

Abstract

Human threats on the world ocean are multiple and escalating. These increasing pressures are causing long-standing regime shifts from high diversity ecosystems to low diversity, degraded ones, usually featured by reduced resilience. The understanding of the effects of multiple threats in affecting marine ecosystems, and the identification of the processes allowing for the recovery of biodiversity are a challenge to ecology. In some areas of the Mediterranean Sea, rocky assemblages can be reduced to complete barrens by the illegal date-mussel fishery. This low diversity state is maintained by sea urchin grazing. These substrates are paradigmatic examples of the degraded state of marine ecosystems after human impact. We explored, through a manipulative experiment, the interplay between nutrient supply and grazing pressure in the recovery trajectories of benthic assemblages impacted by the date mussel fishery. Our results show that grazing pressure significantly affects the resilience of disturbed assemblages, strongly decreasing the recovery rates of disturbed assemblages. When herbivores are removed, experimental nutrient enrichment enhances recolonization patterns, significantly increasing the number of macroalgal taxa, with about the 30% of recovery by macroalgal turf. The combined effect of herbivores in presence of enriched conditions decreased benthic diversity and cover. These findings suggest that 1- The presence of grazers imperils any potential of restoration of disturbed assemblages, 2- in enriched plots where grazers were also removed, recolonization by macroalgae can be observed in 12 months, 3- the two factors have an antagonistic effects. This experimental study is likely to provide useful indications for the management of disturbed assemblages to promote the recovery of assemblages under different trophic conditions.