Sessione
La vita negli ambienti estremi

Poster

Changes in diversity and structure of sponge communities of a semi-submerged sea cave over a half-century time span

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Sea caves are vulnerable ecosystems and represent endangered habitats in Mediterranean Sea because of pollution, thermal anomalies and presence of alien species in recent decades. These environments offer optimal physical conditions that lead to a high level of biodiversity within a limited area. The study of the semi-submerged sea caves provides information about environmental stability on a temporal scale and changes in benthic communities on a local scale. Porifera are very common in these habitats in terms of diversity and abundance and represent a key group for assessing the effects of the possible environmental changes. This study compares the diversity of sponges over a span of time of 63-year (1960-2023) in a semi-submerged cave called "Grotta delle Palombe" at Baia di Trentaremi (Naples), located within the MPA "Parco sommerso di Gaiola". The opening of the cave is narrow and elongated, becoming even narrower toward the end, approximately 60 meters from the entrance. The same sampling method was used as in previous studies by professor Sarà. All the specimens present in standard squares (400 cm2 each) were collected by scuba diving. The number of identified species increased from 69 in 1960 to 72 in 2023, with only 27 species in common. Sponge abundance have also changed: in 1960 *Leucetta solida* (Schmidt, 1862), *Cliona viridis* (Schmidt, 1862) and *Phorbas fictitius* (Bowerbank, 1866) were the most abundant species in the cave. Instead, in 2023 *Dendroxea lenis* (Topsent, 1892), *Jaspis johnstonii* (Schmidt, 1862) and *Leucosolenia* sp.1 predominate. In 1960, *C. viridis* (14,56%) and *G. cydonium* (11,05%) were the most abundant species in terms of coverage, whereas *D. lenis* (6,11%) and *J. johnstonii* (2,5%) were the most abundant in 2023. Total sponge coverage is now around 25%, compared to 55% more than 60 years ago. Anthropogenic impact, together with ongoing climate change, have contributed to these variations, reflecting sponge adaptability to environmental changes.

Changes in meiofauna community during a coral bleaching event in the Maldives

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Coral bleaching represents one of the main threats to tropical marine ecosystems worldwide, with significant impacts also observed in the Maldives archipelago. One element that remains relatively understudied in this context is the effect of marine heatwaves on benthic meiofauna associated with coral reefs, which performs crucial ecological functions within reef sediments, including bioturbation and nutrient recycling. Recent studies suggest that the composition and abundance of meiofauna are strongly influenced by coral health: the loss of three-dimensional habitat and trophic resources following coral bleaching and subsequent mortality can lead to a decline in the diversity and functionality of these communities. The change in benthic meiofauna composition and abundance during the 2024 bleaching event was therefore investigated. Sediment samples were collected by scuba diving at two depths (1m and 8m) in Magoodhoo lagoon (Faafu Atoll, Maldives) before (April 2024), during (July 2024), and after the bleaching event (December 2024). Meiofauna was extracted, counted and sorted to the main taxa level. A total of 8 taxa were recorded of which the most abundant were Nematoda and Copepoda with their nauplii. The highest abundance (1075±388 individuals) was observed at the 1m station before the bleaching event, while the lowest (399±149) was at 8m in the same period. Community composition varied significantly before, during and after the bleaching event. In particular, the relative abundance of Nematoda was markedly reduced during and after the bleaching event compared to pre bleaching values suggesting potential influence of thermal stress during the bleaching event or seasonal dynamics. Conversely, samples from during and after bleaching event showed higher proportions of Copepoda and their nauplii, potentially indicating reproductive events during this period. Depth also played a role in shaping community structure, with deeper stations exhibiting lower abundance. These patterns may reflect environmental changes, such as temperature fluctuations, oxygen levels, and food availability. Our results show coral bleaching events not only affect coral but may also impact meiofauna associated with corals. Understanding the interactions between bleaching events and meiofaunal communities is critical for assessing reef ecosystem resilience and informing targeted conservation strategies in the Maldives, a region particularly vulnerable to the effects of climate change.

Antarctic gastropods and algal turf: taxonomic composition, distribution and ecological interactions in shallow water of Terra Nova Bay (Ross Sea)

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The structure of marine benthic communities is primarily shaped by environmental variables, especially physical factors such as sediment type, hydrodynamics, and oxygen availability. In hard-bottom and algal-dominated habitats, the nature and complexity of the substrate play a key role in determining species composition through physical constraints and biological interactions. In shallow water of Terra Nova Bay (Ross Sea, Antarctic continent), macrofauna was sampled from hard substrate, in the austral summer 2021/2022, during the XXXVII Italian Antarctic expedition of the "National Program of Antarctic Research" (PNRA). Samples, from hard substrates both colonised and not colonised by high algal turf, were collected using an air-suction pump in a frame of 40x40cm. The gastropod assemblages were taxonomically investigated, and algal turf biomass was quantified. *Laevilitorina antarctica* (Smith, 1902) and *Powellisetia deserta* (E. A. Smith, 1907) were the dominant species, accounting for 68% of the total gastropod assemblages, followed by *Subonoba turqueti* (E. Lamy, 1906), which contributed 16%. The presence of algal turf strongly influenced gastropod distribution, with 81% of individuals found on algal-colonised substrate, and only 19% on non-colonised ones. This pattern was statistically supported by the linear regression analysis, which, considering algal biomass as the independent variable, revealed a strong positive relationship between algal turf with gastropod abundance (R2=0.94; p¡0.001), whereas no significant relationship was detected with species richness (R2=0.0008; p¿0.05).
These results reinforce the ecological role of habitat-forming species, such as erect algae, acting as ecosystem engineers. The dominance of a few species suggests that algal turf substrate is highly selective for certain *taxa*, highlighting the importance of structural complexity in enhancing habitat suitability. Overall, in extreme environments, such as the Antarctic continent, turf-forming algae significantly influence gastropod assemblages' composition and spatial distribution.

Revisiting diversity and endemicity of deep Mediterranean polychaetes: occurrence of a *Nereis* clade associated with reduced environments on Tyrrhenian volcanoes

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Recent studies carried out in the southern Atlantic Ocean highlighted the occurrence of four *Nereis* species sharing some morphological features and structuring a supported clade from the molecular point of view. These species have been found in association with experimental organic falls, suggesting adaptation to deep-sea reduced environments. Samplings carried out in 2018 on the submarine volcanoes of the southern Tyrrhenian Sea highlighted the occurrence of an eyeless *Nereis* species associated with hydrothermal vent environments. Morphological and molecular data support its inclusion in the southern Atlantic clade, but also suggest that it represent a distinct, undescribed species. Comparison of the sequences obtained with those publicly available on genetic databases stressed a close similarity with specimens sampled on mud volcanoes in the Gulf of Cadiz, misidentified as *Eunereis longissima*, suggesting that this clade of Nereis might be rather widespread in deep European waters. These results support the hypothesis of the occurrence of a Mediterranean fauna associated with deep hydrothermal vents and more generally reduced environments, and the possibility that some of these species might indeed be endemic to the Mediterranean Sea.

Bluecrab Interreg: the reproductive biology of *Callinectes sapidus* in Caorle and Marano lagoons

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The blue crab *Callinectes sapidus* (Rathbun,1896) is an invasive alien species in the Mediterranean Sea. In recent years, its adaptability allowed it to spread rapidly, posing a significant threat to local biodiversity and traditional fisheries,particularly along the northern Adriatic coast. This study was carried out within the Interreg ITA-SLO –BLUECRAB Blue Crab Lifecycle Understanding and Ecosystem Management in Europe (ITA-SI0600229), which aims to protect vulnerable areas of the upper Adriatic through monitoring and sustainable management involving institutions, fishing companies and local communities. Despite its growing impact, limited information is available about the species' local life cycle and reproductive biology, knowledge that is essential to implement effective control measures. To address this gap, monthly crab samplings were conducted in the Marano and Caorle lagoons at three stations characterized by increasing salinity gradients. In Marano, specimens were catched using a fyke net, whereas in Caorle, two traditional traps were employed: a square one and a round one. At each station, a multi-parameter probe was placed to record temperature and salinity, which are known to influence the species' distribution and behaviour. Carapace width, carapace length and body weight were measured for each individual. A subsample of 20 crabs per lagoon was dissected to assess the gonado-smatic index and hepato-somatic index, as well as to examine gonadal development. Tissues were embedded in resin for histological analysis to confirm reproductive stages. In total, 297 crabs were sampled. In Caorle, the average size is 147.8±28.8mm for females and 152.6±19.7mm for males, while in Marano 171.5±9.8mm for females and 176.2±13.8mm for males. Mean weights are 158.4±56.2g (females) and 229.8±84.7g (males) in Caorle, and 229.0±51.8g (females) and 372.7±71.7g (males) in Marano. The M:F sex ratio is 1:0.79 in Marano and 1:0.82 in Caorle. Preliminary findings indicate a reproductive season extending from May to August, with peak between June and August. Analysis of reproductive indices is ongoing, with the aim of characterizing the timing and duration of ovarian development and identifying reproductive migrations. This study represents the first investigation into the reproductive biology of *C. sapidus* at higher latitudes within the Mediterranean. Initial data suggest distinct physiological responses, potentially linked to local environmental conditions.

Brain evolution in Mediterranean Sea sharks: unveiling adaptive 'cerebrotypes' for different environments

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Chondrichthyans occupy a basal position in vertebrate evolution, providing a relatively unexplored opportunity to study the evolution of vertebrate brains. This study examines the brain morphology of 12 shark species and one holocephalan, all representative of Mediterranean species, in relation to their habitat (bathyal, coastal, or pelagic), hypothesizing a contrast between deep-sea and shallow-water/pelagic brain models.
The relative development of the five major brain areas (olfactory bulbs, telencephalon, diencephalon, mesencephalon, cerebellum, and medulla) was assessed, comparing their percentages across the three habitats and involving PCA analysis. Since the olfactory bulbs are known to evolve statistically independently from the rest of the brain, PCA analysis was performed both with and without the olfactory bulb percentages.
The results show that deep-sea sharks and holocephalans share common characteristics, including a relatively reduced telencephalon, a smooth cerebellar corpus, and an extreme relative enlargement of the medulla, which may reflect adaptations to their specific deep-sea environment. The reduced telencephalon suggests a lower need for advanced cognitive functions, while the smooth cerebellar corpus could indicate an emphasis on energy efficiency rather than fine motor control. The enlargement of the medulla likely supports vital autonomic functions crucial for survival in extreme conditions, as well as the modulation of electroreception and lateral line cues. The lack of habitat-specific development of olfactory bulbs suggests that olfaction may not be as critical or may be subject to evolutionary constraints unrelated to habitat.
Although not a functional analysis, the observed traits suggest the Mediterranean deep-sea Chondrichthyans possess peculiar brain patterns, shaped by both evolutionary history and their adaptation to harsh conditions, reinforcing the concept of 'cerebrotypes.'

The BIOROSS 2023 Project: increasing knowledge of the sponge fauna of the Ross Sea (Antarctica)

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The Ross Sea (Antarctica) has been the interest of several Italian scientific expeditions since 1958. During these campaigns, the study of benthic communities, and in particular Porifera, has been one of the main focuses of research on the area's biodiversity. The most recent expedition took place in 2023 as part of the BIOROSS Project, led by ENEA and funded by MUR-PNRA. Researchers from DISTAV (UNIGE) were in charge of analysing sponge samples from 13 sites located between Cape Wheatstone and Robertson's Bay, collected by Agassiz trawl at a depth range of 50-500 m. A total number of 113 specimens belonging to the class Demospongiae have been collected, among which 42 species have been identified. Most of the specimens were collected at two sites, offshore Cape Wheatstone and along the coast of the Hallet Peninsula, with 42 and 26 samples, respectively. The most represented and diversified genus was *Isodictya* Bowerbank, 1864, of which 30 specimens were collected, belonging to the following 9 different species: *I. cf. delicata* (Thiele, 1905), *I. erinacea* (Topsent, 1916), *I. kerguelenensis* (Ridley & Dendy, 1886), *I. lankesteri* (Kirkpatrick, 1907), *I. setifera* (Topsent, 1901), *I. spinigera* (Kirkpatrick, 1907), *I. toxophila* Burton, 1932, *I. trigona* (Topsent, 1917), and *I. verrucosa* (Topsent, 1913). Moreover, *Isodictya* was the genus with the widest distribution, occurring in 8 out of the 13 sites. Among the identified sponge species, 5 were new records for the area of the Ross Sea, as follow: *Phorbas megasigma* Rios & Cristobo, 2007, *I. cf. delicata*, *I. trigona*, *Ectyonopsis ruthae* (Mothes & Lerner, 1995), and *Antarctotetilla pilosa* Carella & Uriz, 2018. Furthermore, *E. ruthae* and *I. trigona* were found for the first time after the original description. Finally, the species *Microxina sp.* and *Halichondria (Halichondria) sp.*, probably represent two species new to science. This study has therefore broadened knowledge of the sponge fauna of the Ross Sea, increasing the number of known species from 264 to 271, thus improving the understanding of its biodiversity.
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Sky polarization gradient and zonal orientation in young sandhoppers

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It is known that the supralittoral amphipod *Talitrus saltator* (Montagu) uses various celestial orientation factors during daily movements along the sea-land axis of the beach to avoid biotic and abiotic stressors. The sun compass mechanism is one of the main orientation mechanisms used and is innate in young sandhoppers. However, although it has been shown that the sandhopper *T. saltator* perceives polarized light and possesses an arrangement of the rhabdomeres that could allow e-vector utilization, *T. saltator* doesn't use the e-vector orientation of the skylight polarization as a compass cue. However, adult individuals perceive radiance and/or color gradients more effectively when exposed to polarized light. In the laboratory experiments were carried out with young sandhoppers collected in the field over a month old (experts) and laboratory-born sandhoppers of varius ages (inexperts) under an artificial linear polarization gradient. Experts sandhoppers use the linear polarization gradient to steer in the correct direction of the sea-land axis of the original beach, whilst inexpert young born in the laboratory are unable to take any direction independently of their age. However, the latter after a training period in the laboratory under the polarization gradient and a false sun are able to head in the correct sea-land axis even if tested under the sole polarization gradient

Sessione
Approcci molecolari
nella zoologia contemporanea

Comunicazioni