Assessing the role of invasive bivalves in controlling ecosystem dynamic as a tool for better management of Israeli Marine Reserves and Marine Protected AreasGitai Yahel1 & Tal Amit1,2

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Abstract

The Mediterranean Sea, and especially its Levantine basin, experience a rapid and unprecedented rate of marine bioinvasions. In the case of bivalves, all dominant species in the rocky litoral of Israel are Lessepsian migrants and two large oysters, ​Spondylus spinosus​ and ​Chama pacifica​, account for most of the macro-invertebrates rock cover and biomass. In some localities, these species are currently building oyster reefs that modifies the three dimensional structure of the rocky habitat. At the subtidal zone, the invasive mussel ​Brachidontes pharaonis​ is covering large swath of the unique vermetid platforms during boom and bust cycles that displace and eliminate native species from this habitat. The current scientific basis for Mediterranean Marine protected Areas (MPAs) management relies mostly on inventory lists and community composition surveys, whereas studies of the ecological role of the different community members are severely lacking, especially with regard to benthic invertebrates. This lack of critical ecological information hinders educated decisions making as the outcomes of management actions are impossible to predict. While invasive bivalves now dominate the benthic community of Israeli hard substrate, it is currently unknown to what extent they impact ecosystem services. That is, how currently unknown processes such as habitat modification and mass transfer to primary producers and to higher trophic levels can impact more visible issues such as local biodiversity and water quality. This lack of critical ecological information also hinders educated decisions making as the outcomes of management actions are impossible to predict. To address these knowledge gaps we propose to combine manipulation experiments, surveys, and in situ studies of bivalves ecophysiology in order to predict and model processes such as bivalves growth, carrying capacity, ecosystem dynamics, and impacts on biodiversity. The power and novelty of the proposed study come from the application of our previously developed methods and innovative approaches to examine​ insitu​, with unprecedented accuracy and resolution, the full metabolic profile of undisturbed invading bivalves in their natural settings. Pumping rates, grazing, respiration, and excretion rate data, that we will measure in different seasons for individual bivalves, will be ‘scaled up’ using bivalves abundance and size frequency distribution from concurrent surveys, to calculate the effect of the bivalve populations at the community level. Seasonal studies will provide snapshots of the energy budget that will be translated to “scope for growth” (i.e. the surplus of energy available for growth beyond that required for maintenance) of the bivalves. This data will allow calculations of mass transfer processes inside and outside protected ecosystems, both through nutrients supply to primary producers, and as prey for higher trophic levels. We will also test the practicality, cost, and implication of the regulation of bivalve populations. Finally, an assessment of the loss of ecosystem services associated with invasive bivalve regulation will be provided along with clear recommendations for actual management actions and suggestions for future research and monitoring of such actions. Taken together, our data should provide decision makers and managers with educated provide decision makers and managers with
educated predictions and recommendations for the management of the bivalve populations in the Israeli MPAs.