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54° Congresso SIBM: Ambienti estremi come laboratori naturali

R. SANDULLI[1,2], O. MANGONI[3,2]

[1]Dipartimento Scienze e Tecnologie, Università di Napoli Parthenope, 80143 Napoli (NA)
[2]CoNISMa, 00196 Roma
[3] Dipartimento di Biologia, Università di Napoli Federico II, 80126 Napoli (NA)
corresponding author: roberto.sandulli@uniparthenope.it

Overview

EXTREME ENVIRONMENTS AS NATURAL LABORATORIES

AMBIENTI ESTREMI COME LABORATORI NATURALI

The introductory speech of Theme 3 "Extreme environments as natural laboratories" was delivered by prof. Antonio Pusceddu and was entitled: "Extreme Labs in the Field: Frozen Elevators, Anoxic Metazoan Life, High-Variance Transitional Environments". The continuous spatio-temporal changes in marine environmental conditions towards the extreme limits of natural conditions have triggered profound changes and adaptations in all life forms. To this respect, studying the effects of the variations of the most relevant marine environmental parameters, such as temperature, salinity, pH, oxygen content, is extremely interesting and meaningful in the era of global change. In particular, in some aquatic environments (e.g., coastal lagoons, polar systems), such changes generate 'extreme' conditions that may lead to anomalous events such as heat waves. The study of 'extreme' environments helps us not only in the interpretation of evolutive adaptations of organisms living in these conditions but also to identify possible convergences in apparently very different 'extreme' environments, and to foresee future responses to global change.

Following the introductory speech, eight reports were delivered.

The report by Azzola *et al*., entitled "The Biological Communities of an Extreme Environment: The Blue Hole of Faanu Mudugau, Maldives", highlighted how these 'extreme' systems often characterized by anoxic conditions and high hydrogen sulphide concentrations, could host, other than adapted microorganisms, also benthic communities distributed along a bathymetric gradient. In the shallower zone (30-40 m depth) encrusting algae, sponges and scleractinians; in the intermediate mesophotic zone (around 45 m), Chrysophyceae and Cyanobacteria, and in the deeper zone (below 50 m depth), chemosynthetic bacteria (Chloroflexota, Proteobacteria e Desulfobacterota). Blue holes may be considered as natural laboratories for the study of life adapted to extreme environmental conditions.

Bolinesi *et al*. described the land-fast ice as the most productive sea-ice subsystem in Antarctica, due to its thick, porous structure that supports dense communities of sympagic microalgae, particularly diatoms. Pennate-benthic species dominate interstitial spaces, while centric diatoms are more abundant in platelet ice. During the melting season, large quantities of these microalgae are released into the water, contributing to water column stability and promoting planktonic growth. The study, part of the CEFA project (PNRA), focuses on the temporal evolution of microalgal communities beneath land-fast ice in Terra Nova Bay during late spring and early summer 2015/2016. Results showed high variability in the upper water layers, with diatoms remaining dominant throughout.

Della Torre *et al*. treated the topic of adaptive responses of marine invertebrates to acidified environments. Natural CO_2 vents represent a unique opportunity to study long-term effects of acidification in complex and real conditions. For instance, in the hydrothermal CO_2 vents of Ischia Island (Naples), the sea-urchin *Arbacia lixula* (Linnaeus, 1758) and the limpet *Patella caerulea* Linnaeus, 1758 showed diversified adaptive responses, ranging from genetic adaptations and changes in physiological and metabolic functions to ecological interactions.

In the report by Mutalipassi *et al*., entitled ”Alien Metabolites in Phlegrean Lagoons: the Defensive Secretion of the Non-Indigenous Mollusk *Haloa japonica”*, aspects related to coastal phlegrean lagoons and invasion by alien species that displace effective chemical weapons unknown to native specieshave been investigated. The species object of the study, *Haloa japonica* (Pilsbry, 1895), an alien cephalaspidean that has colonized the phlegrean lagoons, when disturbed, produces a mucous secretion rich of a new polypropionate used as chemical defense. This bioactive compound could have an important role in the invasive success of this species.

Napolitano *et al*. showed, with their research “*Patella* spp. (Mollusca, Gastropoda) oxidative metabolism adaptation under ocean acidification conditions at CO_2 vents (Ischia Island, Italy)” that mollusks such as the limpets *Patella* spp. living in the acidified waters of Ischia Island may have adaptive responses in terms of biomarkers production related to local acidified conditions.

Piro *et al*. studied the “Adattamenti Fisiologici e Biochimici di *Posidonia oceanica* e *Cymodocea nodosa* ai Vents di CO_2” at Ischia, Panarea and Vulcano Islands (Italy). They studied samples of *Posidonia oceanica* (Linnaeus) Delile and *Cymodocea nodosa* (Ucria) Ascherson in these extreme environments and compared them with data collected from seagrasses grown at normal pH conditions (8.2). Results showed that *P. oceanica* developes significant metabolic adaptations as a response to acidification. Acidification affects also the proteic turnover, cytoskeleton and arginine catabolism. For *C. nodosa*, proteomic analysis revealed a reduction of total protein. Moreover, some epigenetic modifications were observed.

Virgili *et al*. presented a report entitled: “Favourable to Many, Extreme for Others: the Bizarre Survival Strategy of a New Species of *Heterostigma* Ärnbäck-Christie-Linde, 1924 (Ascidiacea: Stolidobranchia: Pyuridae)”. Ascidians usually prefer to live on hard substrates or to attach to heavy objects. However, a small group of mesopsammic species has evolved specific traits for an interstitial lifestyle, representing a unique, but still understudied, case of tunicate adaptation to soft habitats. A new species of *Heterostigma* from the littoral soft-bottoms of the highly anthropized metropolitan city of Naples has been described. Morphological and molecular phylogenetic analyses were performed. The results corroborate the knowledge on how sessile tunicates adapt and survive in unfavourable substrates.

Zammuto *et al*. described *Bacillus horneckiae* SBP3, a bacterium from hydrothermal vents near Panarea Island, as highly resistant to extreme conditions such as high temperature, low pH, and toxic compounds. It also withstands artificial stressors that mimic space environments, including UV and X-ray radiation and vacuum. SBP3 produces exopolymers and surfactin-like biosurfactants that protect cells and interact with harmful substances. These compounds have potential applications in oil removal, green detergents, antimicrobial products, and environmental remediation. Additionally, SBP3's biosurfactants can adsorb heavy metals like arsenic, mercury, and vanadium, while its hydrating biopolymers may replace synthetic wetting agents in agriculture, food, and cosmetics. The authors emphasize SBP3's relevance for sustainable biotechnological innovation.