

The effect of connectivity on productivity and diversity in micro-algae communities

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Recently, there has been an increasing interest in how local environmental conditions regulate communities in the marine environment. Communities are not isolated entities, but are spatially interconnected by the movement of individuals and the extent to which communities are connected can strongly affect their productivity and diversity.

In this study, we investigated how a connectivity gradient affected the productivity and diversity in interconnected marine micro-algae communities on a local and a regional scale. To do so, we composed regions of 8 communities. Within these regions, we created environmental heterogeneity by applying the herbicide atrazine (100 µg/l) to the half (4) of the communities. Within each region, algae were manually exchanged (by pipetting) between the communities every 3 days. Each region had a different number of connections between its communities, which generated a connectivity gradient. The experiment ran in triplicate during 33 days. At the end, we determined (1) regional productivity (diversity), which is the total productivity (diversity) within each region and (2) local productivity (diversity) which is the productivity (diversity) of each community.

We did not find a significant effect of connectivity on regional productivity. The absence of a regional effect was caused by an opposite effect of connectivity on the local productivity of the exposed and unexposed communities: connectivity reduced the local productivity of most unexposed communities, while connectivity increased the local productivity of most exposed communities. These opposite effects were generated by source-sink effects in which individuals moved from the high-productive unexposed communities to the low-productive exposed communities.

We found significant positive effects of connectivity on regional diversity. Regional diversity increased because a regional subdominant species performed better in highly-connected than poorly-connected communities. In the manipulated treatment, connectivity increased the local diversity of most unexposed communities, while connectivity effects on the local diversity of the exposed communities showed various relationships. Connectivity increased local diversity when individuals moved from communities where they performed well to the communities where they would have otherwise been excluded.

In this study, we demonstrated that connectivity has important effects on the productivity and diversity of communities. We therefore suggest that regional processes are also considered when assessing relationships between environmental conditions and species compositions. Moreover, we argue that studies are needed that address how communities are affected by constructions - such as e.g. dikes and shallows - that interfere with connectivity.

Keywords: micro-algae; connectivity; productivity; diversity