

Microplastics in the Portuguese Coast

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Marine anthropogenic litter was analyzed in eleven beaches along the Portuguese coast, where 99% of all collected items were plastic and 68% were microplastics (MP) in the size range 1 - 5 mm. Higher MP concentrations were found in autumn, near industrial areas, port facilities and in beaches exposed to dominant winds. Resin pellets (79%) were the dominant category in the proximity of industrial areas. Higher concentrations of fragments and polymeric foams (Styrofoam® and foam sponges) were found near fishing ports. The most frequent size classes were 4 and 5 mm (47% and 42% of all findings). Our results suggest that MP have a land-based origin and are either deliberately discarded or accidentally lost in watercourses, beaches or coastal areas. The major stakeholders identified in MP discard and loss were plastic producers and fishing activities. An enforcement of good practices at industrial plastic facilities, and environmental education among fishermen and the general public is crucially needed to reduce MP in beaches and coastal areas.

Keywords: Plastic pollution; Beaches; Marine Litter; MSFD; Accumulation

The response of abundance and community structure of ghost crab communities to changes in human beach use and coastal habitat quality in the East Mediterranean

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Ghost crabs experience population declines and range contractions and the environmental drivers of these declines should be better understood for efficient coastal management. We surveyed ghost crab (*Ocypode cursor*) abundance and community structure at four beaches with contrasting anthropogenic pressures in the East Mediterranean Turkish coast during 2016 summer. In total 24 transects were located in protected beaches with limited anthropogenic pressures and neighboring public beaches with intense human use. The protected beaches hosted more ghost crabs than the public beaches and the ghost crabs in the protected beaches inhabited a larger habitat band. Furthermore, ghost crab communities in the protected beaches consisted of more diverse age groups than that of public beaches. Specifically, the public beaches were devoid of smaller size crabs. The differences in the size composition between neighboring public and protected beaches suggested that the protected beaches might act as a source population for the neighboring public beaches. Overall, our survey supported that ghost crabs may be used as indicator species for anthropogenic pressures on coastal ecosystems and the protected areas scattered along urbanized coastal regions may act as a refuge area and support ghost crab populations in the neighboring beaches facing higher anthropogenic pressures.

Keywords: Anthropogenic Pressures, Beach Use, Coastal Management and Conservation, Indicator Species, Size Diversity

Microplastic pollution on sandy beaches with different human-induced pressures from the European Atlantic coast (Portugal)

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Microplastic pollution on sandy beaches is an issue of major current concern due to their ecological and economic impacts. Yet our understanding of the levels of microplastics in these ecosystems and the drivers of these variations are still limited. In this study, the abundance and composition of microplastics were determined in four beaches with different degrees of urban pressure (industrial, urban, peri-urban and rural beaches) in the European Atlantic coast (Portugal). Beach sediments (5 replicates, 50 cm squares, along the drift-line) were collected in January, June and September 2016. Significant differences were found between the levels of microplastics between the beaches selected, with the maximum concentrations of 79 particles m⁻² observed in the most urban beach, while the beach with lower levels was the rural beach (mean 10 particles m⁻²). The particles were primarily fragments, pellets and fibres with varied colors. The chemical composition of selected particles was analysed using Fourier transform infrared spectroscopy (FTIR). A sub-sample revealed that the dominant plastic polymers were polyethylene, polypropylene and polystyrene. We provide a baseline for future monitoring and discuss how urbanization of coastal areas can influence the levels of microplastics on sandy beaches.

Keywords: Microplastics, Sandy Beaches, Urbanization, Plastic Polymers, Atlantic coast.

Habitat and trophic significance of external subsidies in wrack-associated beach macrofauna assemblages

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The ecological role of algal wrack as key habitat-forming species and their trophic significance for macrofauna was examined by experimental manipulation in a sandy beach from the eastern Atlantic coast. We selected 8 algal species according to their identity and structural complexity: *Laminaria ochroleuca*, *Saccorhiza polyschides*, *Cystoseira tamarascifolia*, *Bifurcaria bifurcata* (all native), *Undaria pinnatifida*, *Grateloupia turuturu*, *Sargassum muticum*, and *Gracilaria vermiculophylla* (all non-native). Thirty-six replicated (n = 4) wrack patches made of different algal species were randomly placed in the supralittoral zone, parallel to the shoreline. After a week, we collected the wrack patches and analyzed the composition of the macrofaunal species associated to each patch. Representative samples of macroinvertebrate consumers and wrack algal species were collected for isotopic analyses to quantify the resource contributions to beach consumers. Our analyses indicated a significant dominance of macrofauna (i.e. higher abundance and diversity) in wrack patches made of structurally complex algal species and wrack mixtures compared to patches made of simple monocultures. We suggest that increasing abundances of invasive algal species will promote changes in the identity traits of the wrack entering sandy beaches. This scenario can potentially affect the habitat choices of macrofauna with potential implications for sandy beach food webs.

Keywords: Sandy Beaches, Macrofauna, Invasive Species, Food Webs, Stable Isotopes.

Sandy beach ecosystem response to different Climate Change and related management scenarios

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Sandhopper (Amphipoda, Talitridae) orientation has been proposed as bioindicator of sandy beaches ecosystem stability. By a machine learning approach we created three predictive models trained with behavioural data (orientation) of a large scale dataset, from Mediterranean and eastern Atlantic beaches. The three models were validated on three test sets of more than 4000 independent observations and applied to create three scenarios related to sandy beaches response to Climate Change. Scenarios were built according to the expected variations of beach slopes (unchanged to 30 degrees) and beach width (0 to 200 meters). Four scenarios were obtained for each condition considered, for a total of 12 scenarios, to which a shoreline variation in direction of 30 degrees was added, associated with the variation induced by coastal defence works. The results show that slope increase positively influences the orientation by decreasing the variability around the dominant seawards direction, whereas the decrease in beach width causes an increase in variability. The greatest impact is caused by shoreline variation in direction, associated to the works of defence, whose presence induces confusion in sandhopper orientation.

Keywords: Talitridae; Scenarios; Behaviour

Towards a paradigm for sandy beach macroinfaunal connectivity

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Population connectivity is fundamental to the persistence of many species. Beaches face numerous threats; reports of declining populations and extirpations emphasise the need to identify drivers of population connectivity in beach species. Genetics is currently the most practical tool available to study dispersal among marine invertebrate populations, and so to inform on population resilience. Here, COI structure (Φ_{ST}) of 17 beach macroinfaunal species (using novel and published data), was assessed as a function of life history (pelagic -, benthic lecithotrophic, and direct development), zonation patterns (sublittoral, midlittoral, supralittoral), and latitudinal range. Analyses revealed low to moderate genetic structure among populations of most intertidal taxa, including pelagic and benthic developers, but strong, significant differentiation among brooders. Zonation revealed an even clearer pattern, with genetic structure increasing significantly up shore. No clear latitudinal trends were evident, however. Life history (pelagic larvae vs. non-larval development) thus seems to be a strong indicator of genetic connectivity, with supratidal direct developers particularly prone to population isolation. Supratidal populations may therefore have low resilience, with a poor ability to recover from perturbations by means of recolonization, which further emphasize the need for proper land-sea protection to adequately preserve beach biodiversity.

Keywords: Genetic Connectivity, Life History, Macroinfauna, Resilience, Zonation

Impact of groundwater discharge on the subsurface biogeochemistry of a high-energy sandy beach system on a NW German barrier island

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The discharge of fresh groundwater and recirculated seawater into the beach face forms an important nutrient-source to the coastal ocean. We have performed several interdisciplinary sampling campaigns on a German North Sea barrier island sandy beach system, to study biogeochemical processes on a seasonal scale. Hydrogeological, biogeochemical, and microbiological investigations were performed in order to understand the highly dynamic beach subsurface. The island is characterized by a freshwater lens and advective groundwater flow (SGD) forming a subterranean estuary (STE) with notable redox and salinity variations. At the beach face an upper saline plume, a saltwater wedge and a freshwater discharge tube are observed. Seasonal changes in beach topography and groundwater seeping were identified via salinity anomalies during transect and grid sampling. Besides nutrients and trace metals, microbial abundances and community structure were determined along the transects. Groundwater/seawater mixtures contain orders of magnitude more nitrogen, silicate, dissolved organic carbon, phosphate, and iron, than coastal seawater. STE fluid composition is influenced by chemical transformation reactions, supply with fresh marine organic matter, aquifer geology, residence time, and microbial community structure. The consequences of SGD for potential eutrophication resp. contamination of nearshore waters have to be considered when establishing beach management strategies.

Keywords: Subterranean Groundwater Discharge (SGD), Subterranean Estuary (STE), Biogeochemistry, Sandy Beach System

Growth of polychaete *Laeonereis culveri* (Webster, 1879) on a tidal plain in the Southeast region of Brazil

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The growth of the semelparous species *Laeonereis culveri* was studied through a monthly sampling from December 2016 to November 2017 in the intertidal region of the tidal flat of Araçá Bay (São Sebastião-SP), using the width of the 6th setiger (W6) as an indicator of size and frequency. This bay went through constant changes that generated severe impacts on its hydrodynamics and general environment, but it still shows a high biodiversity and productivity evidenced by the results of a thematic project: the Biota / FAPESP-Araçá, which identified *Laeonereis culveri* as a key species for the monitoring of the bay. A total of 2,296 individuals from different sizes were obtained (with higher occurrence of 0.91-1.10 mm W6), indicating the presence of distinct development stages. The density peaked in April (0.0029 ind.m⁻³), May (0.023 ind.m⁻³), June (0.024 ind.m⁻³) and September (0.0025 ind.m⁻³). These abrupt rises in density occurred due the incidence of juveniles. During November 2017, few specimens were found because of the heavy rains at the period. Probably, the sediment type and the increase in organic matter had an influence on the capability of *L. culveri* to reduce the growth period without affecting the size of the adult.

Keywords: Polychaete; Benthic Fauna; Growth; Monitoring

Recreational Carrying Capacity Analysis on Mexican Tourist Beaches: An overview

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Beaches constitute an important economic motor income for tourism of the 3 Ss (Sun, Sea and Sand). For locals they are important areas for recreation because of their free access by families, granting their use over all weekends. In tourist beaches, the carrying capacity indicates the threshold of beach use for tourist activity, yet maintaining the capacity to provide satisfaction to visitors. The models defining an optimum number of visitors allow to establish ranges of beach uses based on four approaches: physical, ecological, economic and social. They contribute to prevent environmental damage to the recreational quality and also offer a certainty to potential service providers and administrators about the tourist demand that is required to supply. This research presents the study of the tourist load capacity in the main sun and beach destinations of the pacific coast, Mexican riviera: Los Cabos, Riviera Nayarit, Puerto Vallarta, Manzanillo, Ixtapa, Huatulco and the Caribbean Sea, Riviera Maya: Cancun. The concept is dynamic and relative because socio- environmental variables finally depend on circumstances such as changes in beach conditions and variation in threshold of use. Therefore, any load capacity must be determined periodically in a sequential and continuous process of planning and integral management.

Keywords: Sandy beaches; Recreational Carrying Capacity; Mexican Riviera, Pacific Riviera.

Nestedness patterns and the role of environment and space on the sandy beach macrofauna

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Sandy beach macrobenthic assemblages are thought to be structured by morphodynamic characteristics, and higher environmental stress caused by hydrodynamic conditions is hypothesized to limit species occurrence. As a consequence, the species pool inhabiting harsher reflective beaches (steep slope, coarser grains and high hydrodynamic stress) would be a subset of (i.e., nested in) the fauna of nearby dissipative beaches (gentle slope, fine sands and low hydrodynamics). The direct existence of a nested pattern on sandy beach assemblages, however, is still overlooked. We investigated whether nestedness can be found on the distribution of macrobenthic assemblages on a set of sandy beaches with distinct morphodynamic conditions. Additionally, we tested whether environment exerts a stronger influence on macrobenthic distribution than space (i.e., distance among beaches). Although species richness was higher at dissipative beaches, no nestedness pattern was found. Exclusive species were registered at almost every beach, and composition varied greatly among beach types. Space had an overall stronger influence on macrobenthic distribution than morphodynamic and sedimentary variables, suggesting that macrobenthic species are dispersion limited. Given that different sandy beaches harbor different pools of species, conservation programs need to focus on sandy beaches with complementary characteristics to preserve coastal biodiversity.

Keywords: Metacommunity; Dispersal; Variation Partitioning; Conservation

Erosion and urbanization effects on intertidal benthic macrofauna in the northern Adriatic beaches.

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Five sandy beaches on the Emilia-Romagna coast (Northern Adriatic) were sampled to investigate macrofaunal assemblages. The chosen beaches have similar morphodynamic conditions, the same (micro-) tidal range and similar exposures, but differ by degree of contrasting anthropic impacts, mainly related to extending recreation areas and to protect them from natural erosion by different coastal protection options. Unfortunately, little consideration is given to impact on communities of beach's soft bottom habitats. In this study we investigated patterns of community structure of macrofauna in intertidal zone. Sampling of both macrofauna and environmental variables was carried out at two tidal levels: high and low, along replicate transects. Changes were observed among environmental variables, such as granulometry and organic matter content, as well as in related macrobenthic assemblages of the differently impacted beaches. Overall, the observed changes did not show an ordinate gradient from more natural to more managed beach, but a more complex response to erosion and management options combined effects was observed. Lastly, considering the degree of urbanization and erosion, we have produced a categorization of the beaches, which could be a useful and exportable metric to better assess and manage the effects of considered factors on sandy beaches ecological patterns.

Keywords: Intertidal Sandy Beach Macrofauna; Management; Erosion; Coastal Urbanization

Socio-hydro-ecological basis for a sustainable sand barrier-breaching model in a protected coastal lagoon

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Sandy barrier complexes coupled to coastal lagoons play a key role in defining the ecological functioning of these fragile ecosystems and their services. The artificial manipulation of the barrier natural dynamics (e.g. to control floods, improve fisheries, urbanization) and climate change aggravate conflicts among stakeholders, imposing threats to conservation. Laguna de Rocha (Uruguay) is an emblematic protected lagoon where the sandy barrier opening has been under debate for decades. A transdisciplinary effort of scientists, authorities and local stakeholders allowed developing a protocol for the sustainable artificial opening of the sandy barrier, aimed to reduce conflicts and preserve the natural hydrology. We present the socio-hydro-ecological basis on which the protocol was founded, including the historical reconstruction of the breaching practices, stakeholders' interests, a geomorphological survey of the sandy barrier and its evolution, a hydrological study to understand the oceanic/internal processes driving the opening, and the extent of public/private land flooding. The breaching protocol was agreed on a reduced set of indicators (water depth, sandy berm elevation, and rainfall forecast). Its success is based upon the existence of a participatory group advising on local environmental problems and represents a major improvement given the evidences demonstrating the environmental cost of manipulating sandy barriers.

Keywords: Sandy Barrier Complex; Protected Coastal Lagoon; Artificial Opening; Hydrology; Conservation; Stakeholders.

SENVISAT: Monitoring the evolution of the coastline and the dune vegetation cover of the Marine Natural Park of the Gulf of Lion from very high resolution satellite imagery (Occitanie – France)

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The SENVISAT project (2017-2020), developed in partnership with the Marine Natural Park of the Gulf of Lion, EID Méditerranée and UPVD – CEFREM, aims to conduct a feasibility study using satellite imagery for environmental monitoring of the coastline. The shore of the Park are heavily influenced by meteorological forcing and human activities. Those activities have influenced in the physical environment impacting habitats and coastal ecosystems. Therefore, those several impacts produce the shoreline retreat and loss of sediment from the beach, or even from the dune. The methodology implemented is based on the processing of Pleiades satellite imagery via free software such as the Orfeo toolbox developed by CNES and QGIS in order to: extract the shoreline, survey the dune vegetation cover, distinguish dune morphologies (especially grey and white dunes) and to produce an indicator of geomorphological evolution of the dune system (shoreline and vegetation change detection).

Keywords: Sandy Beaches, Shoreline Monitoring, Dune Vegetation Survey, Remote Sensing

Increased erosion of sea turtle nesting beaches because of non-native *Casuarina* spp. presence, sea level rise and storm activity: A Beach Vulnerability Assessment

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The world's beaches are under severe pressure, because of anthropogenic modification and climate change. The most common coastal management approaches have focused largely on the protection of infrastructure without considering the function of the beach and dune system as a natural protective barrier and a diverse ecosystem. Large scale plantations of non-native vegetation have been initiated in many countries as a coastal protection tool, which not only does not adequately function as a storm protection measure, but has been proven to have other adverse effects, including the promotion of erosion in some instances and negative impacts on sea turtles. The extent of the use of exotic vegetation, specifically *Casuarina* spp., was assessed on 50 sea turtle nesting beaches of the Indian Ocean region, with a concomitant assessment of beach vulnerability to erosion (using a novel index). Beach vulnerability was classified according to four management prioritisation categories: 1) High Risk-High Threat; 2) High Risk-Low Threat; 3) Low Risk-High Threat and 4) Low Risk-Low Threat. The High Risk-High Threat category included 14 % of the beaches and overall, non-native *Casuarina* spp. occurred on 28 %, including some with sensitive sea turtle species. The study emphasizes the need for management prioritisation of several sea turtle nesting beaches and concludes that *Casuarina* spp. are an inappropriate coastal protection measure. Where feasible the removal of non-native *Casuarina* spp. is recommended.

Keywords: Beaches, *Casuarina* spp., Vulnerability

Artificial light pollution negatively affects the locomotor activity of a sandy beach arthropod.

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Natural light sources play a fundamental role on an array of organisms and ecological processes. However, human activity and the growth of infrastructure has resulted in a widespread increase in artificial light pollution that threatens to alter the natural light cycles. The growth of light pollution (LP) is expected to affect biodiversity. Nevertheless, the effects of LP on sandy beach organisms have remained largely unexplored. In response to this lag in our knowledge, we assessed the influence of LP on the locomotor activity the onyscoid isopod *Tylos spinulosus* both in field and laboratory conditions. In the field, an artificial light system was assembled to assess the influence of artificial light conditions on the isopod's locomotor activity. Meanwhile in the laboratory, two experimental chambers were set to assess the same activity using actographs under artificial light and natural light-dark cycles. Our results indicate that artificial light have adverse effects on the locomotor activity patterns both in the field and in the laboratory. In laboratory conditions, in particular, we were able to detect the loss of the isopod's circadian rhythm. Given the steady increase in artificial light pollution, the effects on sandy beach organisms could have unexpected consequences for the whole ecosystem.

Keywords: Light Pollution; Locomotor Activity; Arthropod

Quantifying ecological responses to trophic connectivity between sandy beaches and kelp forests

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Understanding trophic links between ecosystems is necessary to predict food web responses to a changing environment. We quantified trophic connectivity between giant kelp (*Macrocystis pyrifera*) forests with very high primary production (donor ecosystems) and sandy beaches with low *in situ* primary production (recipient ecosystems). The large amounts of drift kelp exported from kelp forests to beaches are known to fuel diverse and productive intertidal food webs. We estimated kelp delivery from kelp forests to beaches and beach ecosystem responses using shoreline surveys (18-25 km), tagged kelp, and modeled currents. Kelp removal from forests and its delivery to beaches varied greatly in time and space. Kelp deposition and retention were strongly influenced by shoreline characteristics and proximity to kelp forests. Recipient beach ecosystems, specifically wrack consumers and food webs, responded clearly to spatial dynamics of trophic subsidies even on a local scale. Diversity and abundance of these consumers were greatest on beaches with upper beach habitat and near headlands. Reproductive biology of an endangered shorebird, the Western Snowy Plover, was also strongly correlated with spatial variation in wrack and wrack-associated prey abundance and composition. Our results suggest that spatial variation in trophic connectivity can strongly affect beach ecosystem structure and function.

Keywords: Subsidy, Kelp Wrack, Spatial Scales, Biodiversity, Shorebird, Snowy Plover

Exploring population responses of wrack consumers to pulsed marine subsidies and disturbance regimes on open coast beaches using long term data

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Population dynamics can be closely linked to resource availability and to disturbance regimes. Although *in situ* primary production is low, sandy beaches can support diverse food webs through subsidies from donor marine ecosystems. In California (USA) sandy beaches receive large pulsed subsidies of marine macroalgal wrack from rocky reefs and kelp forests. Using long term data on wrack inputs and a guild of sandy beach wrack consumers we investigate how consumer population abundance and biomass track these subsidies and whether responses to subsidy fluctuations are lagged and/or species specific. We examine how consumer populations respond not only to variation in macrophyte wrack standing stock, but to variation in donor ecosystem condition as estimated by satellite-derived estimates of kelp forest (*Macrocystis pyrifera*) canopy biomass and sea surface temperature. We explore responses of consumer populations to disturbance that alters beach habitats, including upper beach zones and sand supply. Results indicate links between subsidy inputs and consumer population dynamics that are strongly mediated by the presence of upper beach zones. Wrack consumer population dynamics are strong indicators for the condition of beach food webs and are useful in estimating the magnitude of various ecosystem functions, such as decomposition, nutrient remineralization and secondary production.

Keywords: Sandy beaches; wrack; consumers; subsidy; disturbance; donor and recipient ecosystems

Fish communities of sandy beach surf zones: Unravelling the myths, exploring different methodologies and providing knowledge for management strategies

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Surf zones of sandy beaches are known to be important habitats for fishes, but few studies so far focused on this habitat. As a consequence, there is a need to explore factors that may explain the temporal and spatial variability in species composition to better preserve the ecosystem services this habitat provides. Understanding environmental and anthropogenic factors driving surf zone assemblages and as well as its internal ecological processes, and the connectivity among surf zones and adjacent ecosystems should therefore be considered. This project has 5 main objectives: (1) to find the best sampling method for this environment by comparing two sampling techniques (beach seine netting and the use of cameras); (2) to describe the unstudied surf zone fish communities of a set of Brazilian sandy beaches with different ecological and social features; (3) to assess which factors drive differences in fish community compositions between beaches by investigating the role of several environmental factors and anthropogenic impacts. Lastly, we will (4) investigate connectivity between sandy beaches and off shore environments and (5) trophic interactions in the surf zone. The conclusive aim of this study is to implement this into a management plan in order to preserve these valuable natural resources.

Key words: Sandy Beaches, Surf Zone, BRUVs, Connectivity, Food webs

Substrate-related communities: a study on discriminating ecology and traits of beach resident fauna

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The Habitat Harshness Hypothesis defines a harsh habitat as the one in which the interaction between substrate and swash energy makes burrowing extremely hard, i.e. exposed beaches with coarser substrates. Not all beach resident fauna however relies on burrowing capabilities. Beaches covered in cobbles or decaying macroalgae can host non substrate-related species, and the role of the substrate drying dynamics could become relevant. Two studies hence targeted: 1) analysis of resident communities on a set of six pocket beaches with same exposure and different substrates, 2) presence/absence of amphipods and isopods on 31 beaches around the island of Crete, characterised by different exposure and substrate. Data analysed with PRIMER routines indicate differences between resident communities of sandy substrates and mixed and cobble substrates. This pattern is however based on the contribution of water-breathing organisms such as amphipods and isopods (global $R = 0.666$), while patterns of air-breathing organisms (mostly insects and spiders) were found even across the range of substrates (global $R = 0.077$). Logistic regression models further point to the different relevance of habitat harshness to substrate-related categories within water-breathers. The analysis of substrate as driver of diversity patterns should therefore be extended beyond burrowing, substrate-related species.

Keywords: Substrate; Traits; Talitridae; Oniscidae

Benthic quality assessment and changes in midlittoral sand community structure, in the organically enriched area of Alykes Kitrous (Thermaikos Gulf), Greece.

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Thermaikos Gulf receives a rich input of organic matter from three-river basin resulting in a high productivity area of northeast Mediterranean. The concentrated organic matter has a strong effect in the community structure of midlittoral sandy beaches. The effects of the ongoing pollution of Thermaikos Gulf, described in July 1976 and July 2003. Macrofaunal samples were taken at eight positions along a transect extended from the upper to the lower midlittoral zone at Alykes Kitrous beach, using a special corer sampler, 50 cm² surface and 30 cm length. The analysis of the faunal composition revealed that in 1976, the characteristic community of *Donacilla cornea* and *Ophelia bicornis* was present in the area, with *Eurydice affinis*, *Scolecopsis squamata*, *Saccocirrus papillocerus*, and *Pisone remota* having high abundances. On the contrary, in 2003 this community appeared disorganized with *O. bicornis* and *P. remota* absent from the community and the abundances of the other characteristic species were reduced. The disturbance is confirmed with the use of benthic indices. The changes in the diversity and abundance of the community, as well as the alterations in the spatial distribution of the species, are given and discussed in relation to the ongoing pollution in Thermaikos Gulf.

Keywords: Sandy Beaches; Community Ecology; Midlittoral Zone; Organic Enrichment

On the use of airborne photogrammetry with drone for high-resolution beach morphodynamics surveys.

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Technical means to carry out monitoring of sandy beaches to assess erosion process on coastline have seen the booming of new remote sensing techniques this last 10-20 years. It encompasses techniques as video camera monitoring, LiDAR topographic and bathymetric surveys by plane, as well as recently the photogrammetry with lighter aircraft and drone (or unmanned aerial vehicle). The latter technique has really emerged for coastal application this last 5 to 10 years thanks to spreading of Structure-from-Motion (SfM) algorithms in various software solutions and commercial development of drone for recreational use. The SfM algorithm for image analysis is able to identify ground textures from numerous camera angles. Indeed this algorithm may compute from numerous sub-vertical aerial photographs and few control point placed on the ground some very accurate digital surface model (depending on drone camera resolution). Our contribution is mainly to assess the advantage of such a solution against other beach survey methods and to present result on 3 sites in the South of France. Accuracy of data is striking to model the surface of the sub-aerial beaches, including beach cusps, ridge and runnel morphology and storm erosion scrapes. Apparent objects on the dune as dune vegetation and sand fence can be seen distinctively. On the active shoreface (sandy bare ground) the accuracy of elevation is estimated with an error less than 0.1 m which fulfills most of the expectation for beach survey.

Keywords: Sandy Beaches; Airborne Photogrammetry; Beach Surveys; Morphodynamics.

Life on the edge: Predicting effects of sea level rise on sandy beach ecosystems

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Projected sea level rise (SLR) threatens the biodiversity and functions of sandy beach ecosystems. To generate predictions of ecological responses of California beaches to SLR, we integrated a coastal hazard model of total water level and shoreline evolution (CoSMoS) with high-resolution data on the elevation and distributions of beach features important to biota. We focused on upper beach zones which are most vulnerable to erosion. Loss of upper zones will strongly impact wrack-associated biota, reducing biodiversity by 40-50%, decreasing prey available for birds and fish and eliminating nesting habitat for threatened wildlife. These zones also support sand-trapping vegetation, sand accumulation and nutrient cycling, and provide buffer areas that mobile intertidal animals use during extreme conditions. The landward beach boundary (dune, bluff, armoring) strongly affected upper zone vulnerability. Model results for 50 cm SLR projected significant declines (average >70%, range 51-98%) in widths of upper zones for study beaches with most rapid losses for armored then bluff-backed beaches. Dune-backed beaches were more resilient. Opportunities for preserving intact beach ecosystems are limited to beaches that have scope for retreat. These can include groomed and filled beaches, currently managed for recreation that could be restored to preserve biodiversity and ecological functions.

Keywords: Biodiversity; Total Water Level; Foredune; Shoreline evolution; Ecological Envelope

Long term monitoring of sandy beaches: the challenges of analysing macrofaunal data from two time periods

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A sandy beach monitoring programme was established in the Orkney Islands in 1974 in response to an Environmental Impact Assessment for oil terminal. The programme was finished in 1989 and all monitoring ceased for a period of 12 or more years. When the monitoring was restarted in 2002 changes were applied to the monitoring programme. Monitoring resumed in only eight of the original sites; five new sites were added, the number of sampling stations at each site was reduced and the survey timing changed from summer to late winter. Data from these sites were used to explore long-term patterns of variability in benthic macro-invertebrate abundance and community composition, examining also the contribution of differences within and between sites to overall variability and assessing the nature of the baseline against which any perturbation must be measured. We examine the extent to which interruption of survey continuity, and changes in survey design and protocol may affect the ability to quantify this baseline and draw inferences about long-term patterns. Results highlight the importance of accounting for background variability in determining the extent to which environmental impacts can be detected by a biological monitoring programme and in measuring the scale of any impact.

Keywords: Long-term monitoring, Sandy Beaches; Macrofauna, Benthic.

Surface activity patterns as a mechanism of niche separation of sympatric talitrid amphipods on California beaches.

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The availability of limiting resources can potentially affect inter- and intraspecific interactions. The competitive exclusion principle states that two species competing for the same limiting resource cannot coexist at productive population levels, however, in California, four species of talitrid amphipod (*Megalorchestia californiana*, *M. corniculata*, *M. benedicti*, *M. minor*) coexist on sandy beaches. These mobile detritivores are major consumers of macroalgal subsidies from nearshore reefs. We investigated the hypothesis that differences in surface activity patterns may provide a key mechanism that allows these closely related congeners to coexist by reducing interspecific competition for food and space resources using pitfall traps and mesocosm observations during spring and neap tides. Surface pitfall activity patterns differed significantly among species with, *M. californiana* after sunset, and *M. minor* and *M. benedicti* shortly after sunrise. Surface mesocosm activity patterns also differed significantly, showing *M. californiana* after sunset, *M. corniculata* peaking between 2am and 6am, *M. minor* peaking throughout the night, and *M. benedicti* peaking right after sunrise. Differences in activity among species were more pronounced during neap tides when preferred habitat is more restricted. Our results suggest these sympatric talitrid amphipods decrease interspecific competition via behavioral separation.

Keywords: Sandy Beaches; Talitrid Amphipods; Niche Separation; Interspecific Competition

Large natural and anthropogenic disturbances in the anthropogenic era: Motors of coastal changes along Chilean sandy beaches

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Community attributes of the sand beach macrofauna, have been mostly analyzed in relation to physical and biological factors, usually operating at a near scale distance. Not much attention has been paid to large natural disturbances operating at far scale distances from sites, even when for example, subduction earthquakes, tsunamis and surge storms are key motors of changes in landscape and biological communities over large coastal areas around the globe. In recent years, the effects of some of those disturbances are being exacerbated by extra factors like coastal urbanization and intensification of extreme weather variability, the most visible facet of climate change. Thus, extreme events focused research has increased, becoming a key issue to cope with uncertainties arising from the occurrence of extreme disturbances which can displace ecosystems into new stages due to novel environmental conditions. Responses and resilience of Chilean sandy beaches are analyzed by comparing the effects of earthquakes, ensuing tsunamis and storm surges on community attributes which are also analyzed in relation to the disposal of mine tailings, by far, the most notorious anthropogenic large scale disturbances along the coast of northern Chile.

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Keywords: Sandy Beaches; Disturbances

Increasing Coastal Resilience through Sandy Beach Restoration: A Case Study in Los Angeles, California

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Although highly valued by society, southern California beaches are significantly undervalued as ecosystems that provide coastal resilience. Growing recognition of the value of beaches as resilient functional ecosystems is leading a paradigm shift away from heavily urbanized shorelines, where daily grooming currently eliminates vegetation, wrack, and protective sand dunes throughout most of the region. Geomorphic and ecological results of a 3-acre pilot beach restoration in Los Angeles, California, are testing a cost-effective approach to restoring beaches that fosters coastal resilience and sustainability. Preliminary results after one year suggest the restoration area is diverging from controls and starting conditions. Vegetation and sand morphology data displayed the most rapid responses with no responses detected in macroinvertebrates to date. Variability observed in elevations and the berm crest suggest longer term dynamics are important. Ecological functions observed included responses by breeding endangered shorebirds. The first viable western snowy plover nest for the region in 70 years was found within the restoration area. Continued monitoring will track ecological variables and sand morphology in response to vegetation, fencing, and forcing by storms, king tides, and wave energy. This demonstration project is a model that shows heavy recreational use and habitat restoration are compatible on urban beaches.

Keywords: Urban beach; Coastal resilience; Geomorphology; Western Snowy Plover

Sandy Beach Management: Some Reflections on the Roles of Science and Scientists.

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Climate change and rapidly increasing coastal human populations mean that sandy beaches are, arguably, under greater pressures than most other ecosystems. Consequently, the demand for management is extreme. But management requires goal- and policy-setting, these currently being anthropocentric rather than ecocentric. As well, goals will vary depending on local socio-economic context. Achieving these goals will depend heavily on science and scientists. This paper discusses the roles of science and scientists in the context of sandy-beach management, identifies some priority concerns and knowledge gaps, critically considers predictions that dominant paradigms make, and poses some broader questions for scientists to consider.

Keywords: Sandy Beaches; Management; Science; Scientists

Temperature effect on biogeochemical cycling of algal wrack subsidies in sandy beaches: an open top chamber approach

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The response in decomposition of algal wrack to global warming has not been studied in ocean exposed sandy beaches to date. We used open top chamber to increase soil temperature within the range predicted by the IPCC for western Europe (0.5 to 1.5 °C). The effect of temperature was tested in fresh and aged macroalgae, and bare sand. Results indicated that a small warming (0.5 °C) affected the wrack decomposition through traceable increases in soil respiration through CO₂ flux, inorganic nutrients within the interstitial environment (N and P), sediment organic content and microbial pool gauged through the total soil DNA. The different responses of soil variables indicated that the decomposition stage of stranded macroalgae also influences the biogeochemical processing of organic matter in sandy beaches. CO₂ fluxes, release of organic and inorganic nutrients and microbial activity intensify in aged wrack. At global scale, our results predicts that expected global warming will increase release of inorganic nutrients to the coastal ocean by 30 % for the inorganic N (21 Gg y⁻¹) and 5.9 % for P (14 Gg y⁻¹); that increase for the flow of C to the atmosphere as CO₂, can be estimated in 8.2 % (523 Gg y⁻¹).

Keywords Wrack Decay, Open Top Chambers, Nutrients, Organic Enrichment, CO₂, Global Warming

Micro- and macroplastic on Polish sandy coast (Baltic Sea)

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Plastic pollution was assessed on sandy beaches along the Polish Baltic coast during the autumn of 2017. Two categories of plastic – microplastic and macroplastic – were collected at 11 sites along the Polish Baltic coast, with samples taken from shallow water, at the drift line, in the middle of the beach and base of the dunes. Plastic particles larger or smaller than 5 mm were considered macro- or microplastics respectively. The most common macroplastic particles were described as styrofoam, fibre, bottle cap, cigarette, hard, film, or unidentifiable, with up to 50 items per transect weighing more than 30 grams. Microplastic concentrations varied among collection sites, with a slight predominance found at the dunes (on average 2223 per m²), comparing to driftline (1618 per m²). In shallow water the average concentration of microplastic was 1366 items per m³. The majority of microplastics were fibrous, <1 mm in length, and blue in colour.

Keywords: Sandy Beaches; Macroplastics; Microplastics; Baltic

Differential use of wrack resources provides niche separation in intertidal consumers on California beaches

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Macroalgal wrack is a key resource subsidy to sandy beach ecosystems along the Pacific coast of North America, providing habitat and food for a remarkably diverse assemblage of intertidal consumers. Four talitrid amphipod species (*Megalorchestia*) and a herbivorous beetle (*Phaleria*) co-exist on many beaches. To allow coexistence, these species may utilize common resources differentially. We investigated the degree to which differential wrack resource use provides niche separation by measuring individual consumption rates of each invertebrate species on two abundant brown macroalgae, *Macrocystis* and *Egregia*, a green alga, *Ulva*, a red alga, *Porphyra*, and on surfgrass, *Phyllospadix*. Invertebrate consumption rates differed significantly among wrack species. Three of the *Megalorchestia* species exhibited significantly different consumption of the two brown macroalgae, preferring the less abundant *Egregia*. One of the larger talitrid species and the beetle exhibited no significant differences in consumption of macroalgae, indicating potential for generalist feeding in these consumers. In choice experiments, the two smaller talitrid species exhibited no preferences when offered combinations of algae while the two larger species demonstrated significant preferences. This suggests differential consumption of wrack types may represent an important mechanism for niche separation in this diverse guild of intertidal detritivores.

Keywords: Niche separation; Macroalgal wrack; Intertidal invertebrates; *Megalorchestia*

Macroinfauna movement patterns and swash dynamics on a high energy dissipative beach

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Beach macrofaunal communities on open coasts are well studied, and there is agreement that community patterns are governed by physical factors relating to swash dynamics, sediment features and tides. However, snap-shot sampling and limited expertise are hampering identification of exact drivers. An experiment on a high energy dissipative beach sampling intertidal macrofaunal, using both traditional stratified sampling (at low tide), and dynamic sampling over a tidal cycle (from low to high tide) was conducted, measuring concomitant changes in swash dynamics (including runup and % inundation). Species richness and abundance changed over the tidal cycle with highest richness measured using stratified sampling at low tide (13-20 species) and the highest abundance (total and per m⁻²) was measured at high tide (93 individuals or 114.m⁻²) with dynamic sampling in three levels of the swash. Species behaviour differed among taxa; circa-semilunar migrants like *Donax serra* was tolerant of inundation and maintained their position, whereas *Bullia rhodostoma* moved with the swash and was mainly present in unsaturated sand (<20% inundation). Most amphipods and polychaetes were only sampled at low tide on the low shore, and high-shore crustaceans only on the upper half of shore. Four different behavioural patterns were thus observed among macrofaunal groups.

Keywords: Macrofauna; Swash; Tidal Migration; Sampling Design

Metabarcoding the hidden meiofauna diversity of sandy beaches

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Interstitial meiofauna in marine sediments inhabit one of the most widespread habitats and may represent one of the most diverse communities on earth, yet little is known about the forces shaping community structure, species distribution and abundance. Species identification is problematic in these tiny organisms, and so biodiversity is poorly known. The overall objective of this project was to elucidate factors shaping global, regional and local patterns of sandy beach meiofauna biodiversity. We sampled meiofauna from three levels of beaches with different morphodynamic characteristics, on the US Pacific Northwest coast and the South African south and west coast. Next generation sequencing approaches were used to obtain almost 16 million sequences of the nuclear 18S gene. Initial data showed high diversity on all beaches. Communities were clearly clustered according to bioregion and habitat in most phyla. Differences in community structure were related to grain size in some regions, but not in others. However, relationships between grain size and diversity was only found in some phyla. Our results clearly showed the high biodiversity of sandy beach meiofauna which is not discoverable with conventional morphological techniques. This demonstrated the power of metabarcoding for studying a taxonomically difficult group of organisms.

Keywords: Meiofauna diversity; Metabarcoding; Beach Morphodynamics; Bioregion

The Impacts of Beach Management Regulations on Habitat Availability for Beach-nesting Birds

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Coastal wildlife populations are limited by habitat availability due to stabilization of natural geomorphic processes and intense human recreational activities. Anthropogenic pressures result in few opportunities for increasing habitat through land acquisition or restoration. Coastal storms can achieve this goal naturally; however, wildlife considerations are not given high priority in post-storm recovery planning. We used a maximum-likelihood spatial modeling approach to quantify the impacts of Hurricane Sandy (mid-Atlantic United States, October 2012) on nesting habitat of Atlantic Coast piping plovers. We modeled habitat using a presence-only dataset that included characterizations of eight variables before and after the storm. We compared the net change in habitat both under the current regulatory framework for habitat protections, and a scenario in which all potential habitat was under conservation protection. Hurricane Sandy created 291 ha of habitat; however, because conservation protections post-storm were decoupled from changes in geomorphology, the realized net habitat gain totaled only 16 ha. Furthermore, only ~14% of the statewide breeding population colonized newly created habitat areas over the next three years. Our results illustrate the ability of storms to create coastal habitat for beach-dependent species and the importance of implementing systematic approaches for protecting these habitats to maximize conservation benefit.

Keywords: Coastal Ecosystems; Evidence-based Conservation; Habitat Protection; Species Distribution Modeling; Wildlife Management

Relationship between the ghost crab (*Ocypode quadrata* Fabricius, 1787) and abiotic and anthropic factors on a beach in the south coast of Brazil

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Sandy beaches have been constantly impacted by urbanization and extreme climatic events. These impacts affect beach slope, sediment and organic matter content, and may negatively affect communities and populations. Therefore, monitoring is a effective process to observe how species react to changes in the morphology of the beach, even on highly urbanized areas. The crab *Ocypode quadrata*, a key species in beaches, is a bioindicator because of its sensitivity to climatic and anthropogenic impacts. We monitored a population of *O. quadrata* weekly over 14 months to look for reactions to environmental and recreational pressures. Overall, two potential impacting factors affected the population: (i) a strong storm surge reduced the population by half and (ii) the increase in tourists (Christmas and New Year) more than doubled the population. These fluctuations may reflect a great resilience and capacity of the species to recover from stochastic events. We also evaluated if the presence of supralitoral vegetation had any effect on its along-shore distribution. Density of burrows was higher in the vegetated area of a urbanized beach when compared to the less urbanized site. We can relate greater presence of *O. quadrata* in highly urbanized beaches with the greater protection of vegetal cover.

Keywords: *Ocypode quadrata*; Monitoring; Vegetation; Impacts

Qualitative and quantitative assessment of microplastics in the sediment of three sandy Mediterranean beaches, including different methodological approaches.

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Microplastics are small plastic particles (<5mm) that are found in most marine habitats around the world and several studies are trying to determine their exact effects. They are introduced to the marine ecosystem directly as manufactured microplastics, or indirectly through the decomposition of bigger plastic particles. Microplastics can enter the food chain, and can be found as vectors for the movement of microbial communities, and chemical pollutants (i.e. heavy metals, Persistent Organic Pollutants), influencing both the biotic and abiotic environment. In our study, 2 different ways to measure microplastics were tested in 3 Mediterranean beaches with different human pressure on them. The purpose was to compare different sampling approaches to assess the microplastics of the sediment, taking into account the temporal variability of Summer and Winter season. Statistical significant differences were found in between the beaches, that reflects the differences of use in each beach and at the same time, differences were found in microplastic content, due to the seasonal variability. Finally, depending on the grain size, microplastics can be found in deeper sediment layers, and thus sampling methods that do not sample the same sediment layer, do not seem to produce comparable results.

Keywords: Microplastics; Sandy Beaches; Sediment; Methodology; Granulometry

Role of geoenvironmental dynamics in the biodiversity of sandy beaches and sandflats

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Sandy beaches and sandflats foster rich natural ecosystems that serve for a human society. The response of the macroinfauna to their abiotic environment has been widely studied in relation to hydroenvironmental conditions, sediment types and sediment grain sizes. However, the possible role of varying geoenvironmental conditions in their habitats as well as in the biodiversity of sandy beaches and sandflats remain poorly understood. We have previously shown that the hardness of the surficial intertidal sediments varies by a factor of 20–50 due to suction development and suction-induced void state changes in the essentially saturated states of sandy beaches and sandflats. Recent advances in such salient geophysics involved in intertidal sediments made it possible to closely investigate the linkage between the waterfront geoenvironment and ecology of sandy beaches and sandflats. The results of a comprehensive set of field observations, surveys and controlled laboratory experiments demonstrated that the waterfront suction and the associated geoenvironments govern the performances of the basic living activities of various representative creatures involving crabs, bivalves, amphipods, isopods and birds. A species diversity–geoenvironment relationship was developed based on the responses of diverse macroinfauna to geoenvironmental dynamics, which was found to be consistent in nature with what has been observed through two habitat restoration projects. The present results demonstrate a substantial role of the habitat geophysical environments in the survival and distributions of diverse species, accounting for the cause and effects involved. Hence, such waterfront geoenvironment plays a pivotal role in the habitat selection for the benthos diversity. These findings will facilitate a new horizon of the performance-based geoenvironmental assessment, design and management for the conservation and restoration of habitats with rich natural ecosystems in intertidal zones. They may also provide a rational basis by which to understand the ensuing, and to predict future, macroinfaunal responses to geoenvironmental dynamics of sandy beaches and sandflats in a changing global environment.

Keywords: Sandy Beaches; Sandflats; Biodiversity; Geoenvironment

Sandhopper (Amphipoda, Talitridae) orientation as across scales bioindicator of sandy beaches environmental conditions: a meta-analytic approach

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Sandhoppers (Amphipoda, Talitridae) are well known as key species of sandy beaches. Behavioural (orientation) traits have been extensively studied and proposed as bioindicator of impacts on beaches. To verify its use as across scales bioindicator of environmental conditions, we conducted a meta-analysis on a large dataset of more than 8000 observations from beaches in the Mediterranean and eastern Atlantic coasts. The meta-analysis was conducted through a machine learning application by creating three "virtual sandhoppers" trained with orientation data coming from beaches of the considered geographic area. Finally, the behavioural responses of the "virtual sandhoppers" were tested on three test sets consisting of different sandy beach physical conditions. In each of the three conditions, the results show the presence of a dominant direction towards the sea. The main differences are observed with regards to behavioural variability around the dominant direction, which is greater in Mediterranean beaches than Oceanic ones. A possible explanation are the lower tide and wind power and greater variation in exposure of the Mediterranean beaches. The results confirm the potential use of sandhopper orientation as ubiquitous bioindicator applicable to different conditions both on a small and large spatial scale.

Keywords: Sandy Beaches; Sandhoppers; Orientation; Meta-analysis

Coastal urbanization: intense management regimes alter and strongly degrade sandy beach ecosystems

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Urbanization fragments and degrades habitat and impacts biodiversity and ecosystem function. Conservation and management of coastal ecosystems requires understanding complex ecological responses of natural communities and the vulnerability of ecologically important taxa to increasing urbanization. We evaluated impacts of coastal urbanization by comparing intertidal macroinvertebrate communities of urbanized and unmanaged sandy beaches in densely populated southern California, USA (~300 km). Urbanized beaches had significantly larger grain size (43%) and lower wrack cover (-81%) than unmanaged beaches, but Dean's parameter and intertidal slope did not differ significantly. Strong negative responses of intertidal biodiversity and community structure to urbanization were evident. On urbanized beaches, macroinvertebrate communities had significantly lower species richness (-53%), abundance (-88%), and biomass (-65%). Functional diversity responses to urbanization suggested ecological function was degraded. Two major groups of macroinvertebrates, upper (wrack-associated) and lower intertidal, responded negatively to urbanization with stronger effects evident on wrack-associated assemblages. We identified several highly vulnerable taxa, but found no taxa that flourished on urbanized beaches despite consistent presence of a few apparently resilient species. Our results show that the intense management regimes associated with urbanization strongly degraded the condition and function of sandy beach ecosystems with the most severe impacts to wrack-associated macroinvertebrates.

Keywords: Beaches, Biodiversity, California, Disturbance, Functional diversity, Indicator species, Intertidal zone, Invertebrate, Urbanization, Wrack

Ecological patterns in sandy beaches of Costa Rica: Comparison between Caribbean and Pacific coasts

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The present study compared ecological patterns in sandy beaches between Caribbean and Pacific coast of Costa Rica. The intertidal zone of each beach was divided into five strata from low to high tidal level. In each stratum, sediments samples (corer area: 20.2 cm²) were taken to study the macrofauna. Additionally, grain size composition and total organic matter were determined. The macrofauna was more diverse on the Pacific coast (5 to 10 taxa, per beach) than in the Caribbean (4–6 taxa, per beach). The most diverse was the annelids, followed by peracaridans. The mollusks (Olivellidae) were more abundant in the Pacific Coast. Moreover these differences, on both coasts, show a vertical distribution of taxa from high to low tide level, with higher abundances in the low tidal level. The high tidal level was populated by isopods (Cirolanidae). Faunal differences between both coasts can be explained by environmental differences. The tidal range is narrower on the Caribbean (0.5–1.5 m) than the Pacific Coast (2–3m). The organic matter was lower (2%) in the Caribbean than in the Pacific (2%). In the Caribbean coast, the sediment is ~90% of fine sand (500–63 µm) whereas in Pacific coast this fraction was about 65%.

Keywords: Macrofauna; Organic Matter; Tidal Range; Grain Size

Artificial light as a disturbance factor for sandy beach pill bugs, *Tylos capensis*, at the Alexandria Coastal Dunefields, South Africa.

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While artificial light has become an important resource to humans, the increasingly larger areas that are lit at night poses a threat to species and ecosystem processes. One such group potentially affected by light pollution, is pill bugs (*Tylos spp.*), which inhabit the high shore of sandy beaches. Recent reports suggest that pill bug populations around the world are in decline and at risk of extinction. The mechanisms responsible for the disappearance of pill bugs are not always clear, although light pollution has been posed as a potential driver. Therefore, this study aimed to investigate the potential role of artificial light as a mechanism of disturbance to sandy beach pill bugs, *Tylos capensis*. We first established pill bug responses to natural (lunar) light, by quantifying activity during four lunar phases (new moon, full moon, first and third quarter) at the Alexandria Coastal Dunefield (ACD), South Africa. We then determined the response of pill bugs to a range of artificial white light intensities (10, 100, and 1000 lx), as well as red light (150 lx), and a control (no light), in the laboratory. Lastly, we determined responses to artificial light in an *in situ* experiment, at the ACD. Our results indicated that significantly fewer pill bugs were active during full moon than any other lunar phase ($\chi^2_{(0.05,4)} = 147.93$, $p = 2.2 \times 10^{-16}$). For the second objective, a strong negative relationship was observed between the light treatment and activity duration of the animals ($\rho = -0.70$, $p < 0.05$). The results of objective three were congruent with that of the laboratory experiment, indicating that more pill bugs were active in the absence of light, and at low light intensities. Our study concludes that artificial night light affects the behaviour of *Tylos capensis*. The increase of urban sprawl may threaten vulnerable nocturnal sandy beach fauna through the presence of night glow, even in areas of relative pristine condition.

Keywords: Light pollution; Sandy beaches; *Tylos capensis*; Lunar; Light intensity

Beach cast *Posidonia oceanica* leaf litter vs. beach morphology and dynamics

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This work summarized the studies conducted on the interaction between banquettes and beach dynamic and morphology realized by the authors during the last ten years. This studies were conducted on several beaches of Sardinia Island. Morphological and topographic measurement, sediment collection and analyses and video monitoring were used to realize the studies. This allow us to describe the deposition process in relation to beach exposure. Along exposed beaches the deposition occurred in the berm area, whereas along sheltered beach the leaf litter represent the main material exchanged between submerged and emerged beach. Along embayed beaches the deposition of banquettes is related to the presence of litter in the seabed of the bay. On this beach the deposition of banquette occurs when a storm decrease in intensity, their erosion occurs in the initial phase on an intense storm. This studies allowed to evaluate the impact of removal of banquettes from beaches. When conducted with heavy machinery the removal operations could influence the morphology of beaches in terms of flattening and obliteration of sedimentary features. Sediment content on banquettes could be relevant ($> 100 \text{ kg m}^{-3}$ of banquette), hence the removal of banquette from can affect the sediment budget of beaches.

Keywords: Banquette, Beaches, Mediterranean sea, *Posidonia oceanica*

Preliminary data about the meiofauna of one sandy-muddy beach of the municipality of Calçoene (Amapá, Brazil) and the influence of salinity on its composition

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The oceanic coast of Amapá Estate (extreme north of Brazil), extends for about 750 km, almost completely dominated by mangroves. Sandy-muddy beaches are few, small and difficult to access. These beaches are extremely influenced by fresh water and sediments discharged by the Amazon river, showing low salinity and high turbidity throughout the year. These characteristics make these beaches interesting points of researches, however, related studies are scarce. The purpose of this work was thus to assess the composition and spatio-temporal variability of the meiofauna from the Goiabal beach, Calçoene municipality. We performed 2 surveys, one in November 2015 (end of dry season) and another in January 2016 (beginning of rainy season). Three points (100 m far from each other) in either upper and lower intertidal zone were sampled in both surveys and three replicates of 113 cm³ of sediment in each point were collected. After elutriation, meiofauna was analysed. Representatives of Nematoda, Copepoda and Polychaeta were found; the analysis of the composition indicated an influence of salinity with higher salinities related to an increase of Nematoda density.

Keywords: Sediments; Salinity; Nematoda; Copepoda; Polychaeta, Amazon Region

Wedge clam resource in Thailand: population dynamics and management

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In this study, a transdisciplinary approach was applied by integrating ecological and socio-economic data to support the effective management of the wedge clam resource in Thailand. Ecological and socioeconomic surveys were conducted at Pak Meng Beach, Trang Province, during November 2016 to March 2017. This study aimed to illustrate the importance of clam fishery and to analyze the current state of the fishery based on the fishers' point of view. In-depth interviews were conducted in 2016 with fishers who involved in the wedge clam fisheries in Hat Pakmeng Beach, Sikao District, Trang Province. Based on the interviews, all fishers agreed that the wedge clam fishery is important for their livelihoods in terms of food source and household additional income. High proportion of female fishers (>80%) reflected the high level of women participation in this fishery. Most of the fishers pointed out that the declines in abundance and individual size of clam are currently observed. These could be mainly resulted from the growing number of fishers collecting the clam. To conserve this clam, the respondents recommended to establishing some no-take areas to increase the clam abundance along with enhancing the fishers' awareness. This information serves as a basis for further policy formulation and decision-making on the conservation of wedge clam.

Keywords: Andaman Sea; *Donax scortum*; Management; Marine Fisheries

Biogeographic perspectives of benthic invertebrate assemblages on sandy beaches along the Japan Sea coast

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Benthic assemblages of sandy beaches are primarily structured by physical environment factors and are mainly comprised of peracarid crustaceans and other invertebrates. Around Japanese Islands, the southwestern coastal areas of the Japan Sea are assigned as a part of warm temperate region, while the northern coastal areas are included in a cold temperate region. However, the boundary between the two regions remained to be verified. Due to the ongoing increase of sea surface temperature, we need to develop efficient methods to monitor distribution of coastal species and assemblages. In this study, geographic variations in benthic invertebrate assemblages were surveyed at 39 sites along the Japan Sea coast of Honshu to elucidate their relationships with environmental factors. In total, 78 taxonomic units were obtained using a sledge net sampling and six clusters of assemblage were recognized. Geographical distributions of two of the clusters were localized and mutually exclusive (one in the north and one in the south). The spatial gap between the two clusters located at the central area of Honshu can be proposed as a boundary of geographic regions of sandy beach organisms. Monitoring study should be focused on any changes of these two clusters in the future.

Keywords: Benthic Community; Multivariate Analysis; Microtidal Beach; Distribution

The culture of beaches through education at a basic level in Mexico

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In this study we reviewed textbooks to identify the information given to students and teachers on the topic of beaches. So we elaborate an alternative of community participation to preserve this ecosystems. The beach information that is taught to children is superficial because it focuses on images without explanation of the elements that make up the beach. Nor are the teachers teaching the patterns and processes to be taken care of to preserve them. The legislation that exists is contradictory in its provisions and there is no coordinating document to help solve this problem. So, the beaches in Mexican society are identified only as a place of recreation that belongs to private hotels. There is not therefore a culture of beaches so it is proposed to improve the content in textbooks and start environmental education campaigns that achieve through the children little by little build an awareness of the heritage that the beaches represent.

Keywords: Education, Patrimony, Social Organization.

Management for multipurpose use on sheltered beaches: conceptual framework for conservation and recreation over an ecological basis

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This study aims to review the state of the art of sandy beaches located within the “La Paz” Bay, Mexico, in order to provide a guideline for supporting management plans for multipurpose use on these sheltered beaches. Therefore, 10 ecological principles were considered: i) main physical processes and agents acting on the beaches at significant scales; ii) ecological features of beaches and dunes; iii) current status of the beaches and sediment erosion; iv) effects of human activity; v) existence and socioeconomic activities, ix) health and safety; and x) Regulations, policy, planning and implementation of management strategies. Conservation and recreation indexes were also estimated based on the results. The most appropriated strategies detected for the management on these sheltered beaches correspond with their features and usages, however established plans are not correct. Although, the method applied to sheltered beaches was disigned to exposed beaches it was enough to quickly identify the recreational virtues and needs of conservation on the BLP beaches. The indices value estimated for the different beaches represents real characteristics.

Keywords: Conservation; Degradation; Environmental Indexes; Gulf of California; Recreation

Universality of the linkage between geoenvironment and the distributions of the sandy beach amphipods: *Haustorioides japonicus*, *Haustorioides koreanus*, and *Haustorioides munsterhjelmii*

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Field studies were conducted in order to investigate whether there is a universal linkage between the distribution of the sandy beach amphipods, namely *Haustorioides japonicus*, *Haustorioides koreanus*, and *Haustorioides munsterhjelmii*, and the geophysical environment represented by suction. Suction s means the tension of moisture in soil and is defined by $s = u_a - u_w$, where u_a is the atmospheric air pressure and u_w is the pore water pressure in the soil. By definition, suction is zero at the groundwater level. As field sites for *H. japonicus*, five sandy beaches located on the Japan Sea coast in Niigata prefecture, Japan, for *H. munsterhjelmii*, Shari sandy beach in Hokkaido, Japan, and for *H. koreanus*, Samyang sandy beach in Jeju Island, South Korea, were selected respectively. We performed field studies along the cross-shore transects in each of seven beaches during spring low tides. The mean tidal ranges of the Japan Sea coast, Shari beach, and Samyang beach were about 0.2m, 0.8m, and 2.35m, respectively. At Shari and Samyang beaches where the tidal ranges were high compared to that of the Japan Sea coast, the variations of species densities in relation to tidal level were also observed to investigate the shift of species distribution with tide. *H. Munsterhjelmii* in Shari shifted with tide. On the other hand, *H. koreanus* in Samyang did not shift with tide. The first reason why *H. koreanus* did not shift with the tide, is considered such that in the region where tidal range was high, the distance needed to shift lengthened compared to that in the region where tidal range was low, so the associated energy consumption and invisible risk also increased. The second reason is that the variation of suction, associated with the tide-induced groundwater level

fluctuations was not significant in the shore side where *H. koreanus* occurred. This was due to the significant attenuation of the groundwater level fluctuations in the shore side relative to that in the offshore side. Thus, it was not necessary for *H. koreanus* to shift seaward or landward with tide. Notably, the distributions of three *Haustorioides* species were associated with particular suction, irrespective of the difference in the amphipod species. *Haustorioides* species became absent where suction exceeded about 2kPa in all beaches, despite more than 10-fold tidal range and its variations.

Keywords: Sandy Beaches; Suction; Beach Amphipod; *Haustorioides* species

Geomorphological influences on benthic intertidal and subtidal macrofauna along Southeastern Florida beaches

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Macrofaunal communities on beaches have been shown to be influenced by geomorphodynamic processes such as wave height, grain size, and beach state. There are few intertidal benthic studies in Florida; most studies being subtidal, evaluating responses to dredging. This intertidal community knowledge gap instigated our study. We examined the early summer biodiversity of benthic intertidal and subtidal macrofauna on two beaches with no direct beach nourishment program. Study sites included John D. MacArthur State Park, North Palm Beach, FL in June of 2016 and Gulfstream Park, Delray Beach, FL in June of 2017. Eighty core samples were collected at each site across four levels, two subtidal (-10 m and -25 m from sea level) and two intertidal (+5 m and 0 m, sea level). Low species richness and abundance were found at both sites with few species dominating the community. Preliminary analysis indicates that geomorphodynamic processes influence richness and diversity. Further analysis is in progress.

Keywords: Geomorphology; Benthic Macrofauna, Subtidal, Florida

Brazilian sandy beaches: characteristics, knowledge and priorities

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Because of the large extent of its coast and the influence of different tidal and climatic patterns, Brazil has a large variety of beaches. Nevertheless, knowledge of sandy beaches in the country is still limited. To promote the implementation of integrated studies and detect the effects of regional and global environmental change on the Brazilian coast, we conducted an intensive review of the studies undertaken on beaches and summarized the current knowledge about this environment. A total of 127 studies on the ecology of sandy beach macrofauna were recorded. These studies were conducted on 172 beaches in the four coastal regions; however, the number of publications among regions is quite unbalanced. Approximately 84% of the studies were done in the southeastern and southern regions. Almost all studies (96%) focused on the description of population and community patterns, and most (75%) had a duration of less than or equal to one year. These results highlight the urgent need for more varied and longer time-series studies in order to gain a better understanding of the Brazilian sandy beaches. Only the improved knowledge of this ecosystem can reveal the real effects of environmental changes, and propose effective measures to conserve this coastal ecosystem.

Keywords: Sandy Beaches, Brazilian coast, Knowledge Gaps, Environmental Features, Key Species

Climatic and anthropogenic effects on intertidal biodiversity at Rio de Janeiro (Brazil) sandy beaches

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Climatic and anthropogenic impacts were investigated on different trophic positions including invertebrates, fishes and birds. In non-urbanized beaches, the frequency of storm-wave events was the main predictor of macrofauna density ($R^2 > 60-70\%$; $p < 0.05$), regardless of morphodynamics. In urbanized beaches, lower resilience of the macrofauna community and the ghost crab *Ocypode quadrata* were the main short-term effects of these extreme events. The tourist number on summer months (~2-3 tourists/m²) was responsible for the highest solid waste density (4.5 items/m²) and significant lower abundance of macroinvertebrates in urbanized areas compared to low-visited beaches (<1 tourist and item/m²). Human impact on the trophic structure was corroborated on insect prey (>90%) by surf zone fish related to solid waste density ($R^2 = 0.34$; $p = 0.04$). Energy transfer efficiency over the food webs was lower in the urbanized beaches, as a result of lower abundance of top predators (seabird *Sula leucogaster*) and changes on fish diet induced by macroinvertebrates scarcity. Furthermore *O. quadrata* is road-killed, and avoid building their burrows on trampled sites. The synergistic effects of increasing storm-wave events and urbanization may modify the structure of biological communities and ecosystem functioning by reducing macrofauna populations, which markedly contribute to energy flow in coastal trophic webs.

Keywords: Storm-wave; Human Impact; Macrofauna; Surf Zone Fish; Ghost-crabs