ASSESSMENT OF ACIDIFICATION IMPACTS IN THE MEDITERRANEAN SEA: FROM META-ANALYSIS TO ECOSYSTEM SERVICES VALUATION

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Abstract
We have performed a meta-analysis that examines the biological responses of the Mediterranean organisms to acidification. The obtained results depict possible future impacts on two important habitats: the coralligenous concretions and the seagrass meadows. We used a conceptual model to evaluate the potential impacts of future climate scenarios on ecosystem services and benefits that the two habitats provide. In particular, we have evaluated the direct-use value through a market value for the fishing revenues.

Keywords: Mediterranean Sea, Ecosystem services, Economic valuation

Seawater acidification, together with global warming, is expected to cause significant changes in marine environment over the coming century. In this scenario, the Mediterranean Sea is predicted to be one of the most impacted ecosystems by global change drivers [1]. The effects of acidification on organisms' physiology has been studied during the last two decades but still remains a challenged concept due to the contradictory results of field assessments [2]. Therefore, in order to synthesise the current knowledge, we performed a meta-analysis on 67 published studies carried out in the Mediterranean Sea, both in controlled manipulative experiments and *in situ* experiments close to vents area. For each experiment, the effect of acidification was calculated as the log-transformed response ratio (LnRR) of experimental versus control conditions [3]. The quantitative synthesis obtained by the meta-analysis highlights: 1) an increment of the fleshy algae cover (+122%) which could lead to a competitive advantage over calcifying macroalgae (-79%); b) a reduction of the calcification for both algae (-67%) and corals (-5%); c) seagrass shoots enrichment (+13%) under low pH (7.8) and d) a general increase in the photosynthetic activity (+49%) of macrophytes.

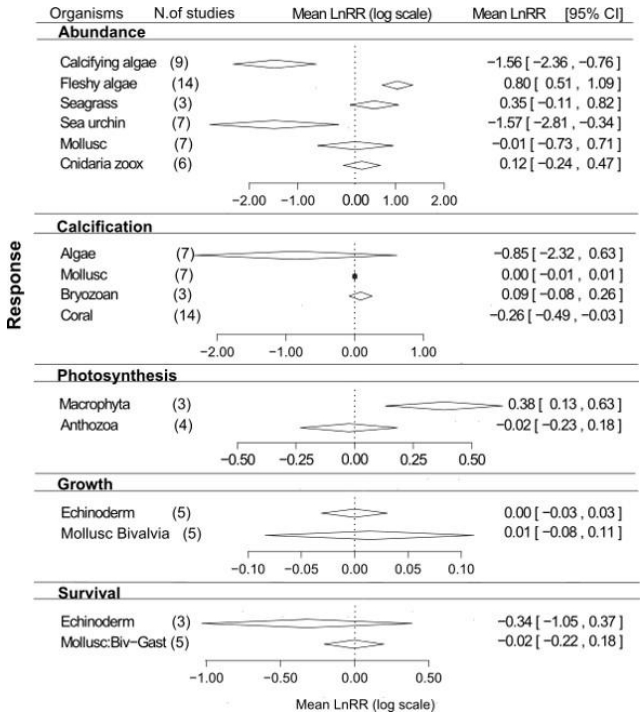

Fig. 1. The mean log response ratio and 95% CI of Mediterranean acidification on physiological responses.

The analysis highlights the existence of direct effects, but suggests the instauration of indirect effects that could trigger a habitat modification. The loss of sea urchins (-80%) combined with the advantages that fleshy algae may have from the acidification, may trigger a transition towards fleshy algae dominated environments. We used the results of the analysis to build a conceptual models of two of the most important and vulnerable habitats of the Mediterranean Sea (coralligenous and seagrass habitats). The models aimed at identifying ecosystem functions, services (ES) and benefits at current and future conditions. Using a preference based approach [4], we estimated the current economic value of coralligenous and seagrass habitats in Italy, and then we assessed future changes through projections of possible acidification scenarios. The direct use value has been evaluated [4] through a market analysis of the fishery provision services. We performed a preliminary assessment of the demersal fisheries production in Italy [5] for coralligenous and seagrass habitats [6] and then we projected their future expected value, considering the habitat alteration due to acidification. The preliminary results have shown a higher economic value of the fisheries revenues from the coralligenous and seagrass habitat. We have quantified the effect of climate change in different scenarios based on change in coverage of the coralligenous and the seagrass meadows and their evolution toward, respectively, hard rock and sand habitats. Our worst-case scenario estimates a loss of demersal resource up to 73% of the current biomass and a maximum economic loss around 100 million of euro per year. Further economic assessments will be performed in order to evaluate the total economic value of the coralligenous and seagrass habitats.

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