SHIFTED COASTAL COMMUNITIES AND ECOSYSTEM FUNCTIONS UNDER PREDICTED WARMING AND ACIDIFICATION

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Abstract

The effects of ocean warming and acidification on Eastern Mediterranean coastal benthic communities were studied in a long-term research using benthic mesocosms ('benthocosms'). Temperature and pH treatments complied with the near-past, present and predicted-future levels. While biodiversity indices did not change significantly with warming (+3ºC) and acidification (-0.5 pH units), community composition shifted from native to non-indigenous species dominance, and the abundance of calcifying species increased. In the summer, community functions presented a shift from autotrophic to heterotrophic system.

Keywords: South-Eastern Mediterranean, Biodiversity, Global change, Alien species

Ocean acidification and warming are causing profound changes to the marine environment. Previous studies mostly tested the short-term physiological response of species to these drivers, while long-term responses of communities, ecosystems and their functions have seldom been investigated [1]. In this study the effect of warming and acidification on the structure and function of coastal benthic communities was investigated in two consecutive 5 month seasonal experiments using benthic mesocosms ('benthocosms') [2]. Where, temperature and pH were offset from ambient diel variability according to the business-as-usual scenario for the end of the 21st century (RCP 8.5: warming +3ºC, pH -0.5) [3], and an additional cooling treatment (-2ºC) was applied to simulate the regional temperature three decades ago. At the beginning of each experiment, dominant representatives of the Eastern Mediterranean subtidal reef were collected and transplanted in each of the 16 1400-L benthocosm tanks. Continuous flow of non-filtered coastal waters supplied larvae of new species into the benthocosm tanks throughout the experiments. Changes in species composition, biodiversity, growth and recruitment, community photosynthesis, respiration, and calcification were monitored throughout each experiment.

Species richness and biodiversity were not significantly affected by temperature and pH (figure 1a, 1b), while species composition differed considerably between treatments (figure 1c, 1d). Where, warming increased the abundance of calcifying and non-indigenous (alien) species. Under low pH conditions, non-calcifying epiphytic algal growth increased, negatively affecting basiphytic algae when combined with warming. Invertebrate epifauna increased under warm and/or acidified conditions.

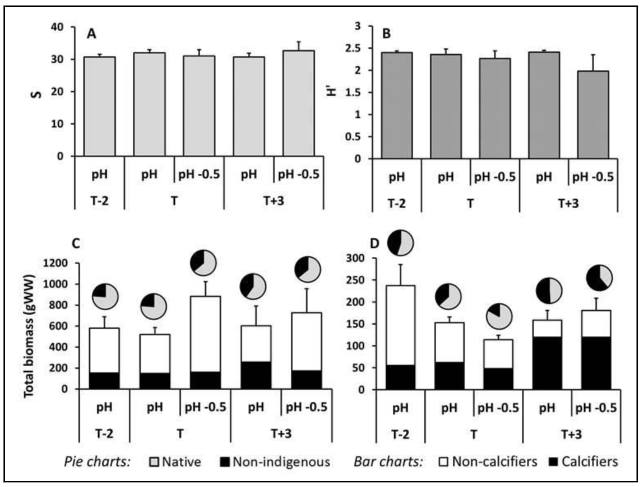

Fig. 1. Community composition in the five benthocosm treatments. T= ambient temperature; pH= ambient pH. A. Species richness (S). B. Biodiversity (Shannon-Weaver index, H'). C and D. Total biomass (g wet weight) of calcifying (black bars) and non-calcifying (white bars) species. Pie charts: relative abundance of native (grey) *vs*. non-indigenous (black) species. C. Winter experiment. D. Summer experiment. Means ±SE (n=3).

Community function rates were greater under cold and acidified treatments (figure 2). Warming in winter reduced the organic carbon sequestration capacity of the benthic community, while during the summer treatment the benthic community exhibited a heterotrophic balance (figure 2). Combination of warming and acidification in the summer led to negative net calcification (i.e., dissolution).

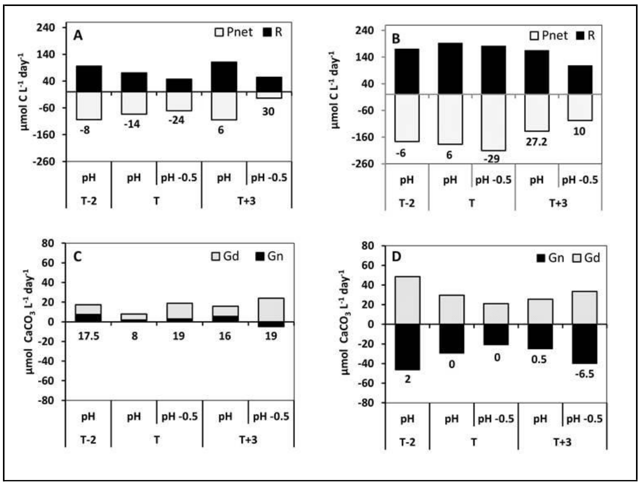

Fig. 2. Community functions. A, B. Diurnal daytime photosynthesis (P_n, grey bars) and nighttime respiration (R, black bars) as µmol Carbon L^{-1} in winter (A) and summer (B). C, D. Diurnal daytime calcification (G_d, grey bars) and nighttime calcification / dissolution (G_n, black bars) as µmol $CaCO_3$ L^{-1} in winter (C) and summer (D). The numbers below bars represent the diurnal net balance.

These results indicate that future conditions in the Eastern Levantine Basin will be more hospitable to non-indigenous carbonate producing organisms and the carbon sequestration of benthic communities will shift from organic to inorganic.

References

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