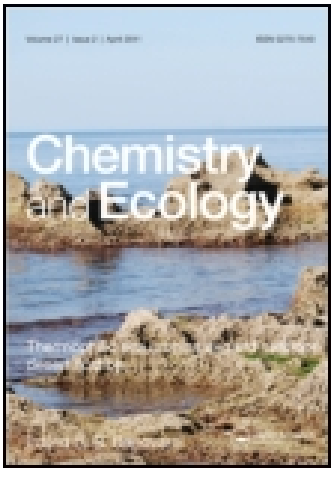

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The Mediterranean intertidal habitat as a natural laboratory to study climate change drivers of geographic patterns in marine biodiversity

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FOREWORD

The Mediterranean intertidal habitat as a natural laboratory to study climate change drivers of geographic patterns in marine biodiversity

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The Mediterranean Sea accounts for <1% of the world oceans' surface cover, but hosts >17,000 species, almost one-fifth of which are endemic. The Mediterranean coastal zone is the place of several intense human activities, most of which occur on, or impact very close to, the intertidal, i.e. the zone between the high- and low-water marks set at the interface between the terrestrial and marine realms. Mangroves, salt marshes and upper coral reefs are typical examples of key intertidal habitats worldwide. They are crucial to the provision of benefits to humans and have received considerable attention from research. However, research dealing with the Northern Atlantic Ocean, the Pacific Ocean and South East Asia cannot be easily transferred to the Mediterranean Sea because of specific coastal morphological features, human pressure and the narrow tidal amplitude (not exceeding 0.5–1.0 m) found in the Medditerranean.

'INTERMED – The impact of climate change on Mediterranean intertidal communities: losses in coastal ecosystem integrity and services', is a CIRCLE-MED, 6FP project by the Universities of Palermo (Italy), Haifa (Israel) and Dubrovnik (Croatia). Launched in November 2008 and closed at the end of October 2010, the aim of INTERMED was to evaluate climate change impacts on intertidal communities in the Mediterranean basin. A forecast of socioeconomic consequences, design of potential mitigation strategies and outreach actions were also planned as integral parts of the project. As a first step, INTERMED undertook a broad-scope systematic reviewing process to gather any available information concerning the Mediterranean intertidal and its adjacent systems. Core results were presented at the International INTERMED Workshop held in Palermo in March 2009, unpredictably showing that very little coherent information is available concerning most bioecological (e.g. functioning and biodiversity) and socioeconomic (e.g. benefits and values) aspects of the Mediterranean intertidal.

We are therefore indebted to *Chemistry and Ecology*, and to its Editor, for offering us the chance to openly raise this issue. In the following pages, selected INTERMED reviews are presented.

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These span a wide range of topics, tackling some of the key features of the Mediterranean intertidal. We hope they may be of inspiration for a renewed impetus in research which helps address and possibly close the many existing knowledge gaps.

The first article deals with an overarching aspect to be studied in the context of climate change, i.e. the potential socioeconomic consequences of climate change impacts on the natural assets. In their commentary, Milanese et al. [1] describe a gap in the qualitative and quantitative knowledge of the provision of benefits from Mediterranean intertidal ecosystems. The authors provide a cross-cutting research agenda and a summary of the available information to serve as a baseline for future studies, including the first list of ecosystem services specific for the Mediterranean intertidal. The need for a better integration of bioecological and socioeconomic expertise and knowledge is advocated.

Lo Brutto et al. [2] tackle the thorny genetic aspects involved in species' responses to climate warming, such as population genetics, quantitative genetic assessments and phylogenetics. The authors initially describe three simple models to capture the population structure for most organisms in the Mediterranean Sea. Specific focus on the 'gene–climate approach' is then provided. This is likely the most up-to-date and appealing approach to correlate climate changes, environmental variables and population dynamics with recent dispersal or novel adaptations.

Chemello and Silenzi [3] deal with Vermetid reefs. These are one of the most important elements of Mediterranean biodiversity and among the least-studied coastal ecosystems worldwide. Vermetid reefs may only exist in warm temperate areas like the southern regions of the Mediterranean basin, including Israel and Sicily. Further to the key bioecological roles they play, Vermetids are also important from a socioeconomic point of view. They have only recently been recognised as natural archives for reconstructing past SST variations and are a popular leisure ground for the local population/tourism sector. Being severely threatened by human activities they deserve dedicated conservation policies.

Offering an ecological parallelism, Gianguzza et al. [4] address the climate change impacts on the ecology of *Arbacia lixula*. This sea urchin is an important ecosystem engineer in the Mediterranean lower intertidal and infralittoral. The authors disentangle climate, temperature and grazing effects by echinoids on macro-algal communities and speculate that climate warming may result in habitats being increasingly favourable to the reproduction and development of these organisms (i.e. barren grounds) at the expense of others.

The last article, by Sarà et al. [5], merges a biophysical ecological (BE) model that estimates the aquatic (high-tide) and aerial (low-tide) body temperatures of an important ecosystem engineer, the bivalve *Mytilus galloprovincialis*, using a Dynamic Energy Budget (DEB) model. This approach allows for the prediction of life history traits of Mediterranean structuring species, in both intertidal and subtidal environments. Such predictions provide a set of hypotheses for future research on the role of climate change in limiting the intertidal distribution of mussels in the Mediterranean Sea, and will be crucial to resource management and conservation plans. Taken altogether, these reviews indicate that Mediterranean-specific information is scant and fragmented, especially as far as intertidal habitats are concerned. This holds at any level ranging from the cellular to the ecosystem as a whole. Predicting where, when and to what an extent impacts are most (and least) likely to occur is imperative if we are to effectively plan for (i.e. mitigate if possible, or adapt to) the effects of climate change (*sensu* B. Helmuth, M. Kearney and G. Sarà – Invited talk at the Symposium 'Alternative Approaches to the Study of Global Warming Effects on Natural Communities' at the Ecological Society of America Annual Meeting, Pittsburgh, USA, 2010).

Although much has been done for other areas, Mediterranean intertidal research is unfortunately still lagging behind.

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