ID: W2816250771

TITLE: Macroalgal feedbacks and substrate properties maintain a coral reef regime shift

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ABSTRACT:

Abstract Coral reefs are among the world's most diverse and productive ecosystems, yet they are also one of the most threatened. The combined effects of local human activities and climate change have led to corals being replaced by macroalgae in various tropical settings, lessening the ecological, social, and economic value of these reefs. Once established, macroalgal regimes are maintained by a range of physical, chemical, and biological feedback mechanisms that suppress the settlement, survival, growth, and hence recovery of coral populations. Our understanding of these feedbacks has come largely from small?scale experimental studies, but their relative importance in sustaining a regime shift has rarely been examined in situ. We investigated the role of macroalgae in limiting coral recovery on an inshore reef on Australia's Great Barrier Reef that shifted to macroalgal dominance in 2001. Coral recruitment on terracotta tiles in habitats with low cover of macroalgae at the regime?shifted reef and at comparable habitats at an adjacent coral?dominated reef was similar, suggesting that neither larval supply nor reef?wide ?avoidance? by coral larvae was contributing to the lack of coral recovery at the regime?shifted reef. However, within the regime?shifted reef, recruitment of corals on tiles, and their survival in the first two months post?settlement, was substantially lower in habitats characterized by dense beds of the brown macroalga Lobophora than in habitats just meters away that were relatively free of macroalgae. Despite the negative effects of Lobophora on recruitment and early recruit survival, there was no effect of Lobophora on the persistence of juvenile corals (1?50 mm diameter). Juvenile coral persistence in beds of Lobophora (50%) was comparable to that in neighboring habitats free of Lobophora (60%) over nine months. Rather, the persistence of juvenile corals was lowest (10%) in unconsolidated rubble habitat, where photographs of fixed quadrats showed that, over nine months, rubble substrate had been redistributed. Our results highlight two bottlenecks to coral recovery; inhibition of coral recruitment and recruit survival by macroalgae, and reduced juvenile coral persistence in patches of loose rubble substrate. Importantly, these processes appear to be habitat?specific and are unlikely to constrain coral recovery at a reef?wide scale.

SOURCE: Ecosphere

PDF URL: https://esajournals.onlinelibrary.wiley.com/doi/pdfdirect/10.1002/ecs2.2349

CITED BY COUNT: 43

PUBLICATION YEAR: 2018

TYPE: article

CONCEPTS: ['Reef', 'Aquaculture of coral', 'Coral reef', 'Resilience of coral reefs', 'Coral', 'Ecology', 'Coral reef protection', 'Coral reef organizations', 'Habitat', 'Environmental issues with coral reefs', 'Biology', 'Fishery', 'Environmental science']