling brown rot in conjunction with or in place of fungicides. However, we also found that in the presence of favorable environmental conditions for brown rot spread, targeted fungicide application may be required to prevent considerable losses. The proposed model could be used to optimize timing and dose of fungicide treatments.

HOW CAN INDIRECT CONTACTS INFLUENCE THE SPREAD OF EPIDEMICS IN FARM SYSTEMS? THE CASE STUDY OF PARMA PROVINCE (NORTHERN ITALY)

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The spread of infectious diseases in livestock farms can cause serious negative impacts both from economic and social viewpoints. Epidemiological studies are thus key in supporting the design of more effective control measures. In this context, network models are commonly adopted tools to describe epidemic spread. Nodes represent farms while links describe the possible pathogen transmission routes, which can in turn be distinguished between direct contacts, i.e. animal movements, and indirect ones, like sharing of equipment and/or movement of workers and vehicles. While there is an already well-established branch of literature investigating the former, indirect contacts are still quite disregarded as potentially important transmission factors. One possible cause is that, while animal movements must be registered in EU-countries national databases, little information is available to date on workers' visits. Here we used data from a collection campaign on calves transportations in the Province of Parma (Northern Italy) occurred between September and November 2014. We built a network and studied its properties to detect which farms could act as super-spreaders or super-susceptibles in the unfortunate case of an epidemic. Our analyses were conducted both on static and on time-varying (weekly) networks and our results highlighted how the use of a static approach may bring to an overestimation of the epidemic final size. Interestingly, we found that indirect contacts can connect farms which are geographically far apart one from another, with non-trivial implications on disease control. Last, to quantitatively enucleate the specific contribution of indirect contacts, we contrasted our outcomes with those obtained by more complete networks accounting also for direct contacts. The comparison revealed that indirect contacts can play a very crucial role in the spatiotemporal pattern of disease spread.

ARE TEMPORAL DYNAMICS IN BIOMASS ALLOCATION A GOOD PREDICTOR OF FINAL YIELD ACROSS BRASSICA RAPA ACCESSIONS?

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Fluctuating environmental conditions within days and seasons are reality for agriculture management. Increasing global populations and environmental change require new breeding methods to produce the highest crop yield in various conditions. Since yield predictions are typically built on plant traits measured at the organ-level under optimal conditions, forecasting crop production in a changing environment is highly challenging. Adding data inputs from genomic and metabolomics analyses to biophysical process models may increase the predictive power for unknown genotypes and environments. The globally cultivated crop, Brassica rapa, is an excellent species for testing this approach because it includes an extremely diverse array of morphological and physiological types. We have characterized life-history traits and morphological diversity across diverse accessions. We used different varieties of oilseed, cabbage, and turnip, along with two Wisconsin Fast Plants (Imb211 and FPsc). Over a period of 15 weeks we continuously examined the plants for height and number of leaves; we also performed harvesting of above- and belowground biomass to assess Relative Water Content (RWC%) and Specific Leaf Area (SLA) every other week. Once a week, measurements of chlorophyll content, chlorophyll a fluorescence parameters, and gas exchange were taken to complete the phenotyping of each accession. We correlated all measured traits to the final yield that was specific to each crop-type (i.e. seeds, turnips, leaves) and analyzed how changes in biomass allocation to roots, leaves and reproductive organs, predicts final yield using the method of decomposition relative growth rate into components such as net assimilation rate, leaf area ratio and leaf mass ratio. Furthermore, we generated a Bayesian network in order to identify relationships amongst morphological and physiological traits and quantify the probability of observing a particular yield at various life stages among different varieties.

ASSESSING SUSTAINABILITY OF FOOD PRODUCTION SYSTEMS IN RESOURCE SCARCE REGIONS. A CASE STUDY IN THE GAZA STRIP

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Pursuing sustainability in food production systems raises intriguing methodological and operational challenges. On the one hand, the multifaceted concept of sustainability requires that the problem is analyzed from different, sometimes conflicting perspectives, such as the environmental, the social and the economic one. On the other hand, finding a balance between sustainability objectives is made difficult by multiple constraints. This is particularly true for rural households in resource scarce regions, where the enhancement of local production, which is key to promoting food security, may conflict with ecosystems preservation. We integrate existing assessment frameworks to investigate the potential of agricultural systems to ensure food security and enhance rural livelihoods in a sustainable manner. We use a set of quantitative indicators to compare production scenarios in terms of their contribution to food supply and income to rural households, as well as their impact on freshwater resources and agricultural land use. We demonstrate our approach by assessing alternative production scenarios in the Gaza Strip, where agricultural production is strongly constrained by resource scarcity and severely limited trading possibilities. Each scenario includes a crop rotation system plus animal production from husbandry and aquaculture. At the scale of a single farm, a clear conflict emerges among nutritional, environmental and economic objectives: cash crops (such as tomatoes and cucumbers) ensure good incomes, but contribute scarcely to protein supply, while crops with better environmental and nutritional performances (such as lentils) have poorer economic performances. At the scale of the whole Gaza Strip, domestic production has the potential to cover an important fraction of nutritional needs and contribute to a significant extent to household income: however, existing environmental constraints impair the satisfaction of food demand by domestic production alone.

A SIMPLE DYNAMIC MODEL FOR ECOSYSTEM SERVICES ASSESSMENT IN AGROECOSYSTEMS

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The ecosystem services (ES) framework has emerged as an effective tool to assess the impacts of land use change on ecosystem functioning, especially in the agricultural sector. The integration of ES into agroecosystems design can support the transition towards sustainable agriculture, but quantitative ES assessments are still relatively scarce, especially at farm scale. We developed a simple model to evaluate agricultural practices in terms of provisioning services (food production), regulating services (carbon sequestration) and supporting services (nutrient cycling). The model explicitly describes the dynamics of crops, litter and nutrient pool. Plant dynamics is influenced by the presence of other species, which mediate (positively or negatively) the availability of resources such as light and nutrients. We modeled competition for light according to Beer's law (to describe light extinction through the canopy), while we described nutrient uptake via the Michaelis-Menten equation. A mortality rate describes the loss of foliage and other dead organic matter, which fall into the litter compartment. Finally, the soil nutrient pool depends on fertilization and denitrification as inputs, and on plant uptake and leaching as outputs. Model outputs include fruit yield, carbon storage and nutrient cycling, indicators that can be used to comparatively assess different agroecosystems in terms of ES. We exemplify the application of the model by investigating the coupled dynamics of banana and cocoa, two economically relevant crops in tropical countries. After calibrating the model on the basis of literature data (yield and standing biomass), we simulate crop dynamics both in monoculture and in intercropping. Preliminary results show that intercropping has better performances (in terms of both yield and standing biomass) compared with monocultures, thanks to the increase of nitrogen in the soil made available by dead leaves and organic matter falling from banana trees.

THE PHYTOPLANKTON COMMUNITIES OF THE ROSS SEA IN A CHANGING SOUTHERN OCEAN

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Antarctic marine ecosystems have been changing for at least the last 30 years, somewhat in response to increasing ocean temperatures and changes in the extent and seasonality of sea ice. The magnitude and direction of these changes vary between regions around Antarctica, that could see populations of the same species changing differently in different regions. Studies on phytoplankton responses to environmental forces are crucial in detecting and forecasting the ecosystem responses to global change. The phytoplankton communities of the Ross Sea are two, alternatively dominated by functional groups, diatoms and Haptophyceae (*Phaeocystis antarctica*). The prevalence of one of these two algal groups determinates the fate and pathway of carbon through the systems. Annual production is regulated by ice extent and the primary productivity is also influenced by micro- and macro-nutrient availability and vertical stratification. All these variables are predicted to change in future, but their synergistic effects on marine biota are difficult to forecast. The aim of this work is to study the physical and chemical forcing that modulate the distribution of phytoplankton (*i.e.*, in terms of biomass, size classes, functional groups) and its photophysiology in different ecological systems of the Ross Sea, as well as in different years (as part of the projects funded by the Italian Antarctic Program). Our results emphasize the occurrence of significant temporal change of phytoplankton in the Ross Sea. The considerable biomass and large size of phytoplankton observed suggest noticeable alterations in Ross Sea summer productivity accompanied by significant anomalies in the distribution of the main functional groups. Compared to previous observations, the *P. antarctica* colonial bloom occurs in an area and in a season usually characterized by the prevalence of diatoms. Moreover, large diatoms were observed in a wide UML, contradicting the classic paradigm of Antarctic diatoms accumulation in highly stratified waters.

PARTICULATE ORGANIC MATTER FLUXES BELOW THE SEA ICE DURING PACK ICE MELTING (TETHYS BAY, ROSS SEA, ANTARCTICA)

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During winter, the annual sea ice in Antarctica gets colonized by a numerous and diverse microbial community and huge amounts of particulate organic matter (POM) mostly associated with microalgae. This material is released in the water column during sea ice melting and is supposed to fuel higher trophic levels dwelling below the sea ice. As part of the project CEFA funded by the Italian Antarctic Program, to provide insights on the dynamics of POM release during sea ice melting (November-December 2015), we investigated quantity and biochemical composition of POM released in the water column during the sea ice melting in Tethys Bay (Ross Sea) at 10 and 30 m depth. Moreover, to shed light on the possible coupling between particulate flux and their consumers, we investigated also the abundance and biochemical composition of two zooplankton taxa commonly encountered in the water column underneath sea ice: *Clione limacina* and *Limacina helicina antarctica*. At 10-m depth, protein flux was characterized by a peak at the end of November and another one in mid-December, carbohydrate flux continuously decreased during the whole sampling period, and lipid flux peaked at the beginning of December. At 30-m depth, POM flux was much less variable (with exception for lipids which peaked at the beginning of November). Rates of POM export to 30-m depth were very high (up to 100%) till mid-November, then decreased continuously during the remaining sampling period, but the last few days. *L. helicina antarctica* and *C. limacina* abundance below the sea ice showed opposite temporal trends, with the former decreasing and the latter increasing during the study period. *C. limacina* was characterized by the dominance of lipids, whereas *L. helicina antarctica* showed a dominance of proteins. During the study period, their biochemical composition resembled that of POM, indicating that sea ice melting plays a major role in trophic successions of zooplankton in Antarctic coastal waters.

CHANGES IN BACTERIAL DIVERSITY ALONG AN ARSENIC GRADIENT IN SEDIMENTS OF CAMARONES RIVER (ATACAMA DESERT, CHILE)

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Arsenic is a highly biologically toxic metalloid naturally present in Camarones River (Atacama Desert, Chile). In this study, changes in bacterial communities associated with metal-rich sediments from three sites (M1, M2 and M3), along a gradient of arsenic (As) concentration in Camarones River, were evaluated using a combination of approaches. Diversity of bacterial communities was evaluated by Illumina sequencing. Bacterial communities possessed moderate diversity that slightly increased across the river, from M1 to M3 sites, according to the concomitant decreasing of arsenic concentrations. Sequences of the dominant taxonomic groups (high abundance ?1%) across all sediment samples were affiliated with Proteobacteria (mainly represented by Deltaproteobacteria), Firmicutes, Acidobacteria, Actinobacteria, Chloroflexi, Planctomycetes, Gemmatimonadetes and Nitrospirae. Changes in their relative abundances from high to low abundant phylotypes or vice-versa resulted in different bacterial assemblages along the river. A great diversity was found within Deltaproteobacteria, mainly represented by anaerobic members involved in the metal reduction, and particularly in respiring arsenate. Sulphate-reducing bacteria, such as those related to Anaeromyxobacter, Desulfobacca and Geobacter, key mediators of anaerobic carbon cycling in sediments, have been reported to play an important role in the detoxification of arsenic compounds.

SPORES OF EXTREMOPHILES RESISTANT TO HEAT: IMPLICATION FOR ASTROBIOLOGY

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The wet-heat treatment represents a common method used in human industry and also in astrobiology to avoid microbial contamination and simulate space conditions. In this work, the resistance to heat of spores from bacilli isolated from extremely cold (active Antarctic soils) and hot-acid (shallow hydrothermal vents of Eolian Islands, Italy) environments was evaluated in comparison to those of Bacillus subtilis 168 used as biodosimetry strain and space microbiology model organism. Spores were obtained from i) psychrotolerant Bacillus sp. strains (Antarctic soils) A30, A34, A43, A45, B51 and B58, and ii) thermophilic Bacillus sp. strains (Eolian vents) V32, V40, Str60, P82, B. horneckiae SBP3 (SBP3), *B. licheniformis* T14 (T14), and Geobacillus vulcanii (Gv). The wet-heat resistance was determined exposing the spores from each strain to wet-heat at 95°C for 30 min. Overall, a higher degree of spore resistance to wet heat than *B.subtilis* 168 was observed for the thermophilic strains, with an exceptional level of resistance seen by SBP3, followed by the Antarctic strain A43. The Raman spectra of unheated and wet-heated spores of SBP3 showed peaks shifting in the protein amide I and III regions, indicating that proteins were largely unstructured in dead spores after wet-heat stress. Differences in peaks assigned to dipicolinic acid (DPA) suggest a key role of this compound in the SBP3 spores heat resistance. These results confirm that the wet-heat treatment kills spores by denaturing one or more key proteins, whereas DPA is involved in the wet-heat resistance mechanism, as well as reported for *B. subtilis*. Further investigations on the wet-heat resistance of spores could help us to develop novel treatments to reduce the risk of contamination in human activities. Due to their heat resistance, studied spores could also have a relevant impact in Astrobiology, as novel bacterial models in the space exploration missions and planetary protection.

EFFECTS OF DEGLACIATION ON ALPINE STREAM ECOSYSTEMS: PRELIMINARY FINDINGS

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Glaciers shrinkage and permafrost degradation are amongst the most evident and dramatic effects of human-driven climate change, and the loss of cryosphere is determining radical shifts in the hydrology and ecology of streams, also in the European Alps. Due to their different sensitivity to climate adjustments, a decreased/lost discharge from glaciers and a parallel increase of permafrost ice contribution to water flow are foreseen in Alpine catchments, and rock glaciers (a common form of permafrost in the Alps) may become increasingly important for the hydroecology of streams. While a large amount of literature is available on the effects of glacier retreat on freshwater ecosystems, very little is known about the ecology of streams fed by rock glaciers. Nevertheless, permafrost ice degradation can have drastic effects on the water physico-chemistry, including pollution from heavy metals, acidification and increased electrical conductivity. We present the preliminary results of a PhD project aimed at assessing the impacts deglaciation on Alpine stream ecosystems. A set of glacier, rock glacier and groundwater fed streams have been selected in the Zay and Solda catchments (South Tyrol, Italy) in order to assess ecological differences among stream types. Water source (H-O isotope analysis), DOC, physico-chemistry and metal concentrations have been analysed at 16 sampling sites in summer 2017, in order to compare habitat characteristics with benthic communities (periphyton biomass, diatoms, macroinvertebrates and meiofauna diversity and abundance), and assess longitudinal patterns and seasonal differences as a function of glacial and periglacial influence. In addition to this, stable isotope analysis (C, N) and metal concentrations in organisms have been undertaken in order to describe the differing foodwebs and the transfer of pollutants.

VIRUSES PLAY A KEY ROLE IN SHAPING THE PROKARYOTIC DIVERSITY OF SHALLOW HYDROTHERMAL VENT COMMUNITIES

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Hydrothermal vents in the Mediterranean Sea sustain a high prokaryotic and eukaryotic biomass, largely due to chemosynthetic processes. In the present study, we have analysed the influence of viral infection and/or environmental parameters on the structure of the prokaryotic assemblages in different areas of the micro-Aeolian volcanic Arc of the Mediterranean Sea: Basiluzzo (characterized by hydrothermal fluid discharges) and Panarea (characterized by CO2 seeping points). The results obtained show that prokaryotic diversity in the areas is driven by either low pH conditions or high viral abundance. Moreover, we found that the physical-chemical conditions of the chimney structures also created micro-environments and thus contributed to shape microbial diversity in the Basiluzzo area. Viruses exert a strong control over prokaryotic diversity and abundance in the Basiluzzo area, increasing microbial-mediated recycling of organic matter, with major consequences on the functioning of benthic ecosystems. Conversely, sediments of CO2 vents show lower viral impact, which could be either due to detrimental effects of the CO2 seepage on viral production or to lysogenic strategies, which have been shown to be important in hydrothermal vents. These results shed more light on the functioning of shallow hydrothermal and CO2 vents in the Mediterranean Sea.

CHANGES IN ANTARCTIC FOOD WEB STRUCTURE ASSOCIATED TO SEASONAL RESOURCE INPUTS: IMPLICATIONS FOR BIODIVERSITY PERSISTENCE UNDER CLIMATE CHANGE

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In the Ross Sea, Antarctica, long-term environmental stability and absence of anthropogenic pressure resulted in a high biodiversity level, mainly represented by benthic invertebrates. In turn, marked seasonality in light and sea-ice coverage controls biological productivity in the region. This forced benthos to adapt to pulsed resource inputs. Disentangling mechanisms of trophic niche modification following changes in food availability will improve our understanding of Antarctic biodiversity organisation. This will provide insights on potential effects of climate change on nutrient transfer, food web stability and vulnerability to biodiversity loss. Based on stable isotope analyses, we described benthic food webs along a gradient of seasonal sea-ice persistence (i.e. from early to late sea-ice break up) in medium-depth waters at Terra Nova Bay, Ross Sea. Species' isotopic distribution varied across locations, suggesting that assimilation of sympagic algae by benthos increased were sea-ice break up occurred earlier. Consumers optimised their foraging when in presence of sympagic inputs. Mean number of feeding links, number of potential competitors, and intraguild predation all decreased where assimilation of sympagic algae was higher, pointing to lower complexity, higher efficiency and stability of the food web. Overall, food webs were more vulnerable to a top-down (e.g. fishing) than to a bottom-up (e.g. ocean acidification) spread of perturbations. The architecture of biodiversity at Terra Nova Bay was reshaped by the pulsed sympagic input in summer. Such dynamic stability of the food web could be a key factor promoting the high biodiversity in the Ross Sea. Potential climate-driven mismatch between the timing of nutrient inputs and consumer demand, together with anthropogenic pressure, may produce unprecedented ecological changes threatening Antarctic food web stability, with the risk of species extinction and decrease in secondary productivity as a consequence.

ISOTOPIC TROPHOSPECIES TO RECONSTRUCT ANTARCTIC FOOD WEBS

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In Antarctica, biodiversity is strongly influenced by key environmental drivers associated with climate change, such as temperature and sea-ice coverage. It is expected that in such climate change scenarios also the biodiversity architecture will be impaired and the study of food webs is crucial to understanding how productivity, energy flux and stability of Antarctic marine ecosystems will be affected. Since transfer of energy and matter depends firstly on foraging choices of individuals within the community, the trophospecies (sensu Cohen) could be effective to reconstruct the food web, overcoming the problem of taxonomical resolutions at whole food web level. Several samples of basal resources, invertebrates and fish were collected at two sites differing in seasonal sea-ice persistence (early vs late sea-ice break up). Each sample was classified taxonomically and analyzed isotopically. Food webs were described according to an innovative "isotopic niche-unit" (INU) method. This is based on the "isotopic trophospecies concept", in which groups of individuals with the same position along food chains and resources axis (differing less than 1‰ d15N and d13C values respectively) are expressed as isotopic trophospecies. Bayesian mixing models were applied to assign trophic links between isotopic-units and quantify food web metrics. Differences in consumer preference for basal resources and in food web topology were observed between locations. The mean number of Taxa belonging to each INU and linkage density between isotopic trophospecies were lower, while the consumption of sympagic algae was higher where sea-ice broke up earlier. The trophic-functional method highlights the real ecological role of individuals in the food web, proving to be a promising simplified approach to develop reliable description of trophic pathways and biodiversity architecture in Antarctica.

ARIADNA SPIDER AS POTENTIAL BIOINDICATOR OF HEAVY METAL EXPOSURE IN THE NAMIB DESERT

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Human activities are strongly affecting the health of ecosystems, so even organisms from natural environments are more and more frequently exposed to increasing concentrations of pollutants. Among these, heavy metals represent persistent components and have therefore a strong impact on both plant and animal populations. Mining activity is the biggest contributor to Namibia's economy in terms of revenue and includes copper, gold, lead, zinc, uranium, diamonds, semi-precious gemstones and minerals. Various spider populations belonging to undescribed Ariadna species are widespread in gravel plains within the Central Namib Desert. These sit-and-wait predators spend their life in individual tunnels dug in the soil so, as it has already been demonstrated for other spiders, they seem to be good candidates as bioindicators of heavy metals. We first analysed the effect of mining activity on three Ariadna populations along a N/S and W/E transect at different distances from mining areas. Three sites were selected at various distance from the mining area. An average number of 35 spiders were collected from each site and shipped alive to Italy. Diameter of entrance and depth of the burrows of single spider were calculated on site. Oxidative stress parameters, selected enzymes involved in metal biotransformation as CAT, GST, MDA and total MT have been investigated as well as gene expression profile of related genes as gst, hsp70 and mt. Cholinesterases have been also characterized in order to use their inhibition as a potential marker of heavy metal exposure. Heavy metal concentrations in both soils and animal tissue were also determined. The diameter of the burrow entrance and their depth show statistical differences among sites. Enzymatic assays as well as gene expression profile also highlight differences among sites. The results obtained show that the Namibian Ariadna spiders is a good candidate as bioindicator of heavy metal exposure in Namib Desert.

RESPONSE OF THE SEAGRASS POSIDONIA OCEANICA AND ASSOCIATED VAGILE INVERTEBRATES IN VOLCANIC VENTS

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Seagrass ecosystems play a fundamental role in coastal environments by increasing local biodiversity and supporting a great variety of ecological services. Unfortunately, their communities can be very sensitive to changes in the marine habitats, including natural as well as anthropogenic induced ones. Shallow-water hydrothermal vents offer the opportunity to study the effects of multiple environmental disturbances on seagrass ecosystems, since their emissions cause local reduction in pH, increase in CO_2 concentration as well as in toxic gases such as H_2S, heavy metals and trace elements. The aim of this study was to investigate the effects of long-term exposure to hydrothermal emissions on *Posidonia oceanica*, one of the most ecologically relevant and threatened seagrass species in the Mediterranean Sea, and on vagile invertebrates associated to the leaf portion. We analysed the structure and composition of the *P. oceanica* meadows, including both the plant and the associated invertebrates, in proximity of hydrothermal vents, and compared the results with *P. oceanica* meadows from no-vent areas. *P. oceanica* density, biomass and epiphyte load were lower in the vent sites compared to the non-vent ones. Leaf number increased in vent sites, while leaf length and width showed an opposite trend. Density and biomass of *P. oceanica* leaf-associated invertebrates resulted highly variable due to the different response of several taxonomic groups, with clear rarefaction of calcified taxa in the vicinity of the vents. The findings of our study show high vulnerability of *P. oceanica* and the leaf-associated invertebrates when long-term exposed to hydrothermal emissions, adding important evidences to the growing body of knowledge regarding the effects of altered environmental features, also in association with climate changes, on seagrass ecosystems.

THE ROLE OF THE HEAT SHOCK PROTEINS IN THE PHYSIOLOGICAL TOLERANCE OF REEF-BUILDING CORALS UNDER CLIMATE CHANGE

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The environmental stresses associated with global changes are widely recognized as the most serious threat to the health of coral reefs, leading to an increase the frequency and severity of bleaching events. As sessile organisms, corals cannot migrate to new environmental optima and therefore, in order to cope with perturbations, they rely mainly on their physiological and cellular stress responses, which represent the first line of defense in reducing the potentially harmful effects of unfavorable conditions. In this context, one of the most prominent and conserved cellular stress response includes the immediate up-regulation of the Heat shock proteins (Hsps), molecular chaperones with important functions in protein biogenesis and homeostasis and consequently in stress tolerance. In our studies, the modulation of Hsps in corals subjected to variations of the main abiotic marine factors, such as temperature, salinity and light have been explored in order to understand the cellular changes that occur not only during the onset of bleaching but also from the initial stress response. Differences in the duration of the Hsps response and in the amplitude of the Hsps expression trends related mainly to the exposure time, and the type and the severity of the stressor were observed. Furthermore, the Hsps modulation appear useful for providing information about the susceptibility of the different coral taxa to environmental disturbances. Our results highlight the crucial role of Hsps in the physiological tolerance of corals under future climate change and as biomarkers capable of diagnosing their health before visible and irreparable bleaching occurs.

AFFECTIVE ECOLOGY CAN HELP ENVIRONMENTAL EDUCATION

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Affective Ecology is the branch of ecology accounting for humans' emotional connection to Nature. Its epistemological statute is interdisciplinary and founded on the Biophilia Hypothesis (Biology) and the Theory of Multiple Intelligences, in particular Naturalist Intelligence (Psychology). Biophilia (as evolutionary trait) and Naturalist Intelligence (as potential goal of education) can be considered the two poles of an environmental education journey. In fact, Biophilia is the set of innate learning rules, evolved in the human species (Wilson, 1993), which enables individuals to benefit from an evolutionist coherent and an ontological fittest relationship with Nature, whereas Naturalist Intelligence is the ability to recognise living organisms and natural objects, to take care of them and to interact with them in subtle ways (Gardner, 1999), which enables individuals to a full realisation of their inborn biophilic potential to connect to Gaia and to empathise with it. From this theoretical framework, we have developed an experimental research program that has allowed us to make several observations regarding fascination triggered by Nature, which unfolds the affective bonds and the cognitive benefits at the basis of the relationship between human beings and Nature, and starting point for any environmental education program.

TRAVELLING THROUGH ECOSYSTEMS AND BIODIVERSITY: LONG-TERM ECOLOGICAL RESEARCH FOR CITIZENS

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Since 2015 Italian ecologists, active in long-term ecological research (LTER-Italy) and in biodiversity study (LifeWatch-Italy), started a process of informal public science communication, through walking and cycling together with citizens along itineraries connecting a number of LTER-Italy sites. The trails, named "CAMMINI LTER", aimed at offering citizens an opportunity to familiarize with the components and conditions of Italian biodiversity and ecosystems, from the sea to alpine tundra. This initiative was conceived to share the research results among a large public, by creating a physical and visible movement of researchers towards and with citizens, relying as well on the slow rhythm of walking and cycling that allow to create an intimate link with people and nature. Cammini LTER intended, in particular, to promote LTER and LifeWatch activities to a not-expert audience and to increase ecological awareness and literacy, moving beyond communication deficit to dialogue, sharing scientific views as well as experiences and emotions. The trails were also an invaluable opportunity for scientists to understand the need to adopt a different cultural approach for more effective interactions with citizens, since communicating and sharing science is an important step for researchers to make their activity more visible and understandable. Actually, the trails produced unexpected effects on the scientists, evidencing the need of a cultural shift: they generated mutual learning by public and scientists and induced profound changes, vivid debates and critical considerations among researchers themselves, about some relevant aspects and needs of science communication. We report here some evaluations and perspectives coming form this experience that has recently crossed the national boundaries, becoming in 2016 the International initiative "TRAIL", selected and launched by the International Long-Term Ecological Research Network (ILTER).

TEACHING ENVIRONMENTAL EDUCATION TO THE TEACHERS: A CASE STUDY

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As we enter a new century and millennium, environmental educators and teachers must come up with new knowledge and techniques that address the demands of a constantly evolving social and technological landscape, while ensuring that environmental education stays relevant to the needs and interests of the community, with particular attention to its younger generation. During the last year, we taught “Ecology and Teaching of Ecology” in the Primary Teacher Education degree course of “Roma Tre” University. The course aimed to give a solid pedagogical background for the Didactic of the Science, giving to the future teachers the skills and tools necessary to transmit a scientific knowledge and point of view to pre-school playgroup and primary school children. The course used the relationships between living organisms and the environment as a main theme to give an overview on many scientific fields, from the abiotic world (physic and chemistry) to the biotic world (biology and ecology) using a constructivist approach. All the arguments were debated from a scientific point of view (to achieve a strong theoretical background), as well as from a practical-applicative one (to learn how these knowledges may be transmitted to the children). At the end of the course, we used the simplified dichotomous keys offered by the Dryades project, to realize a laboratory experience. Dryades is a free resource that give online access to interactive identification tool devoted to plants, fungi and animals, coordinated by the Department of Life Sciences of the Trieste University. These challenges to environmental education require that we reexamine the way we do research and train environmental professionals, educators and teachers, using all the resources that the modern technologies are now offering.

LA SCIENZA INCONTRA L'ARTE

Rosapepe R.

Liceo Artistico Sabatini - Menna, Salerno

LA SCIENZA INCONTRA L’ARTE è il titolo del progetto in cui le api rappresentano il tema centrale trattato dagli studenti del biennio spaziando tra scienza, letteratura, storia, arte, design e software. I ragazzi hanno realizzato alveari di argilla, disegni geometrici e digitali, disegni in bianco e nero e a colori e un disegno a freddo su piastrella in cotto, un piatto smaltato con uno sciame di api in rilievo. Il lavoro è stato svolto utilizzando uno spazio cognitivo condiviso in Google drive. Gli studenti, quindi, hanno cominciato ad acquisire nuove competenze relative ad un apprendimento che utilizza le TIC nella didattica. I prodotti sono pubblicati nella mappa concettuale multimediale, (programma Cmap). http://cmapspublic.ihmc.us/rid=1R13H731M-PLCRNC-2VTJ/Liceo Artistico Sabatini Menna La scienza incontra l'arte.cmap I contenuti del progetto cambiano veste per essere presentati all’inaugurazione della mostra FUTURO REMOTO in Piazza Plebiscito a Napoli nella sessione Scuole in piazza La nuova veste consiste nella narrazione digitale LA SCIENZA INCONTRA L’ARTE eseguita sulla piattaforma PoliCultura del Politecnico di Milano. Le fasi per la realizzazione sono fondamentalmente cinque: scrittura dei testi, ricerca delle immagini, registrazione dei testi, realizzazione del video, upload sulla piattaforma. http://www.dol.polimi.it/narrazioni/2016/LASCIENZAINCONTRALARTE/LASCIENZAINCONTRALARTE_65_3463_web_it_170524112201.zip/# Infine, gli studenti raccontano LA FAVOLA DELLE API con Scratch, un programma per creare storie, giochi e animazioni con cui più che “imparare a programmare, si programma per imparare” senza avere abilità matematiche ed informatiche particolari. https://scratch.mit.edu/search/projects?q=la favola delle api

INQUIRY BASED SCIENCE EDUCATION (IBSE) IS WELL-SUITED FOR TEACHING EDUCATION FOR SUSTAINABLE DEVELOPMENT (ESD) AT SCHOOL? THE RESULTS FROM SUSTAIN PROJECT

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In response to the 21st century global challenges highlighted by the economic, social and environmental crisis, ESD is taking shape in schools. To ensure that ESD becomes more widespread and brings about the desired awareness among pupils, teacher professional development is paramount: it is essential to provide teachers with appropriate and cutting-edge tools and learning materials for ESD. With its focus on problem-solving and critical thinking, inquiry-based science education (IBSE) is well-suited for ESD at school. Like IBSE, ESD gives explicit attention to developing young people's creative ability to problem solve and imagine new scenarios through the active learning processes of conceptualising, planning, acting and reflecting. It provides the space for critical thinking to be combined with the creative act of interpreting images of the future. This dimension helps students to develop skills necessary for democratic engagement. SUSTAIN (Supporting Science Teaching Advancement through Inquiry) www.fondation-lamap.org/en/sustain, has been build on this to explore the way IBSE can contribute to developing ESD: connecting teachers and pupils with real life and contemporary science; introducing topical issues related to science and technology as they are debated in society; applying inquiry skills to issues of sustainability. SUSTAIN has build upon a well-established network of continuing professional development (CPD) providers (11 CPD providers in 10 EU countries, with extensive experience in IBSE) and has developed teachers CPD, classroom activities and IBSE resources for ESD. ANISN (Associazione Nazionale Insegnanti di Scienze Naturali) has been the Italian partner in SUSTAIN (2013 -2016). The network has developed, through collaborative work on 3 cross-cutting ESD topics, (Energy, Food, Everyday object), an innovative IBSE-based "toolbox" on ESD for teachers/teacher educators, which can be used and adapted to local contexts in most European countries.

TRANSFERRING ECOLOGICAL CONCEPTS TO YOUNG PEOPLE BY A FRIENDLY APPROACH

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The young generations have a low sensitivity to ecological issues except for those clearly linked to human health, such as air, water or food pollution. To enhance the ecological conscience in young people, the concepts of natural resources and ecosystem services have to be included in the training. At this purpose, the ecologists should transfer their knowledges to students to improve sensitivity to environmental themes. Several types of projects achieved by secondary schools offer this opportunity. Within the activity concerning the monitoring of Phlegrean Fields lake waters, planned in the "Scuola Viva" Project "Comunicare per Partecipare" (P.O.R. Campania FSE 2014-2020) of the secondary school Augusto Righi of Naples, selected students were involved in an educational path including theoretical and practical actions. Firstly, the students acquired information on the lakes of Phlegrean Fields throughout scientific literature, and they learned some ecological concepts, such as ecosystem services offered from fresh waters to humans, ecological indicators of water quality. Then, they were directly involved in field and laboratory measurements of some parameters of water quality. Later, they learned to use software for data elaboration and representation. Finally, they discussed the performed activity and obtained data. This experience shows that ecological concepts may be effectively transferred to teenagers by using a simplified language and a direct learning approach: "observe, measure and learn".

MEASURING FOREST FLOOR EVAPORATION AFTER PRESCRIBED BURNING IN SOUTHERN ITALY PINE PLANTATIONS

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Wildfires are a growing concern in the Mediterranean area. Prescribed burning (PB) is often used to reduce fire risk, by decreasing fuel amount and disrupting its horizontal and vertical continuity. However, the monitoring of PB effects on ecosystem processes is mandatory before its spread. This study aims to assess hydrological effects of PB on the topsoil by controlled laboratory experiments. The evaporation flux successive to interception of rain water in the litter layer and the fermentation layer (F-layer) was determined using both a water balance approach and an experimental 2H and 18O isotopes mass balance approach. PB was performed in spring 2014 in three Southern Italy pine plantations, dominated, respectively, by Pinus pinea (in Castel Volturno Nature State Reserve), P. halepensis (in Cilento, Vallo di Diano e Alburni National Park) and P. pinaster (in Vesuvio National Park). In each study area, 18 months after PB, two cores, both including litter and F-layer, were sampled in burned and in near unburned (control) plots, respectively, by means of a customized collector allowing to extract "undisturbed" cores. Afterwards, each core was placed into a lysimeter, installed under laboratory controlled conditions (22 °C, RH of 50%), to carry out duplicate infiltration and evaporation experiments. To simulate rainfall, 1 liter of tap water (equivalent to 32 mm of rain) was sprinkled uniformly on the litter layer in the lysimeter and intercepted water from the litter and F-layer was collected for isotope analysis at two different depths for each layer, two times per day until 2 days after the rain simulation. The results showed a slight lower interception capacity of burned litter and F-layers and a decrease in the interception evaporation compared to the unburned conditions. This could be due to a thinner litter layer in burned plots, at least up to 18 months after treatment.

THE LEAF-NETS (LN): A NEW TOOL FOR ASSESSING LEAF LITTER BREAKDOWN IN SPRING ECOSYSTEMS

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Recent studies have highlighted the importance of structural and functional parameters to assess the ecological integrity of freshwater ecosystems. Leaf litter breakdown is known as a key ecosystem-level process and has been widely used to evaluate the functional characteristics of aquatic ecosystems. However, leaf detritus decomposition in spring habitats has been rarely investigated. Considering the small size, the limited spatial extension and the low resistance/resilience to disturbance of spring ecosystems, the leaf-nets have been recently proposed as a new, less invasive, method for sampling crenic invertebrates. One of the advantages of the leaf-nets method consists in its applicability for a concomitant evaluation of structural and functional parameters of springs. Therefore, the main objectives of the research are: i) to illustrate how leaf-nets can be successfully employed in assessing leaf litter breakdown in springs, ii) to add new data on the rate of leaf detritus processing in spring habitats and iii) to make some preliminary considerations on the relationship between leaf detritus breakdown and structure and functional organization of crenic assemblages.

IMPLICATION OF GROWTH AT DIFFERENT LIGHT QUALITY REGIMENS ON PHOTOSYNTHESIS, LEAF ANATOMY AND VOLATILE COMPOUND EMISSION IN TWO PLANT MODELS: A FAST-GROWING CROP AND A FAST-GROWING TREE

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The effect of different light quality on photosynthetic performance, leaf anatomy and isoprenoid emission was studied in two plant systems: a fast-growing crop, tomato, and a fast-growing tree, oriental plane. Plants were grown under three different quality of PAR: RGB (red-green-blue), RB (red-blue) and WL (white light) and analyzed for growth, leaf anatomical traits, photosynthesis and volatile compound emission. The capacity of the two plant models to regulate gas exchanges and optimize functional metabolites and biomass production was evaluated. In both species, growth under RGB and RB light induced a more compact plant size, i.e. reduced plant height, biomass and leaf area. In tomato, RGB and RB treatments determined higher CO2 assimilation rate (A), stomatal (gs) and mesophyll (gm) conductance than WL. Oriental plane showed similar responses, but only gs was significantly higher under RB than under the other light regimes. As regards leaf anatomy, in tomato, leaf lamina thickness was significantly reduced under RGB and RB compared to under WL. In oriental plane, the opposite trend was observed. In both species, leaves grown under RB showed higher stomata size than under WL and RGB. Light quality also influenced photosynthesis-dependent emission of volatile isoprenoids. In tomato, ?-phellandrene was lower but ?-pinene, carene and ?-terpinene emissions were higher under RB and RGB compared to under WL. In oriental plane (a species that emit prevalently isoprene), isoprene emission was reduced under RGB and more so under RB, compared to WL. In summary, it seems that photosynthesis, leaf anatomy, biomass production, and volatile isoprenoid emission are affected by light quality differently in the two plant model, with the crop plant showing a higher capacity to respond compared to the tree. In both cases, control of the PAR spectrum may have important applications to modulate plant productivity and biosynthesis of useful biochemical compounds.

NITROGEN CYCLING IN SHALLOW-WATER CHEMOSYNTHETIC SYMBIOSES

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In chemosynthetic symbioses, one invertebrate host has evolved an intimate association with one or few species of chemosynthetic bacteria. Research to date has focused on inorganic carbon (C) fixation by the symbionts, and transfer of organic C compounds to the hosts for their nutrition. In addition to organic C, all animals require a source of organic nitrogen (N) to synthesize biomass, but N metabolism in chemosynthetic symbioses has received far less attention. Different chemosynthetic symbioses are to varying degrees able to gain their N from ammonium (NH4+), nitrate (NO3-), or dissolved free amino acids (DFAA) in their environment. Furthermore, some symbionts are capable of recycling N waste compounds within the symbiosis. However, recycled N cannot account for new biomass production and net growth. Here we report on 13C, 15N2 and 15NH4+ incubation experiments with shallow-water clams of the species Loripes orbiculatus. These clams inhabit seagrass sediments and host chemosynthetic symbionts that are capable of nitrogen fixation. Our results make evident the remarkable plasticity of these symbioses in using new or available N sources from their environment. Further, our findings suggest a potential role of these chemosynthetic animals in mobilizing bioavailable N that could contribute to seagrass ecosystem functioning.

CAULERPA CYLINDRACEA (SONDER) AFFECTS BENTHIC BIOGEOCHEMICAL CYCLES AND SUPPORTS A DISTINCT FUNCTIONAL DIVERSITY OF BENTHIC MICROBES

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Caulerpa cylindracea (Sonder) is considered one the most successful non-indigenous algal species that has invaded the Mediterranean Sea in the last 20 years. This species poses serious threats on all levels of biodiversity of invaded grounds. Nevertheless, to date, the effects of this alga on trophodynamics of marine ecosystems are substantially unknown. Since benthic microbial communities are highly dependent on the characteristics of the available substrates, we hypothesize that the invasive seaweed *C. cylindracea* has the potential to alter the sedimentary organic matter (OM) features, influencing also the composition and the metabolic patterns of benthic microbial communities. To test this hypothesis, we first compared the metabolic patterns of the microbial communities associated with the thalli of *C. cylindracea* with those in sediments colonized and not colonized by the alga. Then, to ascertain the role of microbial communities associated with the alga on sedimentary OM biochemistry, we also investigated the biochemical composition of sediments invaded and not invaded by *C. cylindracea*. OM sedimentary contents in sediments colonized by *C. cylindracea* were significantly higher than those in seaweed-free sediments. Our results highlight that *Caulerpa cylindracea* can influence the quantity and the nutritional quality of sedimentary OM. In addition, the invasive seaweed *C. cylindracea* hosts microbial populations with specific metabolic patterns and degradation capacities. For the first time, we show that *C. cylindracea*, changing the biochemical composition of sedimentary OM, can influence the metabolic patterns of the microbial community specifically adapted to degrade compounds released by the alga itself, with major consequences on benthic ecosystem functioning.

BEYOND PREDICTIONS: FOREST ECOLOGY IN A CHANGING CLIMATE

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Changing temperature and precipitation patterns and increasing concentration of atmospheric CO_2 are likely to drive significant modifications in forest ecosystems. The Mediterranean Basin has been identified as one of the most sensitive among the European regions to climate change due to global warming. Alterations, and more specifically reductions, in wood growth can be responsible for the decrease of productivity of Mediterranean forests with negative consequences on related ecosystem services such as carbon fixation in long-lasting wood pools. Here, we analyzed the effect that forthcoming changes in climate and atmospheric CO_2 will yield over Mediterranean forests, using a multidisciplinary approach of tree-rings records, stable isotope measurements and models. Tree rings are very powerful record of environmental changes occurring during tree growth at annual and intra annual scales. The combination of ?13C and ?18O in tree rings can provide specific information on the underlying ecophysiological processes and models help to achieve a proper understanding of forest functioning. Our findings provide additional support to the global observations of a slowing down of C sequestration in the trunks of forest trees in recent decades. Data indicate that the CO_2 increase alone has not been sufficient to obtain a tree growth increase. The effect of other changing environmental factors, like temperature, may have overridden the fertilization effect of CO_2. Further, our results suggest that Mediterranean forests would not resist the stressing conditions of a much warmer climate unless species exhibited an exaggerated C fertilization effect.

TROPOSPHERIC OZONE AFFECTS THE CARBON CYCLE BALANCE BY PLANT SPECIES-DRIVEN LITTER DECOMPOSITION RATES

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Litter decay is an important component of the nutrient cycling process in forest ecosystems. The rate of litter decomposition is influenced by several factors including moisture, temperature and nature of the microorganisms and soil fauna active in the decomposition process. Substrate quality has also long been considered a critical factor in determining rate of decay; lignin content of the litter exerts more control over the rate of decomposition than does nitrogen. Furthermore, litter decomposition rates are affected by functional differentiation among species and the magnitude of species-driven differences is larger than previously thought and greater than climate-driven variation. In this framework, tropospheric ozone (O_3) is recognized as a significant phytotoxic air pollutant, and it is considered to be one of the most important factors affecting forest health. In this study, we used an O_3-FACE (Free-Air Controlled Exposure) structure, in order to quantify the effect of O_3 concentrations (ambient air and 1.4 x ambient air) on litter decomposition rates concerning leaves included in litter bags from three forest plant species *Quercus ilex*, *Q. pubescens* and *Q. robur*. Results demonstrates different leaf biomass reduction among species under O_3 fumigation (about -23%, -40%, -43% in *Q. robur*, *Q. pubescens* and *Q. ilex* respectively. O_3 reduced decomposition rates in *Q. robur* (-32%) and in *Q. ilex* (-12%) but increased them in *Q. pubescens* (7%). Decomposition rates were affected by trends in lignin and cellulose, which were different for these species. These preliminary results confirmed that the decomposability of a species' litter is consistently correlated with species' ecological strategy (Mediterranean vs. Continental forests) and the role of species-driven litter decomposition rates could have great impacts on the Carbon Cycle balance at plant community level.

ARTIFICIAL STREAMS FOR EVALUATING THE RESILIENCE OF BENTHIC INVERTEBRATE COMMUNITIES TO DROUGHT IN ALPINE AREAS (FERSINA RIVER BASIN, TRENTO, NE ITALY)

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In temperate streams, macroinvertebrate distribution in the riverbed is strongly related to the variation of CPOM availability, and leaf breakdown studies have recently been used to assess the functional integrity of streams at the ecosystem level. Over the last decades, alpine streams have been shifting from permanent to temporary systems due to the combined effects of global change and human pressures, and droughts are at present one of the most relevant threats for these lotic ecosystems. However, the impacts of droughts on aquatic communities and ecosystem processes have been poorly assessed through field studies, because drying conditions in alpine areas are usually unpredictable and mixed with several co-occurring confounding factors. Hence, we used a set of semiartificial flumes where each variable can be precisely isolated and manipulated. We investigated the effects of droughts of different length on leaf breakdown and on macroinvertebrates functional feeding groups (FFG) abundance and composition in an Alpine non-glacial stream. We simulated a 20 days drought-rewetting-drought cycle in one flume, and a 60 days drought in a second flume, collecting every 20 days from 20 October 2016 (20 days pre-simulation) to 30 January 2017 (20 days post simulation). We deployed 50 packs of 3.0 ± 0.1 g leaves of European beech in each flume, and collected 10 leafpacks randomly on each sampling occasion. We sorted and identified all the benthic invertebrates, and classified them as FFG. The leafs were then used to calculate leaf pack mass loss, and nitrogen and carbon contents. Results show that droughts cause a delay in leaf matter degradation and a decrease in the abundance of all FFG, and that the interruption of the drought with a rewetting period does not have any mitigation effect. Hydrological intermittence significantly slows the input of allochthonous organic matter into the system, and alters the functional feeding group assemblages.

SECONDARY DRAINAGE CANALS HAVE THE POTENTIAL TO MITIGATE EXCESS NITROGEN LOADS IN THE PO RIVER BASIN

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Secondary drainage canals have the potential to effectively mitigate nitrogen loads from diffuse and point sources. In vegetated (*Phragmites australis*, *Typha* spp., *Glyceria* spp., *Typhoides arundinacea*) and unvegetated canals subjected to diffuse and point pollution, nitrogen removal was evaluated by means of reach-scale methods (N_2 open-channel, upstream–downstream N budgets) coupled with laboratory incubations of sediment cores (benthic N fluxes, isotope pairing) and plant N uptake estimation. Studied canals were representative of the two main categories of waterways in the Po River basin, the drainage ditches of the lowland and the irrigation ditches typical of the middle plain, often fed by nitrate-rich spring water. Results were coherent among treatments and sites, indicating an elevated N removal in sediments colonised by emergent vegetation (1.5-5 kg N $km^{-1}d^{-1}$) receiving diffuse and point sources of pollution, whereas N dissipation processes were much less effective in unvegetated canals. The importance of vegetation is related to the fact that provides multiple interfaces (e.g. rhizosphere and epiphytic biofilms) that promote the development and activity of bacterial communities responsible for N removal via denitrification. The upscaling of the experimental results to the whole hydrological network by a GIS analysis allowed to evaluate the effectiveness of N removal processes at the basin scale and the comparison between net abatement in vegetated and unvegetated conditions. Our data provide multiple evidences of the possibility to efficiently control N excess in a worldwide hotspot of eutrophication, by the sole ecosystemic function of denitrification in the secondary drainage network. We simulated also two temporal scenarios, before and after the introduction of mechanical vegetation mowing, which rise a new interpretation and discussion on the causes of eutrophication in the northwestern Adriatic Sea.

EVALUATING SEAGRASS RECOLONISATION PROBABILITY IN THE LAGOON OF VENICE: AN INDIVIDUAL-BASED MODEL APPROACH

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Changes in the physico-chemical properties of an environment can cause stenotolerant species to die-off, resulting in abrupt ecosystemic shifts. Starting from the 1970s, eutrophication induced the decline of seagrass meadows in the Northern Venetian Lagoon, causing the local ecosystem to become algae-dominated. After a decrease in the concentration of nutrients, the confinement of the area prevented natural reversion to pre-disturbed conditions, as seagrasses failed to recolonize the area due to the lack of biologic primers. Project LIFE-SeResto aims to trigger a re-colonization through extensive transplant of native seagrass species in the Northern Lagoon of Venice. In this work we compare different scenarios of development of seagrass meadows, under conditions representative of the project's transplant sites, aiming to derive indices of likelihood of success in seagrass establishment. To achieve this goal, a new numerical model was developed. This is rooted on an individual-based (IB) clonal growth approach, able to represent explicitly the spatial development of seagrass patches. The model accounts both for clonal growth and sexual reproduction. The plant's growth is forced by irradiance and temperature, while the concentrations of N and P are used to simulate the competition with macroalgae. The IB approach was preferred to traditional population models for its capability to deal with extremely low initial biomasses (single sods or rhizomes), and its high spatial resolution. Simulation results were first compared with the available in-situ data on patch development acquired within project SeResto. The model was later used to explore the likelihood of restoration success under different scenarios. This approach could provide supporting information for highlighting which sites will require management in the future, with periodical transplants of new sods, also informing other re-naturalisation projects, in order to transfer the site-specific results to other systems.

NULL MODEL ANALYSIS OF PRESENCE-ABSENCE BINARY MATRICES IN A BI-DIMENSIONAL SPACE

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The most popular approach to identify non-random structural patterns in binary presence-absence matrices (representing either species occurrences in a set of sites, or species interactions) is that of comparing the observed degree of structure with that of a series of randomized (i.e. null) versions of the original matrix. However, the choice of a particular null model over another can strongly affect the outcome of the analysis, and possibly lead to contrasting results. This makes it often advisable to use several different randomization procedures. Yet, available randomization algorithms are based on very different, and somehow 'extreme', ecological assumptions that, in turn, control the mismatch between observed matrix and its null counterparts. This calls for new strategies both to explore intermediate scenarios of restrictiveness in-between extreme constraint assumptions, and to properly synthesize the resulting information. Here we present a new null modeling framework that tackles both issues, by permitting researchers to explore the complete null space delimited by existing algorithms, and to visualize matrix structural patterns in an innovative bi-dimensional landscape of significance/effect size. The simultaneous investigation of a comprehensive (and continuous) portion of the null space can be extremely informative, and possibly key to resolving longstanding debates in the analysis of ecological matrices.

A MULTIDIMENSIONAL NETWORK MODEL FOR THE SPATIAL DYNAMICS OF SCHISTOSOMIASIS

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Schistosomiasis is a parasitic, water-related disease that is prevalent in many tropical and subtropical areas of the world, causing severe and chronic consequences especially among children. Infection in humans is caused by contact with water infested with schistosome larvae (cercariae) that are shed by some species of freshwater snails; infection in snails, in turn, is caused by another larval stage of the parasite (miracidia) that hatches from eggs released by infected human hosts. We study the spatial spread of schistosomiasis within a network of connected villages in the endemic region of Saint Louis, Senegal, in the Lower Basin of the Senegal River. The analysis is performed by means of a spatially explicit metapopulation model that couples local-scale eco-epidemiological dynamics with spatial mechanisms related to human mobility (estimated from anonymized mobile phone records), snail dispersal and hydrological transport of schistosome larvae along the main water bodies of the region. Results show that the model produces epidemiological patterns consistent with field observations, and point out the key role of spatial connectivity in the spread of the disease. These findings underline the importance of a spatially explicit ecological approach for the design of effective strategies for the control of schistosomiasis transmission.

BENEFITS OF ICP-QQQ WITH MS/MS OPERATION FOR ROUTINE ENVIRONMENTAL ANALYSIS

Carcano A.

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Many toxic elements such as As, Hg, Cd, Pb etc. are routinely monitored to ensure environmental safety, while minerals that are beneficial/essential to human health are also measured.
Some analysis applications require greater sensitivity for specific elements, while some complex sample matrices may cause spectral interferences that remain a challenge for ICP-QMS. For example, doubly charged ions of some rare earth elements (REEs) appear at the same mass as key analytes, hindering accurate low-level measurement of arsenic (As) and selenium (Se) in some sample types. In some cases related to different elements for example As which is a well-known toxic element or Se which is an essential element that can be toxic if in excess. As and Se can suffer spectral interferences from polyatomic ions including ArCl+, CaCl+, ArAr+, S2O+, SO3+, GeH+, and BrH+.However, He mode is not effective against doubly-charged ion overlaps. The lanthanides or rare earth elements (REE) can form doubly charged ions (REE++) which overlap As and Se. These doubly-charged overlaps can be avoided using mass-shift mode with O2 as the reaction cell gas. In this mode, the analytes are measured as reaction product ions 75As16O+ and 78Se16O+, mass-shifted to m/z 91 and 94 respectively, where they are free from the original REE++ overlaps. This reaction chemistry can be used in the CRC of an ICP-QMS, but existing ions from the plasma may overlap the newly-formed product ions; e.g. 91Zr+ on 75As16O+, and 94Mo+ on 78Se16O+. To ensure controlled and consistent reaction chemistry, MS/MS mode on an ICP-QQQ is required, where the first quadrupole (Q1) operates as a mass filter set to the appropriate As+ or Se+ precursor ion mass. Q1 rejects all other masses, thereby removing the existing Zr+ and Mo+ ions and preventing them from overlapping the new analyte product ions.

WETLAND AND MARINE VASCULAR PLANTS AS BIOINDICATORS OF HEAVY METALS: A COMPARATIVE ASSESSMENT

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The present study investigated the levels of As, Cd, Cr, Cu, Hg, Mn, Ni, Pb and Zn in the seagrasses *Posidonia oceanica* and *Cymodocea nodosa*, and in the wetland macrophytes *Phragmites australis*, *Arundo donax*, *Typha domingensis*, *Apium nodiflorum*, and *Nasturtium officinale*. Results showed that the bioaccumulation capacity from sediments, translocation, total levels in plant tissues, and bioindication of metals in sediments, are generally species-specific. In particular, the patterns of metals in the aquatic plants studied were overall independent of ecology (coasts vs wetlands), biomass, anatomy (rhizomatous vs non rhizomatous plants), and life form (hemicrytophytes vs hydrophytes). However, marine phanerogams and wetland macrophytes shared some characteristics such as high levels of heavy metals in their below-ground organs, similar capacity of element translocation in the rhizosphere, compartmentalization of metals in the different plant organs, and potential as bioindicators of Cu, Mn and Zn levels in the substratum. In particular, the present findings indicate that, despite ecological and morphological similarities, different plant species tend to respond differently to exposure to heavy metals. Furthermore, this seems to result from the species individual ability to accumulate and detoxify the various metals rather than being attributed to differences in their ecological and morpho-anatomical characteristics.

DISENTANGLING PHYSICAL AND ECOLOGICAL DRIVERS OF PHYTOPLANKTON DYNAMICS IN THE GULF OF NAPLES (ITALY)

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Observatories of marine coastal plankton rely on Long Term Ecological Researches (LTER) conducted at fixed sampling stations. Observed changes in plankton assemblages at these stations depend on both time (e.g., species succession) and space (e.g., plankton patchiness) variations and the interplay between the latter components contributes in confounding the underlying drivers of phytoplankton dynamics. Here we carried out a proof-of-concept study at the LTER station MareChiara (LTER_MC) in the Gulf of Naples (Mediterranean Sea, Italy). The aim of this study was to i) characterize the spatial scales and the provenance of phytoplankton assemblages detected at LTER_MC and ii) dissect processes regulating phytoplankton dynamics. The approach used was integrating the surface current data from a high frequency (HF) coastal radar network with the fixed-point plankton time series at LTER_MC. Despite the strong cross-shore biomass gradients, the phytoplankton community detected at LTER_MC generally originated from the coast, whereas the offshore inflow marginally changed the main traits of phytoplankton assemblages. This suggests that the semi-enclosed Gulf of Naples tends to retain the same communities via coast-ward circulation, especially during summer. Nonetheless, the occasional appearance of offshore species can promote diversity maintenance and, although rarely, sweeps in species dominance. The remarkable resilience of coastal phytoplankton communities may favour their persistence over time and the prevalence of species successions over small time and space scales. Our findings provide a conceptual framework for the physical–biological interactions taking place in coastal basins, which can be generalised to other areas, and point out the usefulness of integrative (physical-ecological) approaches in plankton observatories.

RESPONSE OF BENTHIC INVERTEBRATE METRICS TO RIVER LENTIC-LOTIC CHARACTER: IMPLICATION FOR ECOLOGICAL ASSESSMENT EVALUATION

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The Water Framework Directive 2000/60/EC (WFD) has defined the guidelines for the assessment of ecological quality of watercourses. In the context of the classification of the ecological status (sensu WFD) biological elements are recognized as key features, but it is also acknowledged that the hydromorphological elements, and thus habitat characteristics, play a central role in the interpretation of biological data. For example, it was demonstrated that the proportion of lentic and lotic habitats (quantified through the LRD: Lentic-lotic River Descriptor) is particularly relevant, especially in the Mediterranean area, in structuring macroinvertebrate communities. During the LIFE+ INHABIT project (LIFE08 ENV/IT/000413), models relating biological metrics used for the classification of the ecological status with the lentic-lotic character (LRD) in the Sardinian rivers were developed. In order to deepen the study of this project, this correlation was explored in other Italian geographic areas, such as the Northern Apennines, the Southern Apennine and the Western Alps. More than 50 mainly undisturbed river reaches were investigated. Invertebrate were collected with multi-habitat, proportional sampling and habitat/hydromorphological information with CARAVAGGIO method. Linear and polynomial regression models were used. Results showed that all biological metrics used for official classification in Italy (D.M. 260/2010) are influenced by the lentic-lotic character of rivers. In the presence of a sufficiently long LRD gradient, the relation between the biological metrics and the lentic-lotic character was polynomial. Such results suggest that, in the absence of significant water withdrawal, it is necessary to correct reference values for biological metrics in ecological status evaluation to limit the influence of climatic/seasonal variations. This information will also help quantifying the effects of flow rate reductions and water withdrawals.

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POSTER

FAVOURABLE REFERENCE VALUES: A VALUABLE TOOL FOR CONSERVATION

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The accomplishment of a Favourable Conservation Status (FCS) for habitats and species is one of the main biodiversity goals advocated by the EU legislation, under the Habitats Directive (HD, 43/92/CEE). FCS is a legal concept that must be understood and applied by scientists, managers and policy makers to ensure effective conservation of HD species. Therefore, measurable parameters called Favourable References Values (FRV) have been identified by EU guidelines as tools for assessing FCS. The guidelines now describe a specific methodology to set FRVs, but examples of application to plant and animal species are rare. Here, we summarize the step-by-step process to define FRVs and we verify its consistency for butterflies. Butterflies are good model organisms because their taxonomy is relatively stable, their ecology and biology are generally well known and methods for assessing their population dynamics are standardized. Our Country has a crucial role in their conservation since 16 out of the 29 European HD butterfly species occur in Italy. Among them we focus on the flagship species, *Parnassius Apollo* for which, as for many other HD species, quantitative knowledge is limited. To set FRVs for *P. apollo*, occupancy modelling techniques based on presence data could be an appropriate tool, but the model parameterization may represent a critical step. Also, the resulting (meta)population values must be compared to data gathered independently through optimized, cost-effective monitoring schemes. The proposed procedure to define the FRV for this species must be analysed critically, as it should yield robust results, concurrently comparable to actual abundances and ranges. So, the 'How to' guide is actually ready for turning FRVs into valuable conservation tools: managers and scientists must grasp the opportunity and meet the challenge to appropriately customize it, using effective methodologies and data collection protocols.

IMPACT OF FLOW INTERMITTENCY ON FISH POPULATIONS OF THE UPPER PO RIVER

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Droughts are among the emerging and most worrying environmental problems, as they have increased in both frequency and intensity over the last decades, reaching areas previously not affected by hydrological intermittence, such as prealpine streams. This increase is due to phenomena acting at different scales, from global climate change to morpho-hydrological alterations caused locally by human activities. In addition to data from some lotic systems of Piemonte (NW Italy), we present here the results of a sampling campaign performed in the upper Po river along a gradient of hydrological conditions. This reach is part of the PRIN NOACQUA sampling areas. We selected eight stations (from Paesana to Cardè, CN) characterized by different levels of hydrological scarcity. The withdrawal of surface running waters in the summer months (and sometimes even during the winter) results in a drastic impact on the ichthyofauna. Fish communities of the hydrologically permanent sections maintain a relatively good level of biodiversity and taxonomic richness, while those of intermittent reaches (o sections) seem impaired, destructured and banalized. In particular, we found evident structural alterations in these latter, with the total absence of immature stages. Recurring drought events seem not to compromise water quality while playing a significant impact on fish community. The importance of this study is enhanced by the fact that rare and threatened species, with particular conservation interest, still survive in this area, such as the grayling (*Thymallus thymallus*) and the Marble trout (*Salmo marmoratus*).

FINE SEDIMENTS AND BENTHIC COMMUNITIES IN ALPINE STREAMS

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We present here an overview of our studies performed on Italian Western Alps streams regarding the response of macrobenthos to allocthonous fine sediments. Global climate change and local alterations in stream morpho-hydrology are responsible for the increase of unnatural fine sediment accumulation (i.e., siltation), which is recognized as one of the strongest impact in Alpine streams. Our main objective was to test the sensitivity of several metrics based on macroinvertebrate assemblages, exposed to different source and intensity of siltation. In this context, although specific indexes have been recently developed, their routinely and large-scale applicability appears limited by some aspects, including the systematic resolution and the context in which they were developed. Here we combine a dataset coming from a manipulative experiment with controlled siltation and from two study cases where siltation derives respectively from mining and from reservoir sediment flushing. From the controlled siltation experiment we measured twelve candidate metrics, including taxonomical, structural as well as functional ones. Each metric was calculated both at family level and at a mixed level (family and genus). The selection of the best combination of metrics was statistically performed with an information-theoretic approach. Then, results from real case studies affected by heavy siltation were used as independent dataset for testing the performance of the selected metrics. The resulting most sensitive metrics were then aggregated into a multimetric index in the validation dataset. We observed high correlations between index values and the quantity of fine sediment for both taxonomic levels, especially for the mixed level index. The findings of this study provide useful tools for biomonitoring the effects of fine sediment in low order, mountainous streams and contribute to improve our diagnostic ability concerning stressor-specific alterations.

BIOFOULING IN A MARINA OF THE NORTH ADRIATIC SEA: 1 YEAR STUDY

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Recreational harbours have more floating substrate than commercial harbours and often form semi-enclosed basins. These conditions can facilitate the settlement of fouling species and influence the community structure. Information on biodiversity and the succession of fouling in this environment are still scant, particularly for the Adriatic Sea. To fill this gap, a one-year study of temporal and spatial patterns of fouling diversity and biomass was conducted in an Adriatic harbour. To assess the effect of the sheltered location in the harbour, the biofouling community was compared to a community at the open end of the harbour. From September 2015 to September 2016, a set of 36 FOREX panels (15x15cm) each was submerged at 1 m depth at the inner and the outer part of the harbour of Marina Dorica (Ancona, Italy). Three panels were collected monthly from each site. Total wet weight of biofouling organisms on panels was recorded and the present species were identified. The fouling assemblage was composed by eight groups: algae, sponges, cnidarians, bryozoans, molluscs, polychaetes, crustaceans and ascidians. All groups were represented at both sites after 4 months of immersion, with exception of the settlement of bryozoans, which was delayed by 3 months in the inner harbour. Species composition and biomass did however differ between inner and outer harbour. Of the total 58 species recorded, 56 were found in the outer harbour, while only 41 settled in the inner harbour. The biomass was highest in the outer harbour, with maximum biomass accumulation at the end of the experiment (304.7±91.2 g per panel,±SE).The major contributor was the mussel *Mytilus galloprovincialis*. Contrastingly, biomass in the inner harbour peaked in June (59.3±35.3 g per panel) and was dominated by the tunicate *Ciona intestinalis*. Our study suggests that biofouling in this Adriatic Marina is influenced by the location in the harbour, showing similar patterns as seen in other recreational harbours.

HOW HABITAT STRUCTURE AFFECTS NEKTON FAUNA IN SEAGRASS MEADOWS: IDENTIFYING SUCCESS CRITERIA FOR SEAGRASS RESTORATION IN THE VENICE LAGOON

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One of the major challenges to ensure effective restoration of estuarine habitats is to establish success criteria, allowing to determine whether the objectives of restoration are met. In the northern basin of Venice lagoon (northern Adriatic Sea, Italy), the LIFE project "SeResto" started in 2014 aiming at restoring seagrass meadows by means of small-scale manual transplantation of sods and rhizomes. The interventions are expected to increase the coverage of *Zostera marina* and *Z. noltei* in the area, and to subsequently restore the typical features of faunal assemblages associated with seagrass meadows. The aim of this work is to set success criteria for nekton (fish, decapods and cephalopods) in seagrass meadows, to be used in future evaluation studies. Habitat features that might affect faunal distribution, and nekton species positively responding to desired restoration outcomes were therefore identified, considering a set of natural meadows as reference sites. Nekton sampling took place during spring 2016 at five natural seagrass sites in the northern Venice lagoon. Physico-chemical water parameters and habitat structure (seagrass percent cover, canopy height, shoot density, leaf area index and epiphytal load) were also recorded. A multivariate approach based on GLMs was adopted, in order to disentangle the relative effect of water quality and seagrass habitat structure on nekton assemblages. The analysis highlighted that desired restoration outcomes, i.e. presence of *Z. marina* and *Z. noltei* and greater seagrass coverage, are positively linked to presence and density of some pipefishes (Syngnathidae), large gobies (Gobiidae) and some shrimps (Palaemonidae) in the nekton assemblage. Such components were then identified as indicators of success of seagrass restoration; as a future step of the work, they will be used to evaluate if success criteria for nekton fauna are met in transplantation sites of the northern Venice lagoon.

COLD-WATER CORALS PROVIDE ESSENTIAL FISH HABITAT FOR FISH SPECIES

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Essential Fish Habitat (EFH) are bodies of water and substrate required for fish spawning, breeding, feeding, and a place they can grow to maturity. Cold-water corals (CWC) form one of the most complex biological habitats where they act as substrates presumed to serve as shelter, feeding, and spawning sites for different other species. Even if many studies were conducted on CWC, the exact relationship between them and fish is not still clear. Therefore, the knowledge of a functional role that would qualify CWC as EFH in support of their protection is rather scant. Here, we provide evidence of the utilization of CWC by fish as area for growing to maturity. Using experimental longlines during the spring-summer and autumn-winter seasons, between 2010 and 2014, we collected mature individuals of six commercial fish, *Galeus melastomus*, *Conger conger*, *Helicolenus dactylopterus*, *Merluccius merluccius*, *Pagellus bogaraveo* and *Phycis blennoides*, in two CWC habitats, Santa Maria di Leuca CWC province and Bari Canyon. The presence of maturing and mature individuals as well as post-reproductive individuals were mostly found in *G. melastomus*, *H. dactylopterus* and *M. merluccius*. These 3 maturity stages showed an average percentage in the two investigated areas equal to 93% in *G. melastomus*, 71% in *H. dactylopterus* and 74% in *M. merluccius*. Even if the investigated period did not coincide exactly with the reproductive period, mature gonads were also found for the other three species, indicating that these CWC sites acts as spawning areas and therefore as potential 'renewal network' for the fish populations. This provides a strong argument for the categorization of CWC as EFH in the design of management programs.

FISH EGGS AND LARVAE AS INDICATORS OF SEA-LAGOON CONNECTIVITY

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For many species of marine fish, the sea-lagoon connection is a key element of their life cycle, in particular for those belonging to the guild of the juvenile marine migrants (JMM) that use transitional water ecosystems as nursery grounds. On the sea inlets of the Venice lagoon, a system of mobile dams (MO.S.E.) that will temporarily interrupt the connection between the sea and the lagoon during exceptional high tide events is under construction and is going to be completed by 2019. Aim of this study is to monitor the connectivity between the sea and the lagoon of Venice, to evaluate possible future impacts of the MO.S.E. functioning. Seven sites along three sea-lagoon transects, one for each sea inlet, have been sampled with bongo nets four times along the winter-spring migration of JMM species, from November 2015 till April 2016 and from November 2016 till April 2017. Fish eggs and larvae were sorted and identified, at least at the family level. Overall, 25 taxa were identified: 8 belonged to the guild of juvenile marine migrants, all but 2 found both as eggs and larvae. MM species were 55.2% of the eggs and 80.9% of the larvae. Of this proportion, 84.4% of the eggs and 94.4% of the larvae were clupeids, mainly *Sprattus sprattus*. Overall, higher densities of eggs were found in the first year of monitoring respect to the second one, but in both cases lower egg density was observed inside the lagoon. Considering only the JMM guild, these differences disappear. For the larvae, significantly higher densities were found in the second year, mainly due to the contribution of *Sprattus sprattus*, while no differences were observed between the sea and the lagoon. The monitoring activity, if carried out in the next years till the completion of the MO.S.E., will provide a consistent baseline of information about JMM migration in the Venice lagoon, allowing to use the ichtyoplankton as indicator of sea-lagoon connectivity in relation to mobile dams functioning.

THE ROLE OF THE SCLERACTINIAN-ASSOCIATED HYDROZOANS ON CORAL HEALTH

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Scleractinian reef corals have been acknowledged as the most numerous host group for associated hydrozoans belonging to the genus Zanclea. However, the benefits and costs of this symbiosis are still not clear. Although trophic and/or protection mutualism seems a plausible explanation of the association, a possible relationship between the occurrence of hydrozoans and coral diseases has also been proposed. The objective of this study is to test if Zanclea hydrozoans significantly influence the health of the reef-building corals. To do that, we test the relationship between the occurrence of Zanclea hydrozoans on corals in relation to different colony conditions: healthy, stressed (bleaching, algae overgrowth, fishes and gastropods feeding scars), and diseased (WS, SEB, BrB, BBD). Our preliminary field surveys revealed as the association is widespread in the coral communities of Maldives and Red Sea. A total of 29 scleractinian genera were found in association with Zanclea hydrozoans. The overall Zanclea-scleractinians prevalence resulted high in the coral reefs, but no significant differences were observed between scleractinian genera and coral communities. Furthermore, no positive implications were found for both diseases and stressed corals, although a positive effect against predation (fish bites and Drupella sp.) was observed for scleractinians hosting Zanclea. In conclusion, the potential implications of the hydrozoan–scleractinian symbiosis for coral health, its wide distribution, and the number of species it involves indicate urgent need for further investigations.

CLIMATE CHANGE AND MACROBENTHOS COMMUNITY RESILIENCE IN DELTAIC AREA OF PO RIVER

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Climate changes affect species abundance and distribution through altering the abiotic conditions where they live. One of the most relevant alterations for transitional aquatic ecosystems concerns salinity levels (Day et al., 2009). Evaporation-related effects alter the relations within the catchments, particularly those involving surface, ground waters and salt wedge intrusion (Oude Essink et al., 2010) in deltaic areas. Wetlands in transitional zones are important buffer systems (Day et al., 2008). Their macrobenthic communities need high resilience to overcome salinization phenomena, that occur with increasing frequency in recent years and vary according to seasonal patterns. The aim of the present study is to evaluate the change in biological traits of macrobenthos communities, in a pond system inside a deltaic forest (Bosco della Mesola, Northern Italy) during a 1998-2017 period, as a consequence of increased salinity. Moreover, variations of biological traits along a salinity gradient are described. 17 ponds were sampled with a Surber net in March and June of 1998 and 2017, corresponding to low and high salinity levels, respectively. During the time considered, the community structure suffered a strong simplification, particularly, in ponds with high salinity levels. Those was found to switch from insect-dominated (Plecoptera and Ephemeroptera) to Chironomids-dominated communities. Before the salt wedge ingression, the community was characterized by species with medium and long life span and walker type mobility, to switch to short life span and swimmer mobility. Community of salt ponds have flying adult life and are mainly deposit feeders with borrower mobility, while freshwater ponds are characterized by species with aquatic adult life, swimmer mobility and shredder trophic role. Therefore, resilience seems to be associated with specific biological traits, as faster biological cycles, and the loss of higher trophic level (predators).

THE EFFECT OF FOREST MANAGEMENT ON ENDANGERED INSECTS ASSESSED BY RADIO-TRACKING: THE CASE FOR THE GROUND BEETLE CARABUS OLYMPIAE IN BEECH *FAGUS SYLVATICA* STANDS

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Beech forests are important for biodiversity conservation in Europe and studies to identify sustainable forest management practices are therefore required. The ground beetle *Carabus olympiae* Sella, 1855, may be the symbol of the endangered alpine species with very restricted ranges. This steno-endemic, large species inhabits two beech forests of the western Italian Alps where beech wood is still harvested. Forty-one alive individuals were collected and radio-tracked in 2014-2015 in order to assess the effects of forest management on microclimatic conditions they have to endure, habitat use and movements. All interventions changed habitat availability, with an increase of deadwood and bare ground. Thermo/hygro button loggers showed that temperature was higher and humidity lower in managed than in unmanaged stands, suggesting logging interventions may be detrimental to *C. olympiae*, directly (inducing suboptimal climatic conditions) or indirectly (decreasing the availability of prey). Habitat selection analyses proved that in all scenarios deadwood and stumps were the preferred habitats, used as refuge or shelter during the daytime. Bare ground was never used. The length of the path travelled by individual insects was more variable and the tortuosity lower in managed than in unmanaged stands, suggesting that management induced more uncertain and constrained trajectories. We concluded that logging may exert short-term negative effects on *C. olympiae* ground beetles (as suggested by the increase of bare ground, and changes in climatic conditions and movements). However, the preference for stumps and deadwood suggests that forest management, concurrently, may also be beneficial, on the condition that: i) the coppice, which provides more suitable stumps, prevails over conversion to high forest and ii) deadwood originated from cutting (slash and tops) is properly accumulated.

BIODIVERSITY LOSS IN ALTERNATIVE STATES IMPAIRS ECOSYSTEM FUNCTIONING AND EFFICIENCY IN THE CYSTOSEIRA SP. MEADOWS OF THE MEDITERRANEAN SEA

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In the Mediterranean Sea hard-bottom macroalgal meadows may switch to barrens grounds, as a result of sea urchins overgrazing. These are less-productive systems that display a very low if any resilience and represent an alternative state of the system. Previous studies reported low meiofaunal and nematode biodiversity levels in barren states across the Mediterranean Sea, as a result of habitat loss/fragmentation, associated also with a lower availability of trophic resources. In this study, we analyzed the relationship between biodiversity and ecosystem functioning in six areas of the Mediterranean Sea (Minorca, Sardinia, Capraia, Sicily islands, Croatia and Montenegro). All variables related to ecosystemic functioning (meiofaunal biomass and degradation rates of organic matter), as well as those related to ecosystem efficiency (nematode to microbial biomass, microbial biomass to C decomposition rate, and meiofaunal biomass to predators biomass ratios) showed lower values in barrens than in the Cystoseira sp. meadows, in all the study areas. The biodiversity of these systems was significantly and positively linked to their functioning. These results were consistent in all of the investigated areas, irrespectively of the barren extent and characteristics, suggesting that the degradation of biodiversity due to the loss of habitats provided by macroalgae meadows can cause a significant reduction of the ecosystem functioning. Since barren grounds are expanding rapidly along the Mediterranean Sea and meiofauna are a key trophic component in marine ecosystems, we suggest that the extension and persistence of barrens could also affect higher trophic levels.

DIATOMS PREFER STRANGERS: DIFFERENCES IN EPIZOIC DIATOM COMMUNITIES COLONIZING SYMPATRIC ALLOCHTHONOUS AND AUTOCHTHONOUS CRAYFISH

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In this study, we examined the occurrence of epibiont diatoms on two sympatric crayfish species, the autochthonous *Austropotamobius pallipes* and the allochthonous *Pacifastacus leinusculus*, both in terms of chlorophyll-a concentration and community composition. Interestingly, we detected a significant difference in the chlorophyll-a amount on the exoskeleton of the two species. The signal crayfish showed on average a far more productive epizootic algal community than the white-clawed crayfish, considering diatom chlorophyll-a amounts. This finding was confirmed by microscopical analysis that evidenced a rich and diversified diatom community hosted by the allochthonous species, while virtually no diatom grew on the autochthonous one. Because the two populations coexisted in the same river section, it is likely that these evident differences are the consequence of some biological/ecological differences of the two crayfish species. Among different possible causes (e.g., exoskeleton structure, molting), we hypothesize that this could be related to different behavioral habits. In fact, *P. leinusculus* have a prevalent diurnal activity, while *A. pallipes* spends the light hours sheltered under boulders or other refugia. This different exposure to light obviously can have a significant impact on the growth of epizoic algal populations. Some considerations on the diatom flora on signal crayfish are reported, including comparisons with natural epilithic flora. Understanding the epizoic diatom diversity and distribution on allochthonous freshwater crayfish could lead to a sounder understanding of the ecological roles that these species perform, also because they can act as hosts and vectors of extremely interesting algal species such as the bloom forming Didymosphenia geminata.

THE MANAGEMENT PLAN OF *AUSTROPOTAMOBIUS PALLIPES* IN TRENTINO: PRIORITIES FOR CONSERVATION

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The management plan of *Austropotamobius pallipes* in Trentino (Italy, Central Alps) provides a global approach to the conservation and restoration of native crayfish, a species whose distribution in Trentino has become patchy and greatly reduced in the last 50 years, due to the decline of their habitat, and the introduction of alien species which carry the crayfish plague. The management plan of A. pallipes was developed in 2017 under the patronage of the Provincia Autonoma di Trento - Servizio Sviluppo Sostenibile e Aree Protette [Trento Autonomous Province - Sustainable Development and Protected Areas Office]. The plan addresses: 1) monitoring methods for habitats and populations, with interventions and activities which differ according to the status of the populations (stable, extinct in recent times, reintroduced); 2) conservation and restoration of populations and their habitats in selected areas, with different actions (creation of multipurpose ponds, source areas; rearing and reintroductions); 3) monitoring and control of alien species and their transmissible diseases (e.g. crayfish plague); 4) creation of a database and website for the management of distribution data, and for the collection of records from sensitive categories; 5) involvement of angler associations for monitoring and rearing activities; 5) citizen science activities for updates on crayfish distribution using a dedicated website linked to smartphone applications; 6) dissemination.

MEDITERRANEAN TEMPORARY PONDS: AN EXAMPLE OF NEGLECTED HABITATS FROM LATIUM (CENTRAL ITALY)

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Beyond the great diversity of wetlands and although most of them are preserved and inserted within the Habitat Directive (code 3170*), the Mediterranean Temporary Ponds (MTPs) represent to date an example of neglected habitat. Despite their 'temporary' but cyclical existence, MTPs are important habitat recognized as biodiversity hotspots and ecological corridors for many plants and animals. MTPs have a large variability in the hydroperiod duration, depending on the rain period beginning and intensity and the substrate structure and geological properties. Indeed, the permeability and the slope of the substrate determines the water amount. These hydroperiod changes have significant effects on temporary waters, and may alter the biotic interaction patterns. Climate change, proximity of urban areas, intensification of agricultural activities, expansion of tourism and their scattered and isolated distribution (habitat fragmentation), make MTPs very vulnerable habitats. So, contributing to manage and preserve these habitats means to evaluate the conservation status, and the first step is to improve the knowledge on their distribution within the national territory. Here we propose preliminary results on the MTPs occurrence within the coastal area of Latium (central Italy). Specifically, we monitored, georeferenced, and calculated the area of all ponds within 1.5 km from the coastline in early spring (March and April 2017) and summer (July 2017). Additionally, we confirmed their temporariness by exploiting the temporal geographic information system of Google Earth as well. On the whole, we found 135 ponds, 68 permanent ponds and 67 MTPs, the latter always with a surface of less than 3 ha. Despite the typical plant and animal multi-species assemblages, we also observed some strictly halophytic species such as *Salicornia europea* and *Ruppia maritima* (occurrence of which depended on sea distance) and nuisance elements such as the North American crayfish *Procambarus clarkii*.

WILD BEES OF THE DUNES: FIRST RECORD OF *LASIOGLOSSUM LITTORALE* (BLÜTHGEN 1924) IN AN ITALIAN PROTECTED AREA AND EVALUATION OF POTENTIAL COMPETITION WITH HONEYBEES

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Wild bees (Hymenoptera, Apoidea) are raising an increasing interest in the last years, due to their role in both maintaining wild vegetation and pollinating cultivated crops, the possible competition with honeybees, and their biodiversity per se. However, more than half of wild bees species are considered "Data Deficient" in the IUCN European Red List of Bees, and almost 10% are threatened with extinction. The aim of this work was to investigate the occurrence and distribution of wild bees in the dune system of Migliarino, San Rossore, Massaciuccoli Regional Park (Tuscany) and their possible competition with honeybees, due to the presence of permanent apiaries very close to the dune system. In spring and summer 2015-17, we positioned pan traps and made observational transects in nine sites at growing distances (up to 2.5 km) from the apiaries, investigating the whole depth of the dune system. In 2015-16 traps were positioned once a month in three stations per site (84 traps per sampling event), while in 2017 only once to confirm the persistence of a rare Lasioglossum species identified in the previous samples. Transects were performed once a month in 2016, associated to selective captures by sweep net. Species were subsequently identified on morphological basis. The most common and abundant species was *Lasioglossum littorale* (Blüthgen 1924), a Near Threatened Halictidae species whose presence was not previously reported in an Italian protected area. This discovery is relevant because distribution, ecology, habitat and threats for this species are still largely unknown. The composition and abundance of Apoidea community was substantially homogeneous between sites: an overall low number of different species and of individuals per species was detected, irrespectively of the distance from the apiaries. This suggests that, at least in this case study, the occurrence of Apoidea species could be related to environmental factors different from the presence of the apiaries.

TREE-RING ANALYSIS HELPS EVALUATING THE EFFECT OF DUST-CLOUD DEPOSITION ON PINUS PINEA L. TREES AFTER SEVERE ANTHROPOGENIC IMPACT IN THE VESUVIUS NATIONAL PARK

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The Vesuvius National Park in the Campania Region (Southern Italy) sustains a high level of plant and animal biodiversity. The Park area is characterised by a trail network, subjected to severe anthropic impact due to intensive tourism especially in the spring and summer months. The continuous footfall along some areas such as the Big Cone, as well as the passage of vehicles along the Matrone Road, are responsible for the arising of dust clouds which deposit particles on plant surface. The severe deposition of dust particles on leaves can affect gas-exchanges and anatomical traits, thus affecting the availability of photosynthate for plant growth. The main aim of this study is to analyse whether the deposition of vehicle-rised dust on needles of Pinus pinea L. can induce changes in wood formation. Methods of dendroecology and wood anatomy on tree-ring series were applied with a specific focus on the last 6 years, corresponding to the period in which the traffic of vehicles has been increasing. The analyses were conducted on trees growing along the Matrone Road; trees were selected according to two positions: 1) one located along the side of the road, where a high deposition of dust (HDD) was recorded on needles, and 2) the second, in an inner area where plants were subjected to a very low deposition of dust (LDD) (control plants). Tree-ring growth and basal area increment chronologies of HDD and LDD trees were developed by coring and applying cross-dating techniques to ring-width series. Wood anatomical traits, such as tracheid size and wood density, were quantified. The overall analysis showed that HDD and LDD trees formed a different amount of wood also characterised by different density and conduit size, suggesting a different regulation of water flow especially in the latewood. Such findings can open a debate on the long-term effects of dust deposition on tree biomass production and vegetation dynamics, also considering that tree response can likely be species-specific.

AN INTEGRATED APPROACH TO MONITOR THE TWO MAIN RIVERS OF THE "CILENTO, VALLO DI DIANO E ALBURNI" NATIONAL PARK

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The Bussento and Calore Salernitano are among the most important rivers of the "Cilento, Vallo di Diano e Alburni" National Park. In order to develop informed and clever protection of these areas, a 3 year integrated monitoring is underway, combining physico-chemical water monitoring and biomonitoring. The analyses, performed with an average spatial resolution of 1.5 Km (21 sampling sites) and 3.0 Km (18 sampling sites) on the Bussento and Calore Salernitano, respectively, encompass 7 anions, photosynthetic pigments, dissolved oxygen, pH and conductivity in water, as well as 21 chemical elements both in water and in roots of two aquatic plants, Apium nodiflorum (L.) Lag. and Mentha aquatica L. Multivariate identification of spatial outliers, based on indicators of different pollution sources, is employed to identify critical sites and infer on the causes of environmental contamination. According to the results of the 1st year of monitoring, water had an overall outstanding quality in most of the areas at the sampling time, with localized pollution from wastewater discharges, metallic structures/wastes in the riverbed and sulfate leaching from agricultural soils in a few sites. Accumulation of Ni, Cd and Cr in plants sampled in the two springs, one in the Bussento and one in the Calore Salernitano, as well as accumulation of Fe, Mn and As in plants from one site of each river, were highlighted. Laterite inclusions within the carbonates forming the geologic substrate of the areas may account for Cr in springs, but not for Ni and Cd, or Fe, Mn and As, which have likely an anthropogenic origin. Anyway, environmental contamination appears to be extremely localized and with little ecological relevance at river scale.

INTERMEDIATE PLANTS IN SYMPATRIC PLATANTHERA ORCHID POPULATIONS: A CASE OF INTROGRESSION OR SELECTIVE PRESSURE?

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Platanthera bifolia and *P. chlorantha* are terrestrial and rewarding orchids with a wide Eurasian distribution. Although genetically closely related, they exhibit significant morphological, phenological and ecological differences that maintain reproductive isolation between the species. However, where both species co-occur, individuals with intermediate phenotypic traits, often considered as hybrids, are frequently observed. Here, we combined neutral genetic markers (AFLPs), morphometrics and floral scent analysis (GC-MS) to investigate two mixed Platanthera populations where morphologically intermediate plants were found. Self-pollination experiments revealed a low level of autogamy and artificial crossings combined with assessments of fruit set and seed viability, showed compatibility between the two species. The results of the genetic analyses showed the same genetic patterns of morphologically intermediate individuals with the *P. bifolia* group. These results are corroborated also by floral scent analyses, which confirmed a strong similarity in floral scent composition between intermediate morphotypes and *P. bifolia*. Therefore, this study provided a much more detailed picture of the genetic structure of a sympatric zone between two closely allied species and supports the hypothesis that intermediate morphotypes in sympatry could reflect an adaptive evolution in response to local pollinator-mediated selection.

ALIEN SPECIES: PROS AND CONS IN REMOVING THEM

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Invasive alien species (IAS) are universally known for being a controversial management issue. What makes IAS management a particularly thorny question is that although numerous studies document the negative effects of IAS, the potential benefits of IAS are generally underreported. This may result in wrong assessments on the real socio-economic and environmental impact of IAS. This study aimed to provide new insights to support the decision making of IAS management. In particular, the biased approach to IAS management seems to be a likely consequence of the lack of appropriate metrics able to assess the real IAS impact. A basic aspect of IAS management is to decide whether and when IAS removal is a suitable action. Specifically, this study supported the idea that IAS removal may be considered as a possible solution only after establishing a tipping point relying on economic, cultural and pragmatic evaluations. This analysis should include the identification of the ecosystem services damaged and provided by IAS, the attribution of an economic value to such ecosystem services, and when expressing the interaction between IAS and culture is not possible in monetary terms, then social values and cultural traditions should be incorporated in any management plan. Novel ecosystems are now a fact worldwide that should prompt to be realistic about the extent of efforts required for IAS removal. A significant step towards well- pondered decisions should consider that a change in host communities does not imply necessarily harm, and that the functional roles of a species matter more than its origins.

MACROINVERTEBRATE COMMUNITY RECOVERY ALONG WITH ALIEN FISH ERADICATION IN HIGH MOUNTAIN LAKES

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The introduction of game fish (i.e. salmonid) in originally fishless high mountain lakes can seriously affect their native fauna. Alien fish eradication has the potential to improve high mountain lakes ecosystems, and the extent of recovery may depend on their resilience capability. Here we describe the macroinvertebrate community resilience dynamics after a successful Brook trout (*Salvelinus fontinalis*) eradication campaign in 4 alpine lakes of the Gran Paradiso National Park, undertaken between 2013 and 2017 in the framework of the EU funded LIFE+ BIOAQUAE (Biodiversity Improvement of Aquatic Alpine Ecosystems, LIFE11 BIO IT 020) project. A comparison has been made between the 4 eradication lakes and 10 (5 fishless and 5 containing Brook trout) control lakes. Semiquantitative samples of macroinvertebrates were collected along the littoral accessible habitats, and taxa were identified at the genus/family level. Macroinvertebrates resilience was evident along and after fish removal. Many benthonic and nektonic macroinvertebrates (e.g. Heteroptera, Coleoptera, Trichoptera) rapidly recovered to densities comparable to those found for the naturally fishless lakes. These results show the high potential for resilience of macroinvertebrates community in high mountain lakes and encourage management and conservation authorities to undertake similar eradication actions.

MARINE ORGANISMS MODEL SPECIES FOR THE ASSESSMENT OF BIOLOGICAL, ENVIRONMENTAL AND ECONOMIC IMPACTS ON MARINE AQUACULTURE IN CAMPANIA

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In the last years food fraud are increasingly, both for agricultural and fishery products, making more difficult to preserve and enhance local products. The aim of this project is to use marine model species to study human impacts on the fishing economy in Campania, addressing the ecological and economical topics through taxonomical and molecular multi-approach. Here are presented the outlines methods used for the molecular analysis. Among mussels, the second breed marine species in Europe, with 15.5 % of total farmed species, we chose *Mytilus galloprovincialis* as model species. *M. galloprovincialis* is a sessile species widespread along the Mediterranean coasts, a filter feeder and bio indicator with a great ecological and economical value. Mussels individuals were sampled at different mussel farms in Campania, at their natural environment along the coasts of the Gulf of Naples and at the local fish market. The main aim is to genetically characterize the local mussel in order to assess the presence of cryptic and/or invasive species and to identify any food adulteration, such as the replacement of species. The mitochondrial Cytochrome Oxidase I gene (COI) and the ribosomal 16S gene were used to assess the genetic characterization of *M. galloprovincialis*. The COI and 16S results will be compared with another PCR based technique, the High Resolution Melting (HRM). The HRM analysis allows the detection of single nucleotide polymorphisms (SNPs) in small amplicons using primers specifically designed for this technique. It is generally used to detect food adulteration and to identify bacteria, plant and animal species. The same technique has been used by several authors to identify mussels commercial species and their hybrids within the Mytilus genus.

FORAGING ROLE OF TWO NURSERY HABITATS FOR MARINE MIGRANT JUVENILES IN NORTHERN VENICE LAGOON

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For marine migrant fishes the use of habitat by individuals varies according to ontogenetic stages. Among the different roles and functions of habitats, foraging grounds are extremely important. Indeed, a full comprehension of the foraging role of different nursery habitats within the estuarine systems is a crucial step in understanding, preserving and managing transitional water ecosystems. The aim of this study was to assess the foraging role of two different nursery habitats, analyzing the diet of *Sparus aurata* juveniles during fry migration and ontogenetic changes. Sampling took place, using a beach seine net, during spring 2016 in the Venice lagoon, considering two different habitats of the same station: the intertidal creek and the saltmarsh edge. Previous studies have shown that the highest concentrations of juveniles were found in these habitats. Results shows that density of *S. aurata* juveniles was higher in the intertidal creek, where also the number of individuals with full stomach was higher than in the saltmarsh edge. Especially in the intertidal creek, where individuals had also a higher value of condition factor, results suggest that smaller *S. aurata* (<20 mm Standard Length) feed on Copepoda (Harpapticoida) as preferred prey, while bigger individuals (20< S.L. <35 mm) shift their diet towards Amphipoda and Polychaeta. These results suggest that individuals, after entering the sea, can be found in higher densities within intertidal creeks, probably due to a higher availability of trophic resources. To better understand the reason of these preferences, it becomes now important to analyze the trophic relationships and the food preferences inside these habitats, by deepening the study of stomach contents and prey distributions and also by using the stable isotope ($\delta^{13}C$, $\delta^{15}N$) approach.

C AND N ISOTOPIC SIGNATURES OF ZOOPLANKTON TAXA IN FIVE SMALL SUBALPINE LAKES ALONG A TROPHIC GRADIENT

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Concern on stable isotopes analyses is increasing in freshwater ecology to better clarify ecosystems' functioning. By measuring carbon and nitrogen isotopic signatures, organism food sources and position level along food webs can be tracked, providing quantitative estimates of bi-dimensional niches. In order to verify the forcefulness of some general patterns of carbon and nitrogen stable isotope signatures in lakes of reduced size, we applied stable isotopes analysis to zooplankton community sampled in spring and summer in five small lakes located in the same subalpine region, within a trophic gradient (from oligotrophy to ipereutrophy). Seasonal changes in trophic position and food sources were analysed for the different zooplankton taxa to compare how and whether isotopic signatures and their seasonality are taxa specific. Carbon and nitrogen isotopic signatures were lake- and season-specific, depending on the depth/morphology and the trophic status of each lake, showing already-observed general trends, with some exceptions. Major variations in carbon signature were recorded in Lake Mergozzo and Lake Pusiano, the deepest lakes and with a larger volume, while minor variations appeared in Lake Endine, which has a reduced volume and depth. Carbon was generally less depleted in summer, with the exception of the shallowest Lake Comabbio and, in a lesser extent, of Lake Endine. Nitrogen enrichment was markedly higher in lakes Pusiano and Moro than in Mergozzo, decreasing in all cases in summer time, indicating a great variability of the trophic roles of zooplankton organisms.

CHANGES IN LPUES IN THE NORTHERN ADRIATIC SEA: SIGNS OF FISH STOCK RECOVERY?

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The Adriatic Sea is well known for its high primary and secondary productivity, sustaining a high level of fishery exploitation, hence resulting one of the most exploited area of the Mediterranean Sea. All that has produced a deep impact on the marine resources and also on the entire ecosystem. For these reasons, during the last decade, many efforts have been devoted to implement more effective management strategies, such as the ban, enforced in 2010, of the trawling activities within 3 nm from the coast. In order to assess the effectiveness of this measure on exploited resources, a time series analysis of landing was performed by using the Chioggia's fish market data (2007-2016). Data have been expressed on Landing per Unit of Effort (LPUE - kg per vessel per day), for the three fleet segments selected to trawl activities (large, small and Rapido trawls). The main target species for each métier were analysed and the sequential t-test analysis of regime-shift detection method was applied. Generally, LPUEs showed a significant change in correspondence of the ban, with a decline followed by a recovery both for total LPUEs and target species. In particular, from the 2010 an evident drop in catches was highlighted for large and Rapido trawls, followed by a significant increase after the 2012. Also for small trawls similar (but less evident) changes were recorded. Overall, the analysis highlighted important modifications in relation to the 3 nm fishing ban, disentangling its effect on each métier and on its target species. Nevertheless, additional analyses are necessary in order to assess the effectiveness of the current management strategies and to clarify if the fish stocks are actually in recovery.

NEW STRATEGY TO CONTROL THE OUTBREAKS OF THE CROWN OF THORNS STARFISH *ACANTAHSTER PLANCI*

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Acanthaster planci, the crown-of-thorns starfish (COTs), is a coral feeder widely distributed in tropical and sub-tropical oceans (Haszprunar et al., 2017). In the last decades, COTs have been considered one of the major cause of reefs degradation in the Indo-Pacific since they are capable of population outbreaks which often result in extensive coral mortality. The reasons for a COTs outbreaks are not still completely understood, several theories have been proposed to explain the phenomenon, including the “predator removal” and the “terrestrial runoff” hypothesis. One specific set of these hypothesis are focused on the reproductive success and larval survival as a key factor to trigger an outbreaks. The crown-of-thorns starfish are broadcast spawning gonochoric species, with a very high fecundity producing up to 60-100 million oocytes per season for a single female. Adult COTs aggregation has been considered an important factor for the reproduction success due to the increased chances of fertilization at lower distances as great as 8 m to 100 m downstream.
Population control have been proposed as method to reduce the consequence of an outbreak. Management of COTs outbreak includes manual removal and injection of lethal substances as the most effective methods. In this project we propose a method to avoid the stress-induced spawning by applying a special gel on the aboral side of the starfish. The gel will cover the gonopores and block the leak of gametes in the crown-of-thorns during the stress-induced spawning provoked by removal or injections.

MICROORGANISMS FROM EXTREME ENVIRONMENTS – A COLLECTION OF LIVING STRAINS AT THE DEPARTMENT OF BIOLOGY OF THE UNIVERSITY FEDERICO II OF NAPLES

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Extreme environments are typically characterized by harsh conditions determined by spatial gradients of chemical and physical factors, consisting of strong variations in temperature, salinity and pH. They are usually represented by hot and cold deserts, hot springs, salt lakes, volcanic and thermal areas, sulfide mines near deep-sea vents as well as lithic surfaces of cultural heritage. Extremophilic microorganisms are exposed to hostile conditions and are categorized on the basis of their ability to thrive in a specific type of niche. These types of environments have been shown to host a diverse group of prokaryotes which rely on specialized enzymes to survive. Few microeukaryotes, as the unicellular red algae Cyanidiales, can thrive in an extreme environment. Archaeal and bacterial domains include thermophiles which grow at high temperatures (95-115ºC), whereas, for eukaryotic microorganisms, the highest temperature reported is 62ºC. Piezophiles are pressure-lovers, halophiles are found in high salt concentrations, while acidophiles and alkaliphiles thrive at extreme pH of 0.05-5 and greater than or equal 10, respectively. The Algal Collection at the Department of Biology of the University Federico II of Naples (Italy) is a bioresource center where are maintained over 600 microalgal strains belonging to Cyanobacteria, Chlorophyta, Rhodophyta and Bacillariophyceae. The extremophilic microorganisms are largely represented in the ACUF Collection (over 250 strains), including strains isolated from European and extra-European sites, mostly belonging to the Cyanidiales. Most of them are cultivated and preserved in glass tubes at a range temperature between 22°C and 26°C with various nutrient solid culture media as BG-11, BBM and Allen (using Agar as solidifying agent of choice); few strains (mostly belonging to Bacillariophyceae) are maintained in liquid cultures at a temperature of 18°C. After the initial illumination following transfer, the cultures are allowed to mature for several weeks at 24°C, receiving light of fixed irradiance of 8100 Lux a 16:8 h light-dark cycle. Under these conditions, transfers are made routinely every 1-2 months, although for many species four or six months would be sufficiently frequent. Most axenic cultures are also maintained in liquid media and, depending on the species, are transferred at 14-day, 1- or 2-month intervals. The main target of the ACUF Center is the assessment and the preservation of the biological diversity. Furthermore, this alternative 'living' collection can be also employed as a living library with valuable information about biochemical and evolutionary strategies that push the physical and chemical limits of life. Therefore, the study of extremophiles will provide a better understanding of the origin of life and evolution of key mechanisms involved in cell function. Moreover, these organisms can be also considerable as useful sources for the production of fine chemicals or other biological products with potential biotechnological applications.

A NEW METHOD FOR RANKING THE SEVERITY OF IMPACTS OF ENVIRONMENTAL PARAMETERS AND EXOTIC SPECIES ON NATIVE FISH COMMUNITY AND EXPLICIT PRIORITIES OF INTERVENTION

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The intensification of anthropogenic pressures on riverine ecosystems has been increased the last decades leading to decline of native fish communities. The main causes are identified in a combined effect of habitat deterioration by human activities, such as agriculture, pollution, damming, removal of riparian vegetation and excessive water abstraction, and of exotic fish species introduction. As a consequence, native fish communities have reached critical levels in many regions of the world with severe threats to the conservation of freshwater biodiversity and ecosystem functioning. These alarming conditions require combined and well-designed interventions for restoring environmental quality and containing exotic species invasion. The aim of the study is to find the most informative descriptors of native fish community and to find the sites with the highest priorities of intervention for the recovery of native fish communities. The study was conducted in the most important rivers and canals of Emilia-Romagna region where both fish fauna and environmental parameters were collected. Statistical analysis was performed using the CANOCO software 4.5 for Windows, in order to study native community distribution along variables considered. The results can rank the state of fish community in the region and they can be used in the development of management plans for the restoration of native fish communities in freshwater ecosystems.

THE HIDDEN PATHS TO BIODIVERSITY LOSS

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There are more than 8M species on earth, most of which are yet to be described. According to a conservative estimate, we are losing 0.22% of this diversity per year, which means more than two species per hour. The problem is that most extinction events happen unnoticed, since we tend to focus on charismatic species, and to underestimate the huge impact that co-extinctions, that is the loss of consumers following the decline of their resources, may have on biodiversity. Since extinction is a fundamental ecological process, complex natural systems should be robust to species loss. Actually, their complexity is a strong evidence of that. Yet, they are likely not prepared to withstand the current extinction rate, which is one thousand times higher than the natural one. For this, it seems obvious to look at the magnitude of Global Change as the main driver of species loss. In this talk, I will show that the picture is more complicated, and that the identity of species going extinct is as important as their number.

GROWTH ANALYSIS, GENE EXPRESSION FOR SHADE TOLERANCE, SUSCEPTIBILITY TO INSET ATTACKS, AND AGROFORESTRY TRIALS OF *CANNA INDICA* L. PLANTED UNDER RUBBER PLANTATION

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Canna indica L. is an edible and medicinal crop, traditionally consumed as boiled rhizomes or noodles in South America and Asia. This species is potential to be developed as alternative food to rice, and for animal feeder. Unfortunately, this species has been reported close to extinction due to scant use in the past decades. Here we report studies on the growth, gene expression and susceptibility of *C. indica* to insect attacks under three different light regimes. Data confirmed that *C. indica* is a shade tolerant species and performed best at low light environment. The GAPDH pair 2 showed a promising potential to be used as a reliable primer. Sequencing of GAPDH showed 47 base pairs of highly significant match of the gene sequence with other plants in GenBank. Phenotypically, the shaded *C. indica* showed more leaves than the non-shaded. The leaves were thinner and longer than the non-shaded *C. indica*. Non-shaded *C. indica* produced flower earlier than those grown under the shade (12 days different). The weight of rhizomes was 0.58 and 2.32 kg for shaded and non-shaded plants, respectively. The insects that fed on *C. indica* leaves were: *Valanga nigricornis* (Orthoptera: Acrididae), Systoloderus sp. (Orthoptera: Tetrigiidae), Lepidoptera: Nymphalidae, Pyralidae and Psychidae. These defoliators have never been reported to feed on *C. indica* before. Shade treatments had a significant effect on *C. indica* susceptibility to insects. More leaves of full sun grown seedlings were consumed by defoliators (612 and 479 cm^2 for red and white cultivars, respectively), compared to leaves of seedlings grown under 25% light (31 and 64 cm^2 for red and white cultivars, respectively). No root infestation by insects was observed in this experiment. This finding supports the possibility to utilize idle areas under rubber or oil palm plantation for *C. in*dica cultivation. Currently, we are undergoing trials of agroforestry system, by planting *C. indica* under one hectare of rubber plantation.

COLLEMBOLAN COMMUNITY UNDER DIFFERENT VEGETATION COVER IN MEDITERRANEAN ENVIRONMENT

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It is well known that soil organisms are responsive to vegetation cover. Because plant species differ in both the quantity and quality of resources that they return to soil, they may have important effects on soil biota and the processes that they regulate. The effects of plant community composition on soil communities appear to be context-dependent. Several studies were conducted on the effects of different tree species on arthropod community, but little attention has been devoted to ecosystems dominated by shrub species. These ecosystems account for a substantial part of total land cover, and are particularly relevant in Mediterranean ecosystem. Therefore, this study aimed to evaluate the taxonomic and functional (using functional traits reported in the database of BETSI program-Biological and Ecological Functional Traits of Soil Invertebrates-CESAB/FRB) structure of soil collembolan community under different vegetation cover. For this study, mesocosms were set up with single or combined Mediterranean shrubs: *Quercus coccifera* L. (QC), *Cistus albidus* L. (CA), *Ulex parviflorus* L. (UP) and *Rosmarinus officinalis* L. (RO). Besides, a forest of *Q. ilex* L. (QI) was also investigated. After 6 months, collembolans were collected from surface soils (0-5 cm) and analyzed through taxonomic and functional trait approaches. QC and CA resulted dominant in all the shrub combination. Collembola diversity and evenness were higher for shrubs as compared to QI. Moreover, the number of shrub species present in the mesocosms influenced both taxonomic and functional structure of collembolan community. The combination with 2 species and dominated by CA showed a collembolan community with medium size and pigmented organisms; the combination with 3 species and dominated by QC or CA showed a collembolan community with big size, less mobile and with asexual reproduction; whereas the combination with 4 species showed a collembolan community with small size and non-pigmented organisms.

COMPARING INVERTEBRATE DIVERSITY IN TRANSGENIC BT-MAIZE AND NEAR-ISOGENIC NON BT-MAIZE FIELDS

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Phytophagous arthropods represent a notable item of expenditure in agriculture. A suitable solution, in order to maintain and/or increase the productivity, is represented by the use of transgenic plants. On the other hand, transgenic plants, are at the centre of a non-completed debate about their potential risks in terms of loss of associated invertebrate species and/or communities. Several studies were performed in order to highlight the effects of these plants, but the results are controversial and knowledge gaps still persist. We performed a field study in Catalunya (Spain) with three varieties of both transgenic Bt-maize and the near-isogenic non Bt-maize (12 experimental plots). The isolines had higher contents of ergosterol (indicator of fungal mass), lignin and Ash-Free Dry Mass. Nevertheless, negative binomial regression and the Shannon-Wiener index (bt:1.64, iso:1.61) showed that the invertebrate communities associated to the corn leaves did not differ between the Bt and non-Bt lines. Our results suggest that, for the varieties and invertebrates considered, there are not significant effects on the total counts and invertebrates diversity in the transgenic and isogenic lines. Moreover, we found a significant positive effect of the ergosterol on the invertebrate abundance in the isoline, whereas in the transgenic line this positive effect is lower and non-significant, suggesting that the isoline represents a better trophic resource for the invertebrates in spite of its higher lignin-content.

DOES PHENOLOGY INFLUENCE POTENTIAL DISTRIBUTION OF EUROPEAN BATS? A CAUTIONARY NOTE FOR THE DEVELOPMENT OF SPECIES DISTRIBUTION MODELS

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Phenology is a key feature to describe species niches due to its major importance in capturing seasonality in resource use and climate requirements . This is all the more true for temperate bats, whose ecological needs differ markedly across seasons, especially between hibernation and reproduction. Species distribution models (SDMs) are widespread tools to evaluate a species' potential distribution and identify its large scale habitat preferences. Modelling studies have experienced a recent boost thanks to the increasing amount of data available to implement SDMs: however, despite the chief importance of data phenology to describe a species' niche, the time of year data were collected is often neglected or not controlled for in the process. In this study we tested the hypothesis that the output of SDMs developed for six European bat species will differ according to whether hibernation or reproductive occurrence data are used. We employed a dataset made of 470 occurrence records of bat hibernacula and 400 records of nursery roosts of selected species and developed both separate winter and summer models and mixed models for all of them. Our models were developed for the whole Europe so for our exercise, covering a large geographic scale, we only considered climatic variables. Seasonal and mixed potential ranges differed from each other and the direction of this difference was species specific. Overall, our work highlights the importance of considering data seasonality in species distribution models development in order to encompass all the different ecological requirements related to the species phenology in view of a more effective conservation strategy. We thank the Eurobats Advisory Committee for providing bat occurrence records for many of the countries within the Agreement range.

A CONSERVATION GAP ANALYSIS FOR THE HABITATS DIRECTIVE PRIORITY SPECIES ROSALIA ALPINA (COLEOPTERA: CERAMBYCIDAE) IN EUROPE

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Natura 2000 network (N2000) and national protected areas (PAs) are recognized as the most important core "units" for biological conservation in Europe. We developed species distribution models (SDMs) to detect the potential distribution for the rare cerambycid beetle *Rosalia alpina* L. in Europe and quantified the amount of *R. alpina* suitable habitat within N2000 [special areas of conservation (SACs) and special protection areas (SPAs)] and PAs (e.g. national parks, regional parks, state reserves, natural monument and protected landscape). SDMs achieved excellent levels of predictive performance as indicated by the AUC (0.947 ± 0.004) and TSS (0.787 ± 0.018) values. *R. alpina* suitable habitat in Europe is ca. 754,171 km^2 and the model identified substantially uninterrupted areas of potential geographic distribution in Spain, southern France and Corsica, the Italian Alps and Apennines, Switzerland, Austria, southern and central Germany, Southern Poland, Czech Republic, Slovakia, Bulgaria, Romania, Balkans and Greece. The overlay between the existing system of conservation areas in Europe (N2000 and PAs) and the binary map of *R. alpina* showed that ca. 42% of potential habitat is protected. SACs and SPAs protected ca. 25% and 21% of potential habitat, respectively. However, because the two site types often spatially overlap, when taken together the situation only slightly improved, i.e. the entire N2000 protects ca. 31% of potential habitat. Instead, PAs offer a degree of protection of ca. 29%. Overall, much of the area potentially suitable for the Rosalia longicorn is unprotected, an aspect that should be considered carefully to plan conservation of this beetle at a large scale. Models such as ours may also help focus field surveys in selected areas to save resources and increase survey success.

METAL DEPOSITION AND ACCUMULATION IN *Q. ILEX* L. LEAVES OF TWO AREAS AFFECTED BY DIFFERENT HUMAN IMPACTS

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Anthropization causes an increase of pollutants in the atmosphere that, in turn, leads to a decline of air quality. Leaves are useful tools to evaluate air quality as they intercept air deposition and accumulate, through stomata, pollutants in gaseous form or in fine particulate. However, leaf morphology and biochemical characteristics may be negatively affected by air pollution. The aims of the study were: i) to evaluate the concentrations of Cd, Cr, Cu, Ni and Pb in leaf tissue and deposit in specimens of holm oak, widely used as biomonitor; ii) to estimate the effects of metal accumulation on morphological leaf traits (length, width, petiole, area) in two municipalities: Pomigliano (ME) and Naples (UE), respectively, characterized by mixed (urban and industrial) and urban emissions. At both the sites, the investigated metals, with the exception of Cd, were accumulated in leaf deposits. The comparison of the metal concentrations in deposits on leaves collected at the sites highlighted that only those of Pb statistically different with values higher at ME. Instead, the leaf tissues widely differed for metal composition, with statistically higher values of Cd at UE and Cu and Ni at ME. Besides, the metal capture rate, an estimation of the adsorbed or captured heavy metals on the leaf surface respect to the total concentration, showed statistically lower values of Cu and Ni in leaves collected at ME suggesting, in this area, the consistent presence of fine particulate. Finally, metal accumulation and deposition in leaves collected at ME affected the leaf morphology as the investigated leaf traits showed values lower than in the leaves collected at UE.

GEOCHEMICAL OR ANTHROPOGENIC DERIVATION OF ELEMENTS IN SURFACE SOILS OF THE VESUVIUS NATIONAL PARK

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Soil element concentrations mainly depends on chemical composition of parent material, although anthropogenic activities should be considered. Substrate mineralogy as well as the predominant chemical form of each element play an important role in their mobility and availability. The aim was to distinguish the main derivation (natural or anthropogenic) of surface soil element compositions in the Vesuvius National Park. The investigated area is a good example for this purpose as the soils derive by pyroclastic materials with high capacity to bind elements and it is directly and indirectly affected by human activities. To reach the aim, soil samples were collected along two roads (leading to the Vesuvius cone), at two altitudes (600 and 900m a.s.l.) and on lava with different ages. On the soil samples, the pseudo-total concentrations of 22 elements and their fractions (the exchangeable/water soluble, reducible, oxidasable and residual fractions, respectively F1, F2, F3 and F4) were measured. The soils were characterized by wide variability of pH, organic matter and C, N, S contents among sites. At all the sites, the pseudo-total concentrations of Cr and Cd were traceable, whereas Al, K, Ca and Fe were the most abundant. As the pseudo-total concentrations of the elements were more abundant at low altitudes and near the roads, the vehicular traffic can be considered the main responsible of the high contamination level observed at these sites. The results of NMDS analysis showed that the soils originated by the four lava ages clearly separated for the F1, F2 and F3 but not for F4 suggesting that environmental conditions (plant cover, microclimatic conditions as well as particulate depositions), that occurred over the time, affected the elements mobility and availability.

THE CYANIDIALES OF THE ALGAL COLLECTION OF UNIVERSITY FEDERICO II

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Cyanidiales are a group of asexual, unicellular red algae, which thrive in acidic and high temperature conditions around hot springs. More than 300 strains belonging to Cyanidiales, coming from different acidic geothermal environments of world, are kept in the Algal Collection of University Federico II (ACUF) in Naples (Italy). The culture collections started in 1973 by Roberto Taddei, and was initially planned as a collection of *Cyanidium caldarium* strains (sensu lato) from different acid-thermal sites of Italy. In late 1970's the C. caldarium collection was expanded to similar sites of different countries, with a focus on Central and North America. In these explorations were collected strains from Yellowstone National Park, Playon de Auachapan (El Salvador), Los Azufres and Cerro Prieto (Mexico). Following the American explorations , an expedition to Mount Lawu in Java (Indonesia) allowed to collect Cyanidiales in the locus classicus of *Cyanidium caldarium*. Afterwards in 2006 and at a later stage in 2011, Ciniglia and collaborators increased considerably the number of Cyanidiales strains in the ACUF collection with the explorations of thermal and acidic sites in Iceland and Turkey. Originally, the classification of these microalgae was carried out on the basis of morphological characters, a very simple cellular form, masked the enormous "hidden" biodiversity of this taxa. Using molecular phylogenetic analyses, five lineages of Cyanidiales have been described: *Cyanidium caldarium*, *Cyanidioschyzon merolae*, *Galdieria maxima*, a mesophilic Cyanidium and Galdieria clade with a negligible morphological diversity, including a *Galdieria sulphuraria*, *Galdieria daedala*, *Galdieria partita* and *Galdieria phlegrea*.
A diagnostic essay has been developed in our laboratory, based on the use of species-specific primers. This essay manages to rapidly discriminate in PCR the most representative species of the group. Moreover, the PCR associated with restriction analysis with restriction enzymes MboI and ApoI, allows to discriminate between G. sulphuraria and G. phlegrea. From the alignment of over 100 sequences of Galdieria, Cyanidum and Cyanidioschyzon deposited in GenBank, primers have been drawn on regions within the rbcL gene (plastidial gene coding for Rubisco) preserved in the species of interest, and not in the others. Future environmental PCR studies can significantly augment known biodiversity that we have discovered, confirming that the Cyanidiales are a particularly species-rich branch of Rhodophyta.

BIODIVERSITY AND PRODUCTIVITY TRADE-OFFS ASSOCIATED WITH TWO BIOENGINEERING BIVALVES: THE ALIEN BRACHIDONTES PHARAONIS VS. THE ENDEMIC MYTILASTER MINIMUS

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The role of rocky intertidal habitats in sustaining high level of biodiversity is worldwide recognized. Here, we tested the role of two bioengineering model species, the alien *Brachidontes pharaonis* (Fischer P., 1870) and the native *Mytilaster minimus* Poli,1795, in shaping the associated macrofaunal communities along a gradient of increasing density and facilitating the biodiversity increase. *M. minimus* is the most frequent and common intertidal benthic species in the Southern Mediterranean Sea, and the invasive Lessepsian species *B. pharaonis* is assumed to be the best candidate to replace the native one in the intertidal zone of the entire Mediterranean basin, thus posing a potential threat to the biodiversity of this region. *B. pharaonis* is one among the most dangerous Non-Indigenous Species (NIS) in the Mediterranean basin even if, up to date, studies on both invasiveness rate and the influence exerted in shaping benthic communities are scanty. Specimens were sampled at two sites along the Sicilian coasts during winter. The complex structure of mussel beds seems to trap fine-grained sediment and organic particles and, by biodeposition, provides a strong input of organic matter and phytopigments. The model species showed the same trends with significant differences in the magnitude of biodeposition. Mussel beds have showed a structuring effect on the macrofaunal associated species. The results of macrofauna diversity showed the trade-offs until which these bivalves can sustain a significant higher abundance and diversity indices. The bivalves showed a structuring effect in influencing macrofauna settlement and trapping power. Our results allowed also to investigate the role of this NIS in influencing associated macrofaunal density providing useful insights into the study of invasiveness' effect of this species, and addressing the future monitoring plans and strategies in the Mediterranean waters.

FEEDING HABITS OF *OPHIDIASTER OPHIDIANUS* (LMK.) (ASTEROIDEA) IN MEDITERRANEAN ROCKY REEFS

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The thermophilic Atlanto-Mediterranean purple starfish, Ophidiaster ophidianus, is a species protected under the EU's Habitats Directive which is expanding its distribution in the northern Mediterranean areas as a consequence of global worming. The ecology of the species is largely unknown, specially for the diet. To cover this gap, the feeding habits of *O. ophidianus* have been studied in two different Mediterranean rocky reef areas: the southern Tyrrhenian Sea (Ustica Island, sampled in 2009) and the eastern Adriatic Sea (Molunat, sampled in 2014) by both field observations and ?13C and ?15N stable isotope analysis (SIA). SCUBA divers collected data by turning adult starfish downside-up and collecting photographs of the prey. Prey items of fifty individuals were identified to the lowest possible taxonomic level in each location by analysing the images taken. No significant differences were detected in the field, *O. ophidianus* fed mainly on encrusting coralline algae (Lithophyllum spp.), keratose sponges (Ircinia sp.), other encrusting organisms and sedimentary organic matter (SOM). Isotopic signatures significantly differed between the two areas: ?15N was significantly higher in *O. ophidianus* collected at Molunat than at Ustica. Mixing models showed that *O. ophidianus* collected at Ustica fed on Lithophyllum spp. (68.1%), Ircinia sp. (15%), SOM (16.3%) and bryozoans (Schizoporellidae, 3.7%), whereas at Molunat the starfish fed on Lithophyllum spp. (79.9%), Peyssonnelia spp. (7.9%), keratose sponges (*Scalarispongia scalaris*, 7.4%) and SOM (4.8%). Coupling field survey with SIA we argued that *O. ophidianus* feeds as a grazers, selecting algae and few other animal organisms in Mediterranean rocky reefs.

THE RESTORATIVE SCHOOLROOM OF GRESSONEY-LA-TRINITÉ AS AN EXAMPLE OF BIOPHILIC DESIGN INTEGRATED IN ENERGETIC EFFICIENCY RETROFIT

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Green building research is concerned with external sustainability (energy efficiency, life cycle assessment of materials, etc.) aimed to reduce only human's impact on the environment. On the contrary, the Biophilic Integrated Retrofit Project is devised to combine external sustainability (energy efficiency retrofit) with internal sustainability related to Nature positive effects on individuals (sensation, perception and emotional states). Inspired by the biophilic design, an architectural design model tuned with human biophilia we realized in Gressoney-La-Trinité (Aosta Valley, Italy) a Restorative Schoolroom, i.e. a prototype of school environment where interfaces to stimulate the child's image of the school environment as a place of positive emotions and pleasant feelings, are realized in the most advanced retrofitting systems to improve energy efficiency. The Restorative Schoolroom is an indoor school environment that owns the regenerative characteristics of the outdoor natural environment in order to foster the learning process. The Restorative Schoolroom was realized thanks to three independent research projects developed by the agreement among University of Valle d'Aosta and a few business enterprises of Valle d'Aosta: Quintetto OLS, Quintetto and CCS Aosta. Individually taken, each research product is an advanced development of an existing product with a solid commercial potential, whereas together, they help in different ways to generate the Restorative Schoolroom, a high-end design for a new alpine sensitive architecture.

BENTHIC HABITATS IN A HIGHLY IMPACTED TIDAL INLET

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Coastal transitional ecosystems like lagoons, deltas and estuaries are complex and dynamic systems, highly valuable in terms of biodiversity and productivity. Therefore, they require constant monitoring, but at the same time, they represent a challenge for direct observation because of operational issues such as high turbidity, strong currents, bathymetric constraint, etc. The Venice Lagoon is the widest transitional ecosystem in the Mediterranean. The average depth is about 1 meter but some trait of the tidal channels exceeds 20 meters in depth. The lagoon is connected to the open sea by three inlets (Lido, Malamocco and Chioggia) that since 2006 have been strongly modified by the construction of mobile barriers (MoSE Project) to protect the historical city of Venice from high water. This debated project could affect in the near future the lagoon hydrodynamic and alter the seafloor habitats and morphologies. This research focuses on the Chioggia inlet with the aim of describing this system and highlighting the main changes induced by the anthropogenic interventions. MultiBeam EchoSounder (MBES) high resolution data (bathymetry and acoustic backscatter) and ground-truth samples (sediments and underwater photos), gathered by CNR-ISMAR in 2013 within the National Flagship Project RITMARE (Ricerca Italiana per il Mare), were used to map the seafloor shapes, the grain size distribution, the biota presence and to classify the seabed into benthic habitat classes. We used the MBES data to identify interesting habitats, for example seagrass patches or bio-construction. Finally, we also applied the CoCoNET classification scheme (COast to COast NETworks), a pilot method modified for coastal shallow water, that combines physiography, morphology, substrate and biological information to clusterize the seabed into habitat classes. The main goal is developing a standard protocol of Habitat Mapping to study and characterize these systems based on geological and biological descriptors.

LANDSCAPE TRANSFORMATIONS AND EFFECTS ON ECOSYSTEM SERVICES IN AN APENNINE HILLY AREA (NATURAL RESERVE BOSCO DELLA FRATTONA, IMOLA ITALY)

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The human being has always been trying to change the landscape with all available means. He has caused a loss of identity to the places. The aim of this thesis is to examine landscape changes over a whole Site of Community Importance (392 ha) in Emilia-Romagna, between Imola and Dozza. The area is called SIC "Bosco della Frattona". Finally have been defined the potential of land cover to provide some Ecosystem Services (Burkhard et al. 2014, Scolozzi et al. 2012). The survey was made by comparing historical (1954, 1976) and recent (2011) aerial photos. This images have been georeferenced and digitalized in a GIS environment and classified in six land use classes (by Corine Land Cover): urban fabric, artificial non-agricultural vegetated areas, arable land, permanent crops, forests, shrub and/or herbaceous vegetation association. First, a simple statistical analysis of the vegetal landscape was applied, then a time analysis was made to quantify landscape changes over the fifty-seven years. A general urbanization process was detected in the investigated area over the period 1954-2011, because there has been an increase of urban fabric, artificial non-agricultural vegetated areas classes. The permanent crops class changed in terms of fragmentation increase and patches decrease. Conversely the forest landscape structure changed in terms of decreased fragmentation and area increase. However, this increase is not always positive as in some cases it is the growth of invasive species. In fact, these species have a negative impact on environmental quality, trivializing habitats and causing biodiversity loss. These transformations have a great influence on the ecological functionality of different ecosystems in producing ecosystem services that are useful to the quality of life not only of man. The quali-quantitative analysis of the Ecosystem Services is useful to orient the planning and management towards environmental and economic sustainability to achieving biodiversity conservation goals.

RELEVANCE OF SI UNDER ZN DEFICIENCY IN BARLEY PLANTS

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Silicon is the second most abundant element in the earth ecosystem; despite that silicon is not usually considered as an essential mineral nutrient for higher plants. However its beneficial role in alleviating biotic and abiotic stress is well documented in the literature and it has been applied as an important fertilizer component. Zinc deficiency is one of the most widespread micronutrient deficiencies in plants causing several reduction in crop production. The aim of this work was to investigate the relevance of Si nutrition under Zn deficiency in barley plants. Barley plants were grown hydroponically in a complete nutrient solution and in nutrient solutions with different Zn concentrations, with and without Si supply. We examined Zn uptake, the different nitrogen forms and the efficiency of the plants in their utilization, the nitrogen metabolism and some enzymatic activities related to photorespiration. The results indicate that different Zn nutrition may affect plant growth: at this regard Si supply effectively mitigated the symptoms of Zn deficiency. The relationships between Si nutrition and Zn function in barley plants were discussed.

AGROECOSYSTEM POLLUTION BY POTENTIALLY TOXIC ELEMENTS IN CAMPANIA PLAIN: PRELIMINARY ASSESSMENT OF SOIL BENCHMARK CONCENTRATIONS BY SOIL TO PLANT TRANSFER FACTORS

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The major route of humans exposure to potentially toxic elements (PTEs) is the intake through food; they enter into the food chain principally by plants uptake from the soil and, to a less extent, through foliar deposition. The soil to plant transfer is part of the biogeochemical cycle of these elements and is a complex process, hardly predictable. In this study we investigated the capability of soils and plants to highlight PTEs pollution inputs in an intermingled urban-rural landscape of southern Italy affected by legal and illegal waste disposal and dumping. To this aim, 172 agricultural soil and food-plant (edible part) were collected in pairs from 47 municipalities in the Campania Plain and analyzed for the content of 12 PTEs (As, Be, Cd, Co, Cu, Cr, Ni, Pb, Se, Tl, V, Zn). Soil extractions in 1 M NH4NO3 and 0,05 M EDTA pH 7 were applied to assess PTEs bioavailability. Results were examined according to plant species and main soil chemical properties. Exclusively for Pb and Cd, the soil to plant transfer factors (TF) and the corresponding soil benchmark concentrations were investigated. Zinc, Cu, Cd and Pb were the only PTEs of anthropic origin widely polluting (from 10 to 16%) the soils of the sudy area, but only in a very few cases they exceeded physiological or EU legal values in the edible part of the plants. An evaluation of human risk due to the ingestion of this elements was tried; it was found that for Zn, Cu and Pb there is no risk for consumer health, while for Cd three values slightly exceeded the tolerable daily intake. Therefore we can conclude that crops cultivated in the study area could represent only a moderate risk for human health. Any correlation was found between soil and plant data, which likely highlight different pollution inputs. A large variability characterized the Pb and Cd TF, making very difficult to establish a benchmark concentration in agricultural soils.

GREEN ROOFS AND ECOSYSTEM SERVICES: RUNOFF WATER QUALITY AND QUANTITY

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The I-ZEB Project (Intelligent Zero Energy Buildings) was recently approved within the third framework agreement between Lombardy Region and National Research Council with the main aim of providing technological solutions and innovative materials in buildings from an energy, environmental and structural point of view. Among the proposed strategies, vegetated roofs are becoming a widespread technology in our cities in an NZEB (Nearly Zero Energy Buildings) perspective, since they increase thermal insulation, inertia and evapotranspiration of roof and they contribute to the reduction of the building energy demand for heating and cooling. Besides, they provide many ecosystem services in densely populated areas, such as reduction of stormwater runoff, mitigation of urban heat island effect and noise pollution, aesthetic improvement. A less investigated aspect is the contribution to the reduction of urban runoff pollution by absorbing pollutants present in wet and dry atmospheric deposition. Recent researches showed that during periods of intense evapotranspiration, water soluble substances may be absorbed in the vegetated roof reducing the pollution transfer to the environment. Contaminant concentrations in green roof runoff may be comparable to those found in precipitation (e.g. nitrogen, trace elements), but the strong capability of these roofs to reduce annual runoff may result in a significant reduction of the total pollutant load. Notwithstanding this, if not correctly designed, vegetated roofs may contribute to water pollution by releasing contaminants from soil, fertilizers or drainage systems. For example, significant release of nutrients, DOC and some trace elements was emphasized. The potential of providing ecosystem services in terms of water quality are strongly determined by the green roof type/arrangement and by local climatic conditions. A direct experimental research in Milan will clarify the potential of this technology in a metropolitan area.

EFFECTS OF LAND MANAGEMENT ON ESSENTIAL AND NOT ELEMENTS IN SPANISH OLIVES

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Over 750 million olive trees are grown around the world, 95% of which are in the Mediterranean basin. Most of the global production comes from Southern Europe countries, North Africa and the Middle East. In Europe, the 93% of the production comes from Spain, Italy and Greece. Spain is the country with the largest number of olive trees (more than 300 million) and is now the world's leading producer and exporter of olive oil. The study was carried out in Torredelcampo (Jaén, Spain) and the aim of this study was to evaluate the content of essential and not elements in Spanish olives and soil under different land management. Selected land managements were: (1) conventional tillage (CT); (2) CT plus the addition of oil mill pomace "alperujo (A) (270 Mg ha-1year-1); (3) CT plus the addition of olive leaves mulch (H) (270 Mg ha-1year-1). Alperujo is the solid sludge waste generated by the new two-phase method of olive oil extraction; and olive leaves are those unintentionally collected with the olives at harvest (Moreno et al., 2009). Both wastes contain large quantities of OM and moisture, but do not contain heavy metals or pathogenic microorganisms (Lozano-García et al., 2011). In this way, their analysis aims to evaluate their presence an anthropogenic inputs. This study showed: (a) no improvements were observed in the nutrient content in the soils of the two plots where were additioned oil mill pomace "alperujo" (A) and olive leaves mulch (H) compared with nutrient contents in control plot (CT); (b) the olives showed significantly higher Na, Zn and Fe concentrations than control in both plots; plots H showed significantly higher Cu concentrations instead plot A showed significantly higher P and Se concentrations than control; (c) in addition, trace metals concentrations assayed in olives were compared with the critical values reported by the WHO/FAO Food Standards Program (WHO/FAO 1984) and these were all under critical values.

UPTAKE OF MICRO AND MACRONUTRIENTS IN RELATION TO INCREASING MN CONCENTRATIONS IN *CISTUS SALVIIFOLIUS* L. CULTURES

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Mining and smelting activities can alter the ecosystem degrading vegetation and landscape, causing loss of soil fertility and changes in hydrology and microclimate (Runolfsson et al, 2004). The mining area of Rio Tinto is included in the Iberian Pyrite Belt (IPB), one of the largest metallic sulfide deposits in the world, extending to southern Portugal and the Rio Tinto region (Huelva, SW Spain). Soils, characterized by low pH, are strongly impoverished in macro- and micronutrients essential to the plant metabolism and contain very high concentrations of As, Cu, Fe and Pb (Monaci et al.2011). Manganese is an essential element for plant growth but its excess, especially in acidic soils, can affect plant survive disturbing physiological functions and mineral uptake. The aim of this study was to evaluate, in hydroponic culture, the effects of increasing Mn concentrations (0, 50, 100, 200 and 300 mg /L) on the uptake of a set of micro and macro nutrients in *Cistus salvifolius* L., a species native of the Rio Tinto region. After 15 d culture, plants were harvested and roots and shoots separately analysed; after digestion with (HF (50%) and HNO3 (65%) at a ratio of 1:2), elemental concentrations were measured by AAS (SpectrAA-Varian) with graphite furnace. Standard reference material (CTA-OTL 1) and blanks were considered for quality control as well. To identify the accumulation pattern of the investigated elements, leaves and roots were separately observed by a SEM-EDX microscope. Analytical results showed an influence of increasing Mn concentration in the uptake of some nutrients as Fe, Mg, K, Zn, with different trends detectable in root and shoot.

VARIATION OF THE CHARACTERISTICS OF TECHNOSOLS AFTER SEVEN YEARS FROM THE MESOCOSM SETTING UP

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Urban soil is composed by natural soils mixed to artificial material that can affect the properties, processes and quality of the native soil. These soils are classified as "Technosols" by the World Reference Base for Soil Resources. The aim of this study was to evaluate the quality variations of technosols sampled since 2010 to 2017 in 12 mesocosms (extension: 10 m2) at the University Campus of Monte Sant'Angelo (Naples). In 2006, the mesocosms were set up adding to the native volcanic soils, the resulting materials from the university campus edification. Spontaneous vegetation colonized the mesocosms and in 2010 compost (20 t ha^{-1}) was added to the soils to improve its evolution. Four soil samplings (0-10 cm depth) were carried out: in 2010 (pre-treatment), 2011 (after six months of compost addition), 2013 and 2017. The soil quality was evaluated by some indicators: pH, water content, organic matter, N content, C/N ratio, microbial respiration and biomass (C_{mic}), metabolic quotient (qCO_2), endogenous mineralization coefficient (CEM) and fungal biomass. In the first sampling, the studied soils were poor of N, organic matter, microbial and fungal biomass and showed high value of qCO_2. After compost addition no significant variation of physical and chemical parameters of the soils was observed, whereas an increase in microbial activity and biomass was detected. In 2017, the mesocosms valued a significant variation of all the indicators compared to the previous samplings with a drastic decrease of organic matter content, microbial activity, and microbial and fungal biomasses. On the contrary, CEM was four-fold higher than that at the pre-treatment, indicating a rapid loss of C from these soils.

BIOMAKER RACE: RESPONSE TO POLLUTION IN THE LIVERWORT LUNULARIA CRUCIATA IN THE ITALIAN "TRIANGLE OF DEATH"

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Different structural, biochemical and molecular responses are recently proposed as biomakers of environmental pollution. To test them, we used a liverwort regarded as a "champion" in the response to environmental pollution, so to engage a race between the different biomarkers in relation to efficiency, reliability, speed and economy. The liverwort Lunularia cruciata, known for being a pollution-tolerant species colonizing urban areas, was collected in the town of Acerra (South Italy), to investigate the biological effects of air pollution in one of the three vertexes of the so-called Italian "triangle of death". The results from Acerra were compared with those from the same species collected from the city center of Naples and a rural village located far from local sources of air pollution (Riccia, Molise, South Italy). Biological response to pollution was investigated considering heavy metal bioaccumulation, changes of physiological parameters as vitality, ultrastructural alterations, antioxidant activity, small heat shock proteins (shsp), gene expression examined by semi-quantitative PCR, and comet assay. Alterations of the cell ultrastructure, vitality impairment, increment of gene expression and antioxidant activity, DNA damage were observed and related to the environmental conditions in the three sites. Results showed that between the considered biomarkers the winner are...

EFFECTS OF SUNSCREEN-DERIVED TIO_2 NANOPARTICLES ON COASTAL MARINE MICROALGAE *DUNALIELLA TERTIOLECTA*

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Sunscreens represent one of the main source of engineered TiO_2 nanoparticles (TNPs) source in coastal ecosystems, especially during summer period. Their adverse effects were generally investigated using bare model TNPs and only few studies were based on the NPs extracted from commercial products. Therefore, this study aims to evaluate the effect of TNPs extracted from three different commercial sunscreens upon marine microalgae *Dunaliella tertiolecta*. Microalgae are suitable indicator for marine water pollution and because of they are at the base of the aquatic food web, any modification of their growth could affect higher trophic levels. In order to understand the effective role of the other sunscreen components in the toxic action of the TNPs, TNPs directly purchased from the industry, TNPs extracted from sunscreens and the whole sunscreens were evaluated at microalgae genomic (comet assay), cellular (ROS) and population levels (growth inhibition test). Preliminarily results showed that the toxic effect exerted by the whole sunscreen was lower respect to the toxicity of extracted TiO_2 and of TiO_2 industrial nanopowder for which similar EC50s were detected (EC50 24.39 mg/L[c.i 21.5-25.4] and 24.10 mg/L [c.i19.38-25.43] respectively). These findings suggest that the product formulation may mitigate the toxic effects of TNPs either by direct modification of TNPs properties (reactivity, bioavailability) or by providing organic and inorganic nutrients promoting phytoplankton and hence microalgae growth. Further studies are needed to better understand the real availability of the NPs for organisms also taking into account the UV radiation. Thus, it could be highlighted that the nanoparticles contained in the formulated products such as sunscreens seemed to represent a lesser threat for marine microalgae respected to industrial TiO_2 NPs, although stronger effects for more complex organisms, cannot be excluded.

PHYTOTOXICITY OF GREEN STABILISED MICRO-IRON USED FOR GROUNDWATER REMEDIATION

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Treatment with granular, micro- (mFe), and nano-sized (nFe) iron showed to remove several inorganic and organic pollutants. Recently, there has been a turnaround from nFe to mFe: mFe is cheaper than nFe (i.e. 10 €/kg for mFe compared to 100 €/kg) forming less agglomerates. We reported about the potential environmental impacts of mFe considering phytotoxicity effects on four types of iron powders: A (? 600 µm particle size (ps)), B and C (? 250 µm ps) and D (? 50 µm ps). Three macrophytes (*Lepidium sativum*, *Sinapis alba* and *Sorghum saccharatum*) were investigated (OECD, 2006) (seed germination, seedling elongation, germination index and biomass inhibition) exposing organisms to 20 g/L of each mFe stabilised in 2 g/L of Guar gum (GG) in deionized water (GGmFe), spiked with Cd (CdCl2) (1-100 mg/L). Considering real concentrations, preliminary results indicated: i) no adverse effects on *L. sativum* and *S. saccharatrum* versus all GGmFe; *S. alba* showed toxicity versus C and D GGmFe; ii) biostimulation was observed in *S. saccharatum* versus all GGmFe and *L. sativum* only versus C GGmFe; iv) mFe seemed to reduce Cd effects in all sample, but with a different efficiency: C > D > A = B; v) the presence of GG seemed to increase bioavailability of Cd.

PREDICTIVE MODELLING OF MARINE BIOTOXINS PRODUCTION IN ANTHROPIC ECOSYSTEMS

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The Harmful Algal Blooms (HABs) represent a significant and expanding threat for human health both for their consequences on coastal ecosystem and the direct impacts due to bivalve mollusc consumption. The Italian bivalve production is mainly located in the Northern Adriatic Sea, namely Friuli Venezia Giulia (FVG) and Veneto regions, where eutrophication and episodes related to HABs have occurred since the 70ies. In the recent years lipophilic toxins accumulation in shellfish, primarily Okadaic acid (OA) and its derivates, has become increasingly frequent. This toxins group is known to be produced by various Dinophysis species and Prorocentrum lima. EU established the mandatory weekly monitoring of Shellfish Production Areas (SPA) in order to ensure the compliance with the legislation limits for toxins in bivalve molluscs before being placed on the market. Despite their ecological, sanitary and economic relevance, bloom dynamics and toxins production are still poorly known, particularly in terms of the environmental variables triggering these processes. The aim of this study is to better understand the environmental mechanisms responsible for biotoxins production and accumulation in bivalves in order to implement an early warning system. Data regarding the presence of phytoplankton in water and OA in mussels derived by the 2015-2016 official SPA monitoring activities of the FVG and Veneto regions, together with environmental data acquired from satellite Earth observation, were analysed. A total of 2663 mussels samples were analysed and the presence of OA levels beyond the legislation limits was detected in 24 (FVG) and 43 (Veneto) cases. The developed models allow us to identify the main environmental variables related with phytoplankton presence and toxins production. Risk maps of toxic events occurrence were produced in order to understand the processes and timing that lead to the biotoxins presence in this area.

HOMEOSTATIC CAPABILITY OF A NATURAL MICROBIAL COMMUNITY IN A POLYCHLORINATED BIPHENYLS CONTAMINATED SOIL

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Among anthropogenic pressures, environment contamination is the main cause of biodiversity decrease with consequent reduction of several ecosystem services including those provided by microbial communities such as soil fertility. A historically Polychlorinated Biphenyls (PCBs) contaminated area in Southern Italy have been studied in order to assess the natural soil microbial community remediation capabilities. Uncontrolled spill and improper disposal of dielectric fluids (oil containing polychlorinated biphenyls) from electric transformers have resulted in PCB pollution over a 30-year period. A previous analysis by the Apulia Region Environmental Agency found that at several soil sample points there was PCB contamination exceeding the National legislative limit of 60 ng g^{-1} for gardens, parks and residential areas (Italian D.Lgs. 152/06), with the highest value being 220 ng g-1. Soil samples were collected in order to set up a microcosm experiment in different conditions consisting of the microbiologically active soil alone, in presence of a municipal waste compost and/or in presence of the plant *Medicago sativa*. The compost addition and *Medicago sativa* were used to assess the improvement in the soil quality. At fixed time (1 d, 133 d, 224 d) PCB markers and dioxin-like PCBs were searched for and the changes in the structure (cell abundance, phylogenetic characterization) and functioning (cell viability, dehydrogenase activity) of the autochthonous microbial community were evaluated. The overall results show the capability of the autochthonous microbial community to respond to PCB occurrence, transforming them and degrading low-chlorinated congeners (PCB 28, 52). Compost and plant co-presence significantly improved the soil quality in term of a higher overall microbial activity and cell abundance and promoted the high-chlorinated decrease.

INTERACTIVE EFFECTS OF FULLERENE NANOPARTICLES AND BENZO(α)PYRENE ON ZEBRAFISH EMBRYOS

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This study aims to assess the toxicological consequences related to the interaction of fullerene (C60) and Benzo(α)pyrene (B(α)P) on zebrafish embryos. First C60 was contaminated with B(α)P and significant sorption of the hydrocarbon on C60 was measured. C60 hydrodinamic behavior was evaluated through dynamic light scattering. Embryos were than exposed to C60 and B(α)P alone and to C60 doped with B(α)P. The uptake of C60 and B(α)P were investigated by immunofluorescence and transmission electron microscopy (TEM). The accumulation of C60 was also measured by spectrophotometry. A set of biomarkers of cyto/genotoxicity and oxidative stress and functional proteomics analysis were applied to assess the toxic effects due to C60 interaction with B(α)P. B(α)P adsorption on C60 influenced the hydrodynamic behavior of the nanoparticle increasing aggregation and sedimentation. As a consequence a higher accumulation of C60 was measured in embryos exposed to C60 alone respect to C60 doped with B(α)P. TEM observations showed the presence of C60 nanometric component within microvilli and internalized in enterocytes in embryos upon single and combined exposure. B(α)P accumulated in the gut of embryos exposed to B(α)P alone and combined to C60. C60 alone elicited oxidative stress in embryos, but not genotoxicity. On the contrary, B(α)P alone and the co-exposure did not induce oxidative stress, but an inhibition of GST activity was measured in embryos exposed to C60 doped with B(α)P. B(α)P alone generated significant DNA fragmentation and in co-exposure an increase of necrotic cells was observed. Functional proteomics revealed that C60 inhibited the expression of proteins involved in energetic metabolism. B(α)P alone acted on structural proteins and induced the expression of proteins involved in the homeostatic response to cellular stress. A similar pattern was observed upon exposure to C60 doped with B(α)P suggesting that the co-exposure induced cellular mechanisms similar to B(α)P.

CHARACTERIZATION OF VOLATILE ORGANIC COMPOUNDS FROM A LANDFILL SITE USING PROTON TRANFER REACTION 'TIME OF FLIGHT'-MASS SPECTROMETER

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CNR-ISAFOM

Waste materials buried in landfills can create environmental hazards such as production of greenhouse gases (GHGs), volatile organic compounds (VOCs) and odors. Although VOCs comprise only a small amount of the overall emitted gases, can diffuse into the atmosphere affecting tropospheric chemistry and regional air quality, thus representing a risk for human health. In this study, we used a recently developed Proton Transfer Reaction "Time-of-Flight" mass spectrometer (PTR-TOF-MS), featuring both high sensitivity and high mass resolution, for the real-time detection of VOCs emitted from landfills in the area known as "Terra dei fuochi". In this particular region, located between the provinces of Naples and Caserta (in Southern Italy), urban waste combined with industrial toxic material has been illegally dumped in old quarries or buried in the nearby countryside for decades. VOCs sampling by PTR-TOF-MS technology was performed from July to November 2016, drawing ambient air with an external pump (at a constant flowrate of ~27 l min-1) through a heated and coated PTFA Teflon inlet sampling line, from the top of a micrometeorological tower located approximately in the middle of 4 different landfills. PTR-TOF allowed to thoroughly screen the full mass spectra (ranging from m/z 0 up to m/z 350,000) during two different seasons, summer and fall, in order to carry out a qualitative characterization of the burden of compounds emitted by this landfill site. PTR-TOF-MS measurements allowed chemical formula identification of the detected protonated ions related to VOC having m/z below 237 (as compounds over m/z 237 being sticky and semi-volatiles, resulted in an uncertain identification), with a mass tolerance of +/- 3 mDa. Quantitative estimation of concentrations of these same VOCs in air was performed by theoretical calculation. The detected protonated ions include oxygenated VOC, aromatics, hydrocarbons and terpenes. In particular, oxygenated VOC were the most abundant. An advantage offered by the PTR-TOF-MS high time resolution is the detection and quantitative determination of smaller VOCs up to C5 (i.e. alcohols, aldehydes, acids, ketones) where analysis employing cartridges filled with adsorbent material for Thermal Desorption-Gas Chromatography-Mass Spectrometry (TD-GC-MS) for punctual measurements of VOCs concentration in air might give uncertain quantification.

SUITABILITY OF TOXICITY TEST BATTERY AND APPLICATION OF A TOXICITY INTEGRATED INDEX FOR THE ASSESSMENT OF PLASTIC LEACHEATES IN FRESHWATER ENVIRONMENT

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Plastic is a primary material in the production of intermediate and finished goods and in their packaging. Consumers deal with plastics every day in number of forms, from transportation vehicles to medical equipment, from electronics and apparels to furniture and furnishings. According to the European Association of Plastic Manufacturers, the plastics industry gives direct employment to over 1.45 million people in Europe, with a turnover of 320 billion euro and a production of 57 million tonnes of different plastic materials in 2013, whereas more than 299 million tons of plastics are produced annually worldwide. Considering the substantial half-life of all the different plastic materials, their accumulation in the ecosystems, especially as microplastic, causes an increasing environmental concern. A great deal of scientific research has been devoted to the oceans contamination by plastic and to its detrimental effect on marine ecosystem. Although freshwater and terrestrial environments are recognized as source and transport pathways of plastics to the oceans, there is still a lack of knowledge about these environmental compartments. This work is aimed at evaluating the adverse effects of microplastics on freshwater environment associated with their diffusion through the study of the toxicity of different polymers: polypropylene (PP), polyethylene (PE) and polystyrene (PS). Acute and chronic test were carried out using test organisms belonging to different kingdoms and trophic levels (the plants *Lepidium sativum*, *Sorghum saccaratum*, *Sinapis alba* and *Vicia faba*; the crustacean *Daphnia magna* and the luminescent bacteria *Vibrio fischeri*). This study pointed out that *V. fischeri* was the most sensitive test organism when acute tests are concerned, while *Vicia faba* was particularly sensitive to chronic test, showing visible damage such as necrosis and chlorosis. No significant toxic effects were observed for *S. saccharatum*, *L. sativum*, *S. alba*. Our results indicated that PP was the most toxic among the tested polymers. This toxicity could be related to the presence of solvents (methanol, cyclohexane) employed for its production. According our preliminary results, microplastics cause relevant adverse effects to different freshwater organisms.

TRENDS AND INDICATORS OF CHANGES IN A DECADAL TIME SERIES IN THE GULF OF NAPLES

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The LTER-MareChiara research program (LTER-MC), started in 1984, aims to study the structure and functioning of the plankton of the coastal system of the Gulf of Naples in relation with environmental characteristics and climate change. The weekly sampling frequency and the high taxonomic resolution make it a highly informative program for the study of plankton dynamics at the seasonal and interannual scale. Research conducted in the recent years outline LTER-MC as a relatively stable system, where the seasonally-driven biological and environmental variability is by far more pronounced than the inter-annual one. However, despite the noticeable resilience of the system, some significant trends and oscillations were detected over the years. For instance, a drastic decline in copepods abundance caused a decrease of the copepods- zooplankton ratio of approximately 20% in the last 8 years. Another significant change was seen in the abundance of species of the genus Pseudo-nitzschia, which includes toxic species and increased of about 25% over the summers of the last years. As to the size-structure of the phytoplankton community, small species increased until the end of the millennium followed by a trend reversal over the last years. Overall, changes observed in the plankton are more subtle compared to those seen, e.g., for temperature and salinity and do not show a close relationship with these variables. However, they could be indicators of environmental changes at the local or regional scale and have a direct or indirect relationship with the status/health of the Gulf of Naples ecosystem.

METHYLATION OF THE CIRCADIAN CLOCK GENE IN THE OFFSPRING OF A FREE-LIVING PASSERINE BIRD INCREASES WITH MATERNAL AND INDIVIDUAL EXPOSURE TO PM10

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The consequences of exposure to particulate matter (PM) have been thoroughly investigated in humans and other model species, but there is a dearth of studies of the effects of PM on physiology and lifehistory traits of non-human organisms living in natural or semi-natural environments. Besides toxicological relevance, PM has been recently suggested to exert epigenetic effects by altering DNA methylation patterns. Here, we investigated for the first time the association between the exposure to free-air PM10 and DNA methylation at two loci ('poly-Q exon' and '50-UTR') of the Clock gene in blood cells of the nestlings of a synanthropic passerine bird, the barn swallow (*Hirundo rustica*). The Clock gene is a phylogenetically highly conserved gene playing a major role in governing circadian rhythms and circannual life cycles of animals, implying that change in its level of methylation can impact on important fitness traits. We found that methylation at both loci significantly increased with PM10 levels recorded few days before blood sampling, and also with PM10 exposure experienced by the mother during or shortly before egg laying. This study is the first where methylation at a functionally important gene has been shown to vary according to the concentration of anthropogenic pollutants in any animal species in the wild. Since early-life environmental conditions produce epigenetic effects that can transgenerationally be transmitted, DNA methylation of genes controlling photoperiodic response can have far reaching consequences for the ecology and the evolution of wild animal populations.

PAH UPTAKE BY A MOSS CLONE (*SPHAGNUM PALUSTRE*) USING SPECIALLY DESIGNED DEVICES

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In the frame of the FP7 European project "MOSSclone", focused on the use of a moss clone for the standardization of an air biomonitoring protocol (patent EP3076171-A1; WO2016156443-A1), three different devices filled with devitalized *Sphagnum palustre* L. clone were tested for polycyclic aromatic hydrocarbons sampling: a new concept spherical device called "Mossphere", a "Mossphere" sheltered in the upper side, and a conventional metallic bell, with the moss disposed as a disk in the inside. These three devices were simultaneously exposed in different site typologies (background, rural, urban and industrial) in two campaigns (6 weeks each), and PAH contents were analysed. The Mosspheres showed higher values of total PAHs when compared to both sheltered Mossphere and bell. The sheltered devices seem to reduce the uptake of air particulate matter on the moss, which is significant in the case of the most polluted areas. Moreover, the effect of pollutant washout is negligible in the unsheltered devices. The differences among sites were wider in unsheltered Mosspheres, with total PAH concentrations from 3- to 5-fold higher in more polluted than in less polluted areas. Higher PAH concentrations were observed for the intermediate and heavy PAHs (compounds mainly associated to particulate matter) in the moss clone unsheltered Mossphere in contaminated sites. Among the specifically designed devices, Mossphere seems the more efficient for PAH monitoring. It presents some advantages in respect to conventional moss bags due to its configuration (a layer of moss between two spheres concentrically disposed) that permits a high exposure surface. The use of a Sphagnum clone permits to standardize the material used to set up the Mossphere, and the very low PAH contents of this clone makes it a good tool to monitor air PAH content also in remote and natural areas.

THE ROLE OF GREEN INFRASTRUCTURES IN CHANGING CLIMATE: THE URBAN RUNOFF MITIGATION IN AN URBAN CENTER OF NORTHERN ITALY

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Climate change in Northern Italy is expected to increase rainfall extreme events in the next decades. This can lead to flooding phenomena that affects local populations and their assets. Green infrastructures can play a fundamental role in the mitigation of urban runoff by favoring water infiltration and increasing evapotranspiration, thus providing an important ecosystem service. The present study provides an assessment of the water regulation service provided by green spaces in the urban center of Dolo (Northern Italy). This area is often subjected to urban flooding events, due to the insufficient capacity of its drainage network. Urban green infrastructures were mapped by processing the data of LiDAR (Light Detection And Ranging) survey at 50cm resolution. The urban runoff was calculated using the Soil Conservation Service - Curve Number (SCS-CN) method and projecting four different precipitation scenarios at 10, 45, 90 and 168mm. The potential reduction of urban runoff by green infrastructures was quantified through two indicators: the water amount of runoff reduction (?V) and the runoff reduction coefficient (Cr). Moreover, a vulnerability index of local population, based on the presence of children and elderly people and buildings conditions, was computed at sub-area (i.e. urban section) level. The results show that private properties are those that contribute more to urban runoff, while public properties provide higher levels of water regulation services. The analysis allows the identification of priority areas of interventions through combining hydrological values with vulnerability index, providing a suitable tool to address urban planning decisions based on an ecosystem-based approach.

EVALUATION OF TRACE ELEMENTS CONTENT IN BUFFALO MOZZARELLA PRODUCED IN TWO DAIRY COMPANIES

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Trace metals concentration in milk and dairy products is due to several factors such as not only the environmental conditions but also possible contamination during the manufacturing process. Southern Italy, that have 73% buffalo, is an important source of income for rural areas and in particular for Campania Region, which has a large number of them (254,030). Buffalo milk is entirely used for cheese production, especially mozzarella. The aim of this work was to assay some trace metals concentrations in the mozzarella and in milk sampled in two dairy farms of Caserta province. This study is a part of a larger work which involves a physico-chemical characterization of buffalo mozzarella, in different companies of the Campania Region, to emphasize the goodness of its peculiar characteristics, but also of healthiness that make excellence in Campania. The data showed that: (a) metals concentrations in milk were under low limits set; (b) Cu, Pb and Cr concentrations in buffalo mozzarella appeared similar to those found in milk, while Ni and Al concentrations were significantly lower; (c) Pb and Cd concentrations, the only present in the normative (1881/2006), were under low limits (1881/2006).

SPONTANEOUS PLANT COLONIZATION OF SOIL AND SLUDGES FROM THE BAGNOLI BROWNFIELD SITE: EFFECTS ON SUBSTRATE PROPERTIES AND POLLUTANTS MOBILITY

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This work was carried out on the brownfield soil and post-washing sludges from Bagnoli (Naples, southern Italy) dismantled steel plant, moderately polluted by Pb and Zn, with the aim to analyse the effects of spontaneous revegetation on chemical properties of substrates and mobility/bioavailability of pollutants. From 2006 to 2011, spontaneous plant colonization was monitored in presence or absence of acidic peat as organic amendment both inside the Bagnoli site and after transferal to the nearby Oak Park of Portici Royal Site. Both substrates, before and after plant growth, were characterized for the main chemical properties. Metals mobility and bioavailability were assessed using single (H2O; DTPA) and sequential extractions (EU-BCR). At the end of the experiment, plant ability to uptake metals was evaluated on selected species. Overall, 57 plant species healthily grew on the substrates, most of them were found in the Park of Portici (91%), showing plant colonization was mainly affected by the immediate environment rather than by substrate properties. Peat addition improved revegetation and increased plant biomass. The substrate properties (pH, O.C.) were slightly affected by plant growth. Metals speciation showed a low risk of Pb and Zn mobility being mainly trapped in the mineralogical structure of oxides and silicates. However, Zn water solubility and DTPA availability slightly increased in both substrates after plants growth. Restricted metal uptake and tissue accumulation by selected plants were measured. Phytostabilization with native plant species can be an efficient, environmentally appropriate and low cost technology for rehabilitation of industrial sites. The addition of organic matter may help the spontaneous revegetation. However, the changes induced by peat and plants in substrate properties appear to cause an increased solubilization of metal pollutants, suggesting a continuous monitoring of naturally revegetated brownfield sites as crucial step for environmental protection.

ANALYSIS OF MACROFOULING ASSEMBLAGE COMMUNITIES IN THE PORT OF LIVORNO AND NEAR MARINAS (TUSCANY, ITALY), WITH A PARTICULAR FOCUS ON ALIEN SPECIES

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The construction of port areas originates new enivironments characterized by high internal spatial heterogeneity and impacted by a number of anthropic activities. In this regard, the study of macrofouling assemblage communities in these environments can be a valuable method to evaluate the effects of different types of impact in port areas. Since the port areas are major hotspots for the arrival of alien species, the quali-quantitative determination of the presence of these species in macrofouling communities, in relation to different types of disturbance, can help to identify sensitive areas that could facilitate the establishment of non native species. For this purpose, in the present work have been sampled fouling assemblages by scrubbing docks and submerged artificial walls. In the port of Livorno have been identified different station, related to the destination use, and other stations have been located in three marinas (Molo Nazario Sauro, Ardenza and Antignano) located just to the south of Leghorn harbour. A preliminary analysis of samples showed a marked heterogeneity in terms of community structure related to the station which the samples came from, with the presence of several non-native species, among them the polychaetes *Syllis pectinans*, *Hydroides dirampha*, *Branchiomma luctuosum* and *Branchiomma bairdii*, the opistobranch *Anteaeolidiella lurana*, the isopod *Paranthura japonica*, the caprellid *Caprella scaura*, the ascidians *Styela plicata* and *Polyandrocarpa zorritensis*, the bryozoan *Watersipora sp*. and the sponge *Paraleucilla magna*.

AGRONOMIC USE OF OLIVE POMACE: SHORT AND LONG TERM EFFECTS ON N MINERALIZATION AND NITRIFICATION IN SOIL

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Olive groves are one of the most important tree crops in Europe, covering about 7 Mha in Mediterranean area, with Spain, Italy, Greece and Portugal accounting for more than 70% of olive oil extraction. As a consequence, an huge quantity of wastes to dispose is produced from these countries in a short period of time. However, due to the high content in organic matter, total N and available K, solid olive mill waste (olive-pomace) could be considered a good amendment, potentially able to restore soil properties in degraded agricultural ecosystems, in spite of the content in tannins and polyphenols affecting microbial activity. In a previous study, we showed that pomace amendment increased soil quality as assessed by a minimum data set of soil chemical and biological parameters, but, in the short time, had no effect on nitrate content in soil. In this study, we carried out a laboratory experiment (under controlled conditions of soil moisture and temperature) to test the effects of fresh and composted pomace amendment (with or without the addition of a mineral fertilizer) on N mineralization and nitrification in a no-amended and 8-years amended soil. The results showed that, on the short time, pomace addition did not stimulate N mineralization and nitrification in both soils, with an almost complete inhibition of nitrification in the soil amended for long time.

PCB-OXIDIZING BACTERIA ALONG THE PASVIK RIVER (HIGH ARCTIC NORWAY)

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Anthropogenic impact over the Pasvik River (Norway) is mainly caused by emission from runoff smelter and mine wastes, as well as domestic sewage from the Russian, Norwegian and Finnish settlements situated on its catchment area. The river flow could have a pollutant effect also on the fjord system up to the larger Varanger fjord. Within the multidisciplinary project SpongePOP (EU INTERACT), this study aimed at describing the influence of polychlorinated biphenyls (PCBs) on the bacterial communities along the River. Sediment and sponge samples were collected from 11 stations during two seasonal surveys in 2014 (May and July). A total of 507 strains (451 and 56 from sponge and sediment, respectively) were isolated. Among them, 126 were able to grow in the presence of the polychlorobiphenyl mixture Aroclor 1242 (86 and 40 from sediment and sponge, respectively). The presence of the bphA gene portion was positive, as determined by PCR, in 45 isolates (36 and 9 from sediment and sponge, respectively), proving their ability to degrade PCBs in the river system. The subsequent phylogenetic affiliation showed that the strains belonged to the genera Pseudomonas and Serratia (among the Gammaproteobacteria) and Arthrobacter (among the Actinobacteria).

HEAVY METAL TOLERANT BACTERIA FROM CONTAMINATED SITES ALONG THE PASVIK RIVER (HIGH ARCTIC NORWAY)

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The Pasvik River (Arctic Norway) is the largest river system in the northern Fennoscandia and represents a border area between Finland, Russia and Norway. The human activity developed in recent years has meant that the river became deposit of numerous pollutants, including heavy metals. A localized contamination by HMs probably exists in sites where materials (e.g. bombs, ammunition, bullets) of the Second World War were discharged. Within the multidisciplinary project SpongePOP (EU INTERACT), this study aimed at describing the HM-tolerant bacterial communities along the River, in relation to HM contamination. Water and sediment samples were collected from 11 stations during two seasonal surveys in 2014 (May and July). For bacterial isolation, samples were opportunely diluted and plated on agar plates amended with different heavy metal (HM) salts a different concentration (up to 10.000 ppm). The concentration of eighteen HM in samples were determined by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) after pyrohydrolysis with HNO_3 and H_2O_2. Of the totally isolated strains, isolates that tolerated high concentrations (between 1000 and 5000 ppm, depending on the metal) of metals were tested for multitolerance and identified by the 16S rRNA gene sequencing. A total of 43 isolates (29 and 14 from sediment and water samples, respectively) showed multitolerance. Multi-tolerant isolates mainly belonged to the Gammaproteobacteria and Actinobacteria, followed by Bacteroidetes, Firmicutes with the genera Stenotrophomonas, Pseudomonas, Serratia and Arthrobacter that were well represented.

BACTERIAL AND ARCHAEAL COMMUNITIES IN ANTARCTIC BRINE POCKETS

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Two distinct hypersaline brine samples (TF4 and TF5), separated by a 12 cm-thickened ice layer, were collected from a perennially frozen lake in Tarn Flat (TF), Antarctica. DNA libraries for Ion Torrent sequencing (Ion 314 chip) were prepared from extracted DNA by PCR using the engineered primers 27f and 338r. The raw data were analyzed using bioinformatics tools to determine the quality criteria of the reads. Differences of the prokaryotes communities between TF4 and TF5 were investigated via linear discriminant analysis effect size. Prokaryotic functionality was characterized using a functional inference-based (predicting functional profiles from metagenomics 16S rRNA, Tax4Fun) approach. The two sites shared only 22.2% and 18.5% of OTUs for Bacteria and Archaea, respectively. In both archaeal and bacterial communities Shannon diversity was higher in TF5 than TF4 (p value).

UNDER ICE FLAGELLATES BLOOM DURING LATE AUSTRAL SPRING AND SUMMER IN TERRA NOVA BAY (ROSS SEA, ANTARCTICA)

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Stazione Zoologica Anton Dohrn

Water samples, under the pack ice from 0–100m, were collected in a coastal area in Terra Nova Bay (Ross Sea) from December to January (2015-2016). We investigated the phytoplankton community and their variation over time. Flagellates, phytoplankton composition were represented by flagellates, in which a 41% was the Chrysophyceae, Pentalamina corona. After that, a gradual increase of the Prymnesiophyte Phaeocystis antarctica were observed. The maximum abundance of P. antarctica were reached at 30 m on 30th December with 28 106 cell/l (51%). At the same time the 41% were represented by the Chrysophytes Ochromonas spp. with 23 106 cell/l. P. antarctica decreased in terms of cell concentration but remained the most abundant species within the phytoplankton community (up to 92% with 17 106 cell/l) until the end of the sampling where diatoms represented the most abundant group (19th January). For the first time a high to a very high portion of flagellates, from 40% up to 91%, of the total phytoplankton community was observed in the Ross Sea. The flagellate assemblages showed a different temporal pattern under the ice and along the water column, probably in relation with abiotic parameters. The ecological role of these flagellates under the pack ice should be studied in detailed.

COMBINED EFFECT OF IONIZING RADIATION AND LIGHT QUALITY ON MUNG BEAN SEEDLINGS: IMPLICATIONS FOR GROWTH IN SPACE ECOSYSTEMS

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In the view of long-term manned missions for Space exploration, the knowledge of mechanisms of plant resistance to IR is an open challenge for biologists. The selection of the best plant species to be cultivated in closed ecosystems on board space platforms, should consider not only the plant role in regenerating resources (e.g. oxygen and air), but also their importance as source of edible biomass for astronaut diet. In order to reach efficient plant growth, it is important to modulate the lighting during cultivation, also considering its possible interaction with space factors, such as IR. In this study, we analyse the behaviour of mung bean (Vigna radiata L.) seedlings grown at different light quality regimes (W-White, R-Red and RB-Red-Blue light) after the exposure of germinated seeds at three doses of X-rays (0.3, 10 and 20 Gy) along with the non-irradiated control. Plant growth was monitored by measuring stem elongation, dry biomass, and total leaf area. Fluorescence a emission measurements, the amount of chlorophyll and carotenoids, as well as the Rubisco level, were analysed to evaluate the integrity of the photosynthetic machinery. More specifically, we evaluated the possibility that different light qualities would affect plant capability to withstand IR. Our results showed that the growth under R wavelengths promoted stem elongation compared to W and RB, independently from applied X-ray dose; the different doses did not cause changes in root length and root/shoot ratio. The RB treatment was responsible for the lowest production of chlorophylls and carotenoids at all doses of X-rays. Photochemistry was affected by neither different light regimes nor X-rays doses. R light induced a higher stability of protein expression level that was insensitive to the delivered dose of X-rays. Overall results indicate that the growth under R light helps seedlings to buffer the effects of different X-ray doses.

DWARF BEAN AS ELIGIBLE CANDIDATE FOR CULTIVATION IN ARTIFICIAL ECOSYSTEMS IN SPACE: HEAVY IONS-INDUCED CHANGES IN HIGHER PLANTS

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In the view of Space exploration, plants will have a key role in Bioregenerative Life Support Systems (BLSSs) to sustain human permanence in extraterrestrial environments. In Space, plant growth might be strictly inhibited by ionizing radiation of different quality and type. Within this framework, there is common agreement on the need to investigate plant response to ionizing radiation as one of the most limiting Space factors. This study aimed to test the effects of sub-lethal doses (1, 10 Gy) of C and Ti heavy ions, provided at dry-seed stage, on the development of dwarf bean plants (Dolichos melanophtalmus DC.) to assess whether low doses of heavy ions may induce stimulation of specific physiological traits rather than cause constraints in plant growth and photosynthesis. To reach this goal, the life cycle of plants from irradiated seeds was followed from seed-to-seed. Plant development was monitored by recording plant height, leaf area, number of leaves, flowers and pods. Photosynthesis was monitored by fluorescence measurements and photosynthetic pigment content amount. The occurrence of oxidative stress, as well as plant capability to counteract the radiation-induced changes, was assessed by the determination of endogenous hydrogen peroxide production, acid ascorbic amount and poly (ADP-ribose) polymerase (PARP) activity. Our results showed that all plants complete the life cycle, producing new seeds; however C ions at dose of 10 Gy induced constraints in plant growth, seed production and leaf lamina expansion, compared to control and other treatments. Photosynthetic activity was also reduced by 10 Gy C treatment. Both C and Ti ions at dose of 10 Gy determined a significant an increase in intracellular hydrogen peroxide, ascorbic acid amount and PARP activity. The overall results indicate that both C and Ti ions at the dose of 10 Gy stimulate defense mechanisms in dwarf bean plants, thus preventing harmful consequences that may compromise plant viability.

IMPACT OF MICROPLASTICS ON BENTHIC DEEP-SEA ECOSYSTEMS OF THE MEDITERRANEAN SEA

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Deep-sea environments (beneath 200 m depth) are the largest biome of the world and represent more than 95% of the global biosphere. Global change and anthropogenic impacts, including the input of plastic litter, are threatening the deep-sea ecosystems. Indeed, recent studies revealed the presence of plastic debris in bathyal and abyssal sediments of the Atlantic and Indian Oceans and in the Mediterranean Sea, and plastic fragments have been also reported within deep-sea fish and other organisms. However, the quantitative relevance of (micro)plastics in deep-sea ecosystems, and the extent to which such components affects benthic deep-sea life is practically unknown. In the present study, we determined the abundance and typology of plastic debris (from 5 millimetres down to few micrometres) in different sub-marine canyons of the Mediterranean Sea, which are expected to be major sinks of marine litter. In addition, we performed laboratory experiments to assess the impact of microplastics on two deep-water coral specimens, *Dendrophyllia cornigera* and *Madrepora oculata*. Sediment samples and coral specimens were collected in the Tyrrhenian, Ionian and Southern Adriatic Seas at depths ranging from 200 to 1400 m in the framework of RITMARE project. Sampling was performed along bathymetric gradients from the shelf break down to the inner part of the canyons. Here, by using a procedure specifically optimised for extracting microplastics from deep-sea sediment samples we provide results on the abundance and identity of plastic fragments determined by a combination of different techniques (optical microscopy, SEM and FT-IR spectroscopy). We also show the results of the responses of the deep water corals incubated in aquaria with different concentrations of various microplastic polymers. Results obtained in this study provide new insights into the potential impact of microplastics on benthic deep-sea ecosystems.

EXPLORING THE BIODIVERSITY OF POLYCHAETES AND THEIR MICROBIOMES AT TERRANOVA BAY (ROSS SEA, ANTARCTICA)

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The Ross Sea (Antartica) is an important site for deep-water formation and one of the most productive areas of the Southern Ocean, representing a hot spot of biodiversity. Antarctic polychaetes represent one of the dominant taxa of benthic marine communities (which account for more than 70% of macrofauna) and key components of food webs. In different marine ecosystems, polychaetes can live associated with microbes, which play key roles in driving host functions, nutrition and health. However, studies on such associations in Antarctic ecosystems are still very limited but they could be fundamental for understanding the adaptation strategies of Antarctic polychaetes to extreme environmental conditions. In the present study, we compared the diversity of polychaetes based on morphological and molecular-based approaches and we investigated the diversity of associated microbial assemblages. To do so, polychaetes were collected in the framework of the Italian National Program of Antarctic Research (XXX Italian Expedition in Antarctica) at Terra Nova Bay (Ross Sea), in three selected areas characterized by different trophic conditions and at increasing distance from the coastline (25m, 70m, 140m). Polychaetes, previously morphologically identified, were used for molecular analysis targeting COI, 12S and 16S rRNA genes of the animals and 16S rRNA of the associated prokaryotes. Amplicons of animal target genes were sequenced bySanger, whereas those of prokaryotes by high-throughput sequencing approach (i.e. Illumina MiSeq). Results of this study expand our knowledge on the biodiversity of polychaetes inhabiting Antarctic ecosystem and provide new insights on the potential factors influencing the diversity of associated microbial assemblages.

PHYTOPLANKTON FROM THE TARA ARCTIC EXPEDITION: DIVERSITY AND DISTRIBUTION

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The TARA Arctic Expedition is an interdisciplinary study which aims at studying the planktonic system of the Arctic Ocean from viruses to zooplankton based on a sampling campaign at 20 stations conducted from May 2013 to October 2013. Within this project, we studied phytoplankton diversity and distribution across the Arctic Ocean based on light and electron microscopy analyses of samples collected by Niskin bottles and plankton nets. A total 199 taxa were identified: 55 Dinophyta, 119 Bacillariophyta, 7 Prymnesiophyta (of which 4 coccolithophores) and 18 taxa belonging to other groups. Phytoplankton abundance and species composition greatly varied across the study area and even among samples from the same area. Diatoms were dominant in the northern Baffin Bay, in the Chuck Sea and at one station of the Kara Sea, which showed the highest phytoplankton density (1.83 x 106 cell•L-1) due to a bloom of Chaetoceros spp.. In the northern Baffin Bay and in the Chuck Sea the most abundant diatoms were still species belonging to the genus Chaetoceros, whereas pennate diatoms, including the colonial species Fossula arctica, were only abundant at another station of the Kara Sea. Prymnesiophytes, most probably non-colonial stages of Phaeocystis spp., showed a peak (> 90 %) in the Norwegian Sea, whereas undetermined small flagellates were dominant at several sites. Dinoflagellates were never abundant across the area investigated and coccolithophores were only recorded at stations influenced by Atlantic waters. While a detailed comparison of the spatial distribution with the hydrographic characteristic of the different subareas is still pending, preliminary analyses showed phytoplankton communities grouping based on their geographic position and temperature.

VOLUNTEERS INVOLVEMENT IN A CITIZEN SCIENCE PROJECT: THE CASE STUDY OF “IL PESCE GIUSTO”

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The involvement of citizens in different phases of scientific research projects, also known as Citizen Science (CS), is becoming an increasingly integral part of the contemporary scientific research.
During the realisation of a CS project many decisional steps have to be faced and multidisciplinary elements have to be considered like the economical ones (the resources to develop and promote the project), technological (the tools to gather, analyse and validate data), and management (establishment of the project team and the geographic or temporal scale to cover). Moreover, researchers have to properly focus on social aspects like the target and also the definition of the real motivations of citizen scientists. All those aspects are part of a decisional process that we have faced during the realisation of “Il pesce giusto”, a citizen science campaign for the sustainable consumption of marine resources. Herein, general data related to the volunteer involvement phases in the Argentario area are discussed, particularly how to spread the project, how to recruit participants and how to collect data. This local case study area has been identified, as the literature suggests, to maximise the invaluable face-to-face promotion through events and talks in order to connect volunteers and researchers and to build a sense of community. By this way, it will be possible to compare the efficacy of in-person and virtually recruitment. Difficulties come to light in the crucial aspect of the role of the volunteers in the project: the co-created project, very recommended by literature, represent unfortunately a highly cost-effective approach; a contributory approach had to be chosen. The main obstacles are illustrated as well as the answers we found across literature.

ITALY, A BRIDGE BETWEEN EUROPE AND AFRICA, AND ITS XEROPHYTIC SPECIES

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Mediterranean regions are characterized by great biological diversity. As result of several orographic, geographic and climatic conditions, Mediterranean ecosystems are recognized as biodiversity hotspots and are a primary target of conservation efforts. Italy forms a kind of bridge between Europe and Africa along which the transition from temperate to mediterranean macrobioclimates occurs. The coastal areas of the peninsula, as well as the Appennines and pre-Appenines areas, have numerous xerothermic habitats, where local climatic conditions allow the survival of biocenosis associated with warm-arid climates. Examples of habitats characterized by xeric conditions are the dry pasture, the Alpine siliceous gravel, the Alpine and Apennines cliffs. Plants of Mediterranean environments generally have distinctive features and adaptations that can help them to cope up with environmental stress and, presumably with the effects of climate change. For example, first, they can migrate to areas that have more suitable environmental features; secondly, they can adapt to new environmental conditions through phenotypic plasticity and, thirdly, they can evolve according to natural selection. The relative importance of these differentiated responses for each species will depend on a variety of factors, such as intensity and direction of environmental change, morphological evolution of the plants, permanent genetic variation, and interactions between existing species. Xerophyte plants, often not more considered in Mediterranean environments, are extremely useful for a bioclimatic reading of the environment and to understand the complex adaptations required to occupy extreme ecological niches. The purpose of this paper is to illustrate the main xerophyte plant species present on Italian district and their adaptations.

IF DANTE HAD KNOWN PHYTOPLANKTON: PART I THE INFERNO: THE HARMFUL ALGAE BLOOMS

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Microalgae are plants that form the base of food webs. Sometimes, however, their roles are more sinister. Under the right conditions, algae may grow out of control — and few of these “blooms” produces toxins that can kill fish, mammals and birds, and may cause human illness or even death in extreme cases. Other algae are nontoxic, but use all the oxygen in the water when they decay, clog the gills of fish and invertebrates or smother corals and submerged aquatic vegetation. Moreover they cause discolored water, form huge, smelly piles on beaches or contaminate drinking water. Collectively, these events are known as harmful algal blooms, or HABs. However, in Italy, awareness of their existence in nature and their toxicity is not widespread outside the scientific world. This work, adressed to High School students, was developed under the "Alternanza Scuola - Lavoro" project (Italian Law n. 107/2015) between the Liceo Classico "G. Palmieri" of Lecce (Italy) and the Environmental Protection Agency of Puglia (ARPA), Department of Lecce (Italy). In particular, this work wants to describe allegorically the “HABs’ world” with themes of Italian literature. Specifically, since HABs can be defined as “bad” due to their negative characteristics, some of these algae have been assimilated to sinful souls that, during their journey into the Hell (Inferno) of the Divine Comedy, Dante and Virgilio come across.

SQUIRRELS@SCHOOL: HOW TO INCREASE KNOWLEDGE ABOUT INVASIVE ALIENS

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Invasive species are the second largest threat to biodiversity after habitat loss, but this threat is largely unknown to citizens. Increasing the awareness and promoting social participation is thus fundamental to allow the enhancement of invasion management. This is the goal of information and education activities carried out in the framework of the LIFE U-SAVEREDS Project, which is tackling the issue of the introduction of the Eastern grey squirrel (*Sciurus carolinensis*) in Umbria, Central Italy. Beside concrete conservation actions, the Project is implementing a specific Information and Communication Plan to spread knowledge about the competition between the grey and the native red squirrel squirrel (*Sciurus vulgaris*) , and also about the impact of the alien species on forest biodiversity in general. In particular, through the educational activities it aims at the involvement of younger citizens in the preservation of biodiversity and nature. The 'Squirrels@School' campaign provides specific educational pathways to the schools of Umbria (Perugia and Corciano Municipalities) and Perugia, aimed both at pupils and teachers. For two years, educational activities have been carried out to properly inform the pupils about biodiversity conservation issues and the problems arising because of the introduction of alien species, and to provide analysis tools and knowledge on local biodiversity. Within the LIFE Project, environmental education is thus playing a role to raise awareness among citizens on the importance of biodiversity, on the need to remove invasive species and it is promoting virtuous actions and behaviors in defense of biodiversity.

L'ANISN, UNA GRANDE RISORSA PER I DOCENTI DI SCIENZE

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ANISN

L’Associazione Nazionale Insegnanti di Scienze Naturali (ANISN) (http://www.anisn.it/nuovosito/) è nata nel 1979 con l’intento di supportare l’attività dei docenti di Scienze delle scuole secondarie di primo e secondo grado. È ente accreditato per la formazione dei docenti, per la valorizzazione delle eccellenze con le Olimpiadi delle Scienze Naturali nazionali ed internazionali e con i Giochi delle Scienze Sperimentali. È stata soggetto promotore del programma SID e partner di vari progetti europei tra cui Scientix (http://www.scientix.eu/) che ha visto diversi docenti Italiani impegnati a livello europeo nella promozione dell’Insegnamento delle discipline STEM. Orgoglio della sezione Campania è la pubblicazione semestrale del “Bollettino”, che rappresenta uno strumento utile per la condivisione di buone pratiche d’insegnamento e novità dal mondo scientifico.

DEVELOPMENT OF A PROCESS-BASED MODEL TO EXPLAIN THE PHYSIOLOGICAL MECHANISMS BEHIND THE EARLYWOOD-TO-LATEWOOD TRANSITION

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In extratropical ecosystems, the growth of trees is cyclic, producing tree rings composed of large-lumen and thin-walled cells (earlywood) alternating with narrow-lumen and thick-walled cells (latewood). So far, the physiology behind wood formation processes and the associated kinetics have been rarely taken into account in relation to the emergence of this particular pattern. We developed a mechanistic mathematical model that simulates the development of conifer tracheids, explicitly considering the processes of cell enlargement, and cell-wall deposition and lignification. The model is based on the assumptions that (1) the process of deposition of microfibrils of cellulose affects the elasticity of cell walls gradually slowing down cell enlargement; and that (2) the deposition of cellulose and lignin is regulated by the availability of soluble sugars. The model was calibrated using anatomical data from the xylem of three conifer species growing at the Alpine treeline in northern Italy and two species of the Canadian boreal forest. Simulation results show that the model reliably reproduces the anatomical traits and kinetics of the simulated species. In spring, at the beginning of the growing season, the low sugar availability in the cambium results in slow wall deposition that allows for a longer enlargement time producing large cells with thin walls (i.e. earlywood). On the other hand, in late summer and early autumn, high sugar availability produces narrower cells with thick cell walls (i.e. latewood). This modelling framework provides a mechanistic link between plant ecophysiology and wood phenology and a useful tool to unravel how environmental changes could impact wood anatomy.

A CELL-BASED APPROACH IN MODELLING PLANT TISSUES RESPONSE TO ECOLOGICAL STRESSORS: THE CASE OF FIRE SCARS

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Plant tissue behaviours are known to be dependant on both cell-cell interaction and subcellular dynamics. This, together with the complexity of genetic networks underlying subcellular dynamics, makes very hard to experimentally test hypotheses about morphogenesis and stress response without losing important informations. Computer simulations developed in the last ten years could be valuable additions to the biologist's toolbox, also helping disentangle the aforementioned multi-scale interactions and giving valuable insights over theoretical hypotheses. VirtualLeaf is a cell-based framework for modelling plant tissue dynamics, able to describe mechanical cell-cell interactions and subcellular dynamics using simplified cells. We effectively used VirtualLeaf to test general hypotheses regarding the effect of cell wall thickening on cell growth both for isolated cells and whole tissues. We found that the way thick cells are arranged inside a tissue has implication on how the tissue shape evolves in time and also impact on cellular properties like proliferation trajectories and cell shape and area. Here we developed a simplified model of cell proliferation in a trunk wounded by a fire. The starting point of the simulation was a virtual tissue whose boundary layer (i.e. the cambium) proliferates in every point except for a small "hard" zone (i.e. the scar). We assumed this is the state of the tissue after wood compartmentalization and callus formation, thus avoiding the complication of simulating cell de-differentiation. We then programmed a description of mechanical interactions among cells, and formulated rules for cell growth and division. The time dynamics of the simulated tissue show that the existence of a fire scar causes an alteration of the growth trajectories of the cells proliferating around the scar, that is engulfed in the tissue as a consequence of this alteration. The final state of the simulation is comparable with a real tissue, supporting the hypothesis of mechanical dynamics as fundamental drivers of the engulfment process.

AQUATIC VEGETATION LOSS AND ITS IMPLICATION ON CARBON CYCLE IN A FRESHWATER WETLAND

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Freshwater wetlands suffered heavy pressures during the last decades, resulting in dramatic losses of aquatic vegetation and the consequent decrease of the ecosystem services provided by these environments. The present study investigated the effects of aquatic emergent vegetation loss on carbon cycle of a freshwater wetland dominated by *Phragmites australis*. Particularly, the vegetation loss during the period 1985-2016 was detected by processing satellite images and described by vegetation indexes. Leaf litter decomposition was measured by collecting litterbags after 7, 30, 60, 120 and 180 days (November 2016-May 2017). Experiments were replicated in two stations (vegetated and bare sediment) and with different mesh sizes (10x10mm and 1x1mm). Moreover, net primary productivity, carbon content in leafs and sediments, water chemistry and macrobenthonic fauna living on litterbags were described and measured. The total mean decay rate was 0.00643 d^{-1}, with highest mean values for 10x10mm mesh size in bare sediment station (0.00827 d^{-1}) and lower mean values for 1x1mm mesh size in vegetated station (0.00525 d^{-1}). Echinogammarus sp. was the dominant taxon of the macrobenthonic fauna in all the replicates, demonstrating its importance in the leaf breakdown process. Results also highlighted that *P.australis* productivity exceed the rate of leaf decomposition, making this wetland a carbon sink. However, aquatic vegetation loss in time resulted in important losses in terms of carbon sequestration capacity. This study demonstrated that *P.australis*-dominated wetlands should be regarded and managed as important carbon sink, with the aim to maximize their capacity to mitigate climate changes.

THE TREE-TALKER - COST-EFFECTIVE IOT WIRELESS TECHNOLOGY FOR PLANT STRESS INDICATION

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Extreme climate, pathogen infections, are triggering important plant physiological functions such as water and carbon exchanges. Intensity, duration, timing and frequency of stressful events are responsible of threshold-type non-linear responses that can drive ecological systems to abrupt shifts between alternative stages or to collapse (tipping points). Often tree responses are delayed or induced by memory effects driven by persistent climate anomalies or directly respond to specific climate shocks. To identify in real time shifts and anomalies in biological patterns and onset of tipping points long term high frequency monitoring is required. Such new scale of investigation, compared to inter-annual observations of tree growth and defoliation patterns, can help not only to highlight emergent properties of system behavior in response to perturbations but also to set up early warning strategies of forest management. A monitoring network suitable for such goal should have a sufficiently large scale dimension and high frequency monitoring of both plant stress indicators and climatic variables. To meet this goal at affordable costs cost-effective wireless technology for plant stress indication is needed. Recently Internet of Things technologies (IoT) have grown rapidly and represent today a unique opportunity for improving our environmental monitoring capabilities allowing real time data transmission and massive monitoring points at low cost. We present a new cost-effective IoT wireless technology for plant stress monitoring, the “TREE-TALKER” equipped with low cost sensors to monitor 1) tree radial growth, as indicator of photosynthetic carbon allocation in biomass; 2) sap flow, as indicator of tree transpiration and functionality of xylem transport; 3) stem water content, 4) light penetration in the canopy in terms of fractional absorbed radiation and 5) light spectral components related to foliage dieback and physiology. Additional parameters such as soil temperatures and moisture and meteorological variables can also be monitored at high frequency. Each device is provided with one micro-controller (ATmega328) which also acts as connection wireless system (using a ESP8266 low power chipset) to a telephone network and internet allowing to remotely control and dowload in real time data collected every 15 minutes. All the sensors acquisition and wireless transmission work in sleep mode until there is a request of data transmission to optimize power consumption.

INTERREG MED BLUEISLANDS PROJECT: IDENTIFICATION AND MITIGATION OF THE EFFECTS OF THE SEASONAL VARIATION OF WASTE GENERATION ON MEDITERRANEAN ISLANDS DRIVEN BY TOURISM

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BLUEISLANDS - Seasonal variation of waste as effect of tourism - is an EU- financed project within the 2014-2020 INTERREG MED program. It is led by the Ministry of Agriculture, Rural Development and Environment of Cyprus and brings together 14 partners from 8 countries in the effort to address and mitigate the effects of waste generation in 9 Mediterranean islands driven by tourism. The project will assess seasonal variation of marine litter and seawater quality, set-up action plans through which waste generated can most effectively be addressed, and evaluate the efficacy of each action plan. The environmental impact of tourism will be evaluated by the two research partners, UAB (Autonomous University of Barcelona, Spain) and CoNISMa (National Inter-University Consortium for Marine Sciences, Italy). UAB will assess the marine litter dynamics (including micro- and macroplastics) in coastal areas of the 9 Mediterranean islands. The amount and type of marine litter found on 3 selected beaches of each island, as well as in the surface waters and the underlying marine sediment will be regularly monitored, covering high and low touristic seasons. The selected beaches encompass different case-scenario including high and low touristic destinations and the surveys' results will be used to assess the impact of tourism on the amount and type of waste generated. CoNISMa will monitor the impact of tourism on coastal waters through short-term macroalgae deployments in impacted and control sites during the tourist peak and reference seasons in three Mediterranean islands. Macroalgae are useful bioindicators, as they absorb and assimilate nitrogen in a very short time; the occurrence and extent of plumes of nutrients of anthropogenic origin will be detected through their nitrogen stable isotope composition (?15N). This approach represents an efficient early-warning system for seawater quality monitoring, helpful for environmental managers.

MODELLING THE GROWTH OF SPARUS AURATA JUVENILES IN THE LAGOON OF VENICE

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Differences in the growth of juveniles of gilthead seabream Sparus aurata were studied by means of an integrated modelling-data approach. This was based on a mathematical model of fish juveniles, and on new empirical data collected in the lagoon of Venice, an important nursery area located in the Northern Adriatic Sea. The study was carried out in two tidal creeks, which were selected with the aim of comparing juveniles growth in two contrasting habitats. These creeks were characterized by comparable resources availability, but showed differences in the thermal characteristics, induced by their different morphological features. A bioenergetic Scope for Growth model, previously developed for adult gilthead seabream, was re-parameterized for the specific goals of this work. In particular, values of parameters defining fish catabolism were estimated on the basis of species specific literature studies, while the parameter defining the fish energy intake was re-calibrated independently on the time series of weight data collected at the two sites. The model included a heat exchange module, previously validated for the Venice lagoon, which is capable to estimate hourly water temperature based on hourly air temperature and the specific bathymetric features of the site. Field data characterizing the composition of the seabream juveniles diet in the lagoon were adopted to force the model. Field data showed differences in the seabream juveniles growth pattern in the two studied habitats. Model calibrations allowed to estimate the net energy intake at each site. Observations on the degree of stomach fullness of the fish, and on diet composition, were used to corroborate model results. These preliminary results allowed to focus on the different role of thermal conditions and thropic availability in shaping the growth of seabream juveniles. We believe that this work can be of interest for informing the future management of nursery areas in the framework of climate change.

DO PARASITES PREFER SALTIER ENVIRONMENTS? A LARGE SCALE SAMPLING TO VERIFY PARASITES'DIVERSITY ALONG A SALINITY GRADIENT

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Studies on host-parasites interaction are recently going under deeper attention by the scientific community. Parasites are strongly capable to influence the population dynamics and possibly give important information on the food web structure, biodiversity and environmental stress. Interactions between parasites and their hosts are expected to change in relation to climate change, especially in enclosed basins such as the Baltic Sea, characterized by a combination of fresh water discharge and limited water exchange, which in turn generates a strong large-scale salinity gradient. During recent years, changes in heat waves frequency, precipitations and drought are occurring in the Baltic Sea, and the impact of all these correlated phenomena is expected to generate modifications in delicate interactions such as the host-parasites one, leading to lack of defences in the hosts but possibly also threatening the different steps of parasites' complex life cycle. The aim of this study is to analyse the correlation between parasites' load and biodiversity, following the salinity gradient of the Baltic Sea, using the periwinkle *Littorina littorea* and the mussel *Mytilus edulis* as target and host species, respectively. A field sampling was run on the East coast of Germany and along the Danish coast, where the salinity gradient ranges between 9 and 25 PSU. Specimens collected were transferred at the laboratory, the size registered, and then freshly dissected under microscope to verify the presence of parasites and assess their abundance. This study represents the first attempt to analyse the effects of salinity shifts in the host-parasites interaction in order to run in the near future laboratory experiments, which will allow to foresee the future modifications due to climate change.

FOOD-WEB MODELS TO INTEGRATE PLANKTON DIVERSITY AND ECOSYSTEM FUNCTIONING IN THE LAGOON OF VENICE (ITALY)

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The overwhelming biological diversity of plankton cascades in a broad array of physiological requirements and performances, trophic behaviours and adaptive potential to environmental changes. A further complexity component is provided by inter-specific trophic interactions establishing among plankton organisms. To this respect, plankton (and, thus, ecosystem) functioning is strongly dependent from both species-specific behaviour (sensu lato) and the tangled and nested plankton food-web. Recent advances in plankton system ecology aimed at integrating plankton diversity and system functioning via food-web models based on ecological-network approaches. The latter allowed: i) searching of key players in food webs – a fundamental step towards biological conservation; ii) estimating the extent of ecosystem functionalities, such as carbon transfer to other marine species; and iii) identifying "collective" behaviours allowing whole-system response and adaptation to environmental changes, such as anthropogenic perturbations, and even regime shifts. In this contribute, we present the development of food-web models focusing on the plankton community of the Lagoon of Venice (Italy). We focused our work on "Palude della Rosa", a Lagoon sector setting at an intermediate position between inner and outer sides of that ecosystem. The plankton community studied therein is alternatively influenced by river run-off and seawater intrusions, the latter dynamics potentially determining the plankton community adaptation via sequential re-arrangements of the plankton food web in terms of direction and extent of trophic flows. Summer was the period chosen for our investigation, for the absence of strong tides and the presence of economically important ecological processes, such as potentially noxious phytoplankton blooms and nursery/growing area for many fish species.

DETERMINATION OF LABELLED AND UNLABELED NITRATE VIA COMBINATION OF SEDIMENT SLURRIES AND MIMS

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A method for distinguishing between labeled and unlabelled nitrate forms is based on the use of stable isotope 15N-NO3-. We present an approach based on the microbial reduction of the mixed pool of 14 and 15N-NO3-, the determination of the produced 29 and 30N2 via membrane inlet mass spectrometry (MIMS) and the back calculation of the original nitrate concentrations. The reduction is carried out in exetainers containing sediments and water sample, under anoxic conditions. We prepared a wide range of standard solutions containing 15N-NO3- in various combinations with 14N-NO3- in fresh as well as in marine waters. We used organic-enriched sediments exposed to elevated concentrations of nitrate in order to have a large pool of denitrifiers in the slurry. We recovered nearly 80% of the initial nitrate concentration, regardless the ratios of the two isotopes in the standards. The recovered versus added nitrate relationship was linear up to 700 µM, allowing a wide range of experimental applications. The MIMS is a reagent-free machine and many samples can be processes in just a couple of days, we think this method has a high potentiality and many applications for ecological studies.

SILICIFICATION PROCESS IN DIATOMS: MOLECULAR RESPONSE AND SILICA CHEMICAL-PHYSICAL INTERACTIONS WITH CELLULAR COMPONENTS UNDER DIFFERENT SILICON CHEMICAL FORMS

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Diatoms are a major group of unicellular eukaryotic algae widely distributed around the world in marine and freshwater ecosystems playing a dominant role in silicon biogeochemistry. The frustule formation process called silicification is based on the conversion of soluble silicic acid into amorphous silica and it is related to cell division and replication, and finally to the biomass production in the ocean. The silicon transport in diatoms is a carrier-mediated transport using silicic acid transport proteins (SITs), while silica morphogenesis and cell wall formation are mediated by a family of proteins called silaffins (Sils). In order to understand the silicification mechanism in diatoms, we examined transcript level variations of the SITs and Sils in *Thalassiosira pseudonana* in response to different silicon sources, i.e. biogenic or crystalline silicon particles. We also applied the electron paramagnetic resonance (EPR) technique by choosing a surfactant probe, able both to interact with the different silica chemical forms and enter the cell membranes of *T. pseudonana* cell suspension. It was found that the amorphous biogenic silicon slowed down the internalization process probably due to formation of colloidal particles at the cell surface after silicic acid condensation. Weaker interactions occurred with sponge spicules silicon source if compared to the other sources. The EPR results were explained by analyzing transcript level changes of silicon transporters (SITs) and silaffins (SILs) in synchronized *T. pseudonana* cultures. The results indicated that the transport role of SITs is minor for silicic acid from both biogenic and crystalline substrates. SIL3 transcripts were expressed in the presence of all silicon sources, while SIL1 transcripts only with sponge spicules. The data suggest that the transport of the silicic acid from various silica sources in diatoms is based on different chemical-physical interactions with the cell surface.

FROM SOIL TO BIRD COMMUNITY: A GUILD-BASED APPROACH TO INVESTIGATE RELATIONSHIPS BETWEEN FOREST VARIABLES IN A SMALL-SCALE ECOSYSTEM

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Forests provide numerous ecosystem services, which are of key-important in a changing world (FAO, 2010). Accordingly, forests have a major role in the global carbon cycle and have key significance as reservoirs of biological diversity (Innangi et al., 2015). In this view, typical forestry management has begun to be replaced by a more sustainable approach to harmonising forest harvesting with biological conservation and, carbon sequestration (Balestrieri et al., 2015). Birds, especially bird guilds, have been used as indicators of biodiversity and/or habitat quality in forests given their relative ease of detection and their strong association with many forest features (Balestrieri et al., 2015; Basile et al., 2016). Thus, we decided to investigate a small-scale forest ecosystem, the Astroni crater, using a bird guild as indicator of complex ecological interactions. The Astroni crater, surrounded by Naples urban area, hosts a 250 ha WWF Oasis with Holm oak (*Quercus ilex*) dominating on the upper parts and a mixed wood found in the more humid bottom of the spent volcano. In detail, we studied the guild of tree-nesting insectivorous birds made up by six species (*Picus viridis*, *Dendrocopos major*, *Jynx torquilla*, *Cyanistes caeruleus*, *Parus major*, and *Certhia brachydactyla*) as well as topographic, tree, and soil variables in 10 random locations per cover. The results showed that *P. viridis*, *C. caeruleus*, and *P. major* are present in Holm oak wood, while the other guild species are less abundant and found in the mixed wood. The guild abundance was mostly related to soil organic carbon stock (R^2=0.619, $p<0.001$). Thus, we were able to model the potential distribution of the guild in the whole crater. Our results provide evidence of broad connections form soil to bird community that can be investigated on larger-scale ecosystems to evaluate forest management practises that could implement both soil carbon stocks and biological diversity.

SPECTROPHOTOMETRIC METHODS FOR THE DETERMINATION OF LIGNIN AND CELLULOSE APPLIED TO SOIL SAMPLES AS A PROXY OF HUMUS CONTENTS

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The origin and destiny of humus, a soil organic matter (SOM)fraction that is most resistant to decomposition, are not completely understood yet (Cotrufo et al., 2015). Given its polygenic origin, humus is difficult to study. There is a general consensus that humus originates from plant structural components, namely lignin and cellulose (Campbell et al., 2016). While there is a number of methods to estimate lignin and cellulose in plant material, the applications to soil are limited and usually complicated and expensive. Conversely, humus can be estimated in soil by titration chemical methods which aim to estimate the carbon linked to humic (HA) and fulvic acids (FA). Thus, we conducted an experiment aimed to compare, within soils, spectrophotometric data for lignin and cellulose, based on Fukushima et al. (2015) and Updegraff (1969) respectively, to HA and FA (MIPAF, 2000), along with data on SOM, TOC and TN. We used soils from 6 different beech woods in central-southern Italy, sampling in 4 layers from topsoil (0-5 cm) to subsoil (30-40 cm). Our results showed a decrease of all measured variables along depth. The relationship between spectrophotometric cellulose/lignin and HA/FA was tested by means of Linear Mixed Models (LMM). Our results showed that lignin was a highly significant predictor for HA/FA ($p<0.001$) but less significant for TN and C:N. Considering the conditional determination coefficient (R^2_c), the best fit was between lignin and HA+FA ($R^2_c=0.224$). Cellulose was a highly significant predictor ($p<0.001$) for all dependent variables, with the exception of C:N. In contrast with lignin, conditional determination coefficient (R^2_c) were higher. Among the significant models, the best fir was between cellulose and HA+FA ($R^2_c=0.776$). Our finding support the hypothesis that humic substances derive from cellulose and lignin and it is a first support to the applicability of these spectrophotometric methods to soil as a proxy of humification processes.

EVALUATION OF PHYTOTOXICITY IN SEDIMENTS OF LAKE MEGANTIC-CHAUDIÈRE RIVER AFTER A CRUDE OIL ACCIDENTAL SPILL

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In the night of July 5, 2013, a freight train carrying light crude oil from North Dakota derailed in the town of Lac-Mégantic (Quebec, Canada), causing explosions, fires and the spill of 7000 m3 of oil. A multidisciplinary group of researchers initiated a vast research program in order to use this case as a learning instrument for various environmental studies that included emergency actions and environmental impact evaluation. As a part of this study, the toxicity of sediments has been evaluated by means of phytotoxicity tests using three plant species (one mono- and two dicotyledons). The seed germination and root elongation tests on cress, cucumber, and sorghum, have been run according to the Italian Official Method UNI MU 1651:2003 protocol on 22 samples, collected in 2016 and 2017 along the first 25 km from Megantic Lake on Chaudière River. The chemical analyses of the sediments, and specifically those of the organic chemicals, provided by Laval University, have been used to look for possible correlations with the results of the seed germination – elongation tests. As general conclusion, none of the sediments proved to be definitely toxic for the three plant species. However, to various degree all sites altered the seed germination or the development or one or more of the plant species, inducing a bio stimulation (response higher than in the respective negative controls). A common interpretation of this effect is called hormesis, which seems to be the first response to the exposure to one or more toxicants acting together: actually, the seeds respond to the exposure to a slightly toxic sample increasing their metabolism, hence apparently developing better and faster than in the negative controls, with the result that the toxicant(s) intake is “diluted” within a larger mass of plant tissue. In this way, the inner local concentrations are lowered and the seeds are able to better cope with the toxicant metabolic interferences.

PARASITES IN COMMERCIALLY RELEVANT MOLLUSCS OF THE NORTH ADRIATIC SEA: A PRELIMINARY INVENTORY

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The Mediterranean Sea, with its hydrogeographical features, combined with anthropogenic activities and non-indigenous species invasions, represents an ideal hotspot for studies on climate change effects. These characteristics are more evident in the Northern Adriatic Sea (NAS), a shallow semi-enclosed basin, where boreal affinity species find suitable conditions. In this area, aquaculture activities are widespread, especially of bivalve such as *Ruditapes philippinarum*, introduced in Italy in 1983 and become one of the most exploited resource. Phenomena such as the rise of temperature or shifts in salinity could lead to both direct and indirect effects on bivalves populations, involving delicate interactions with other organisms. Among them, host-parasite relationships have until now received few attentions. Parasites are important bioindicators of the ecosystem health, since they are capable to cause castration and mass mortalities in their host populations, with different impacts, e.g. on biodiversity. These effects become even more evident when this symbiosis is affected by abiotic stressors. Up to date, studies carried out in the NAS dealing with the host-parasites interactions in molluscs were mostly restricted to protozoan (e.g.: Perkinsus sp.) known to cause fitness deficit in common bivalves. Instead, few is known on other parasites, many of them characterized by complex life cycle and in which bivalves often represent the intermediate host. The aim of this study is to provide a preliminary inventory of the parasites species found on the West coast of the NAS in two commercial species: *R. philippinarum* and *C. gallina*. The sampling was carried out in different sites, both outside and inside the Venice lagoon; collected specimens were transferred in laboratory and freshly investigated for parasites component. This first analysis could represent the baseline for further studies with the perspective to evaluate the effects of climate change on host-parasites interactions.

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