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Interactive effects of fishing and climate change on coral reef fish populations

Marine Science

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Context

Climate change and over-fishing are widely regarded as the major threats facing coral reef communities worldwide. Typically fishing has a 'top-down' effect on communities, through the removal of large predators, whilst climate change causes degradation of habitat, which affects fish that recruit, feed and shelter within corals. The independent impacts of these threats are well-studied; however, the interactive effects between fishing and climate change are yet to be examined. This interaction may be particularly important on reefs off the mid-western Western Australian coastline where per-capita boat ownership and recreational fishing pressure is extremely high.

Two critical processes that determine the community structure of coral reef fish are recruitment and early post-settlement predation. It is hypothesised that the degradation of coral-associated habitat due to climate change will cause a decline in recruit numbers. Conversely, fishing will reduce abundance of large predators and increase numbers of smaller habitat-associated predators, thereby increasing post-settlement predation. Examining how changes in habitat and predators interact and influence post-settlement survival of fish will be critical to understanding the impacts on biodiversity of fish communities and fish populations.

Aims

- Determine how habitat degradation instigated by climate change and changes in fishing pressures affect the composition of the fish communities on Western Australian coral reefs.
- Assess diet of predatory species targeted by fishers.
- Identify microhabitats preferentially used by juvenile fish.

Progress

- An assessment of marine heatwave and cyclone impacts on WA coral reefs was published in *Coral Reefs*. The study shows that coral cover on some reefs is at the lowest levels recorded.
- The loss of coral due to heat stress can have flow on effects for reef fish assemblages. We looked at fish on reefs 1 year after the 2016 bleaching and 7 years after the 1998 event to assess short and long term impacts. Our results show declines in small bodied fish a year after bleaching, primarily due to reduced cover of branching corals that provide refugia. The breakdown of coral skeletons 7 years after bleaching is associated with lower abundance of both large and small fish. These findings were published in *Coral Reefs*
- By assessing 25 years of catch data from local fisheries in the Seychelles we were able to investigate the impact of the 1998 bleaching event on fisheries productivity. Encouragingly, catch per unit effort had remained steady after the bleaching, primarily due to increased catch of species that associate with macroalgae rather than coral. There was however more variation in the size of the catch and reduced diversity of fish within the catch. The results of this study were published in Nature Ecology and Evolution

Management implications

Regime shifts from coral to macroalgae on tropical reefs are associated with changes in fish assemblages and the ecological processes/services they provide. In particular, reduced abundance of small fish after coral loss may mean less prey for predators or fewer juveniles to replenish adult populations. Increased abundance of fish that typically inhabit macroalgae may however offset the loss of coral dependent species. More macroalgal associated fish may for example maintain some functions and services like local fisheries, though an overall reduction in fish diversity will compromise the resilience of the assemblage to further disturbance.

Future directions

Explore the changing role of marine reserves following regime shifts from coral to macroalgae