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Description of the funded research project

1st Call for H.F.R.I. Research Projects to Support Faculty Members & Researchers and Procure High-Value Research Equipment

Title of the research project: Global scale quantitative patterns in the response of benthic organisms to environmental disturbance

Principal Investigator: Ioannis Karakassis

Reader-friendly title: Global response of benthic organisms to environmental disturbance

Scientific Area: Environment and energy

Institution and Country: Greece

Host Institution: University of Crete, Department of Biology

Project webpage (if applicable): http://marineecologyuoc.weebly.com/

Budget: 153300

Duration: 28 months

Research Project Synopsis

Benthic habitats cover most of the ocean bottom and therefore constitute the largest single ecosystem on earth in spatial coverage. It has been shown that environmental disturbance causes a remarkably similar response of benthic systems by increasing the presence of opportunistic species and reducing the percentage of the sensitive or K-strategy taxa. This response has been shown to be fairly stable globally in the case of species diversity and could be easily recognized by experts from different parts in the world.

During the past 15 years the interest in this issue has been revived under the effort to arrive at EU or even global standards for the assessment of environmental/ecological status and the development of suitable indicators, under the EU Water or Marine Strategy Framework Directives. With the development of different indicators based on benthic macrofauna, it is now important to evaluate their universal suitability.

Inter-regional comparison of the response of benthic communities to stress could be based on data involving species or higher taxa (e.g. families). In the former case, there is a 1:1 comparison of responses but there is a high probability that the species lists between remote biogeographic regions will be very different and therefore the comparisons will include only a few cosmopolitan species thereby introducing a biased approach. In the latter case, comparisons will include higher taxa which share a relatively common genetic background and functional capabilities and at the same time they are likely to be present in more geographic regions and in adequate quantities to allow statistical interregional comparisons

The aim of this study is to compare the tolerance/sensitivity of higher benthic taxa to environmental disturbance in different parts of the world. More particularly we will focus on ubiquitous benthic taxa to determine if they share common and evolutionary stable characteristics regarding their ecological role despite differences in their current geographical distribution. These characteristics may be expressed by their sensitivity and response to disturbance and other functional characteristics that could be categorized and pooled into specific ecosystem functions

Project originality

The objectives of the proposed study include the testing of a series of hypotheses on a global-scale related to the response of benthic communities to stress using sensitivity-tolerance scores. The combination of different methodologies and approaches focusing on biodiversity, functional characteristics and geographical distributions on a global scale is the projects novel aspect. The hypothesis to be tested can be summarized in the following points:

1. *Tolerance/sensitivity scores for families do not change significantly among regions (Mediterranean, Atlantic, Pacific etc.). If yes, these scores may be seen as a conservative measure of (or a proxy to) the sensitivity of each higher taxon to disturbance that could be used in various contexts (monitoring pollution, alien spp. introduction etc.)*
2. *Tolerance/sensitivity scores are significantly inter-correlated among regions despite the changes in their actual values.*
3. *The above scores and ranking vary considerably between regions, reflecting evolutionary variable pathways and coexistence of diverse taxa in different regions*
4. *Test the above hypotheses for different functional types of macrofaunal organisms using Biological Traits Analysis*
5. *Evaluate and compare the habitat suitability of indicative macrofaunal species using relevant Species Distrubution Modeling methods.*

Expected results & Research Project Impact

The proposed project will identify a quantitative scale of sensitivity-tolerance for higher benthic taxa (e.g. Family level) based on local data in areas investigated in different parts of the world. It is expected that one of the following will hold true:

a) All families have similar scores and the same ranking order
b) Different scores but similar ranking order,
c) Some taxa (hopefully the most common ones) have (a) or (b).
d) There is a chaos: fundamentally different ranking for different taxa among biogeographic areas reflecting important divergence during the evolutionary history.

If (d) is the case there is a series of new hypotheses to be tested regarding functional roles of benthic taxa. However, in case of a, b or c, the results will be valuable for research and monitoring because:

1. *There will be a measure for assessing the "ecosystem health" with a limited amount of sampling*
2. *Depending on the outcome of inter-regional comparisons, global environmental quality standards could be designed and therefore assessment of the severity of environmental change induced by human activities in different parts of the world.*
3. *The study will focus on solutions to real-world issues of coastal marine spatial planning of activities like aquaculture and will provide platforms for continued impact as a legacy of the project. We anticipate that the results of the project will form key resources for policy-makers and planners implementing the EU MSP (Marine Spatial Planning) Directive*
4. *Development of tools for the needs of the environmental managers and policy makers, based on global standards, will largely facilitate the implementation of the EU Directives and Environmental Policies and the synchronization of the practices currently followed on marine ecosystem management.*
5. *Expanding the scientific knowledge about the global marine ecosystem processes, functional characterises species distributions and risk of invasion.*
6. *Creating and more importantly making available to the scientific community of a "global" data set, that may be used in future studies to address new questions.*

The importance of this funding

Our research team has been studing anthropogenic impacts on marine ecosystems and biodiversity for three decades. As a result of this engagement, we have often been invited to participate in international committees and working groups in which the issue of establishing environmental quality standards (EQS) was often raised in order to quantify environmental disturbance, to assess the environmental impact of a wide range of activities and geographical areas and set boundaries on ecosystem degradation. This issue is raised from various stakeholders such as international organizations, government agencies and companies engaging in activities related to the marine environment. The proposed project is designed to provide answers that will facilitate the benchmarking of environmental impacts in different biogeographical zones and will therefore facilitate the prediction of large scale environmental changes and allow both pollution/disturbance measures to be taken.

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