

Fishing down a Caribbean food web relaxes trophic cascades

Peter J. Mumby^{1,*}, Robert S. Steneck², Alasdair J. Edwards³, Renata Ferrari¹, Robin Coleman⁴, Alastair R. Harborne^{1, 5}, Janet P. Gibson⁴

1Marine Spatial Ecology Lab, School of Biological Sciences & ARC Centre of Excellence for Coral Reef Studies, Goddard Building, University of Queensland, St. Lucia Campus, Brisbane, Queensland 4072, Australia

2School of Marine Sciences, University of Maine, Darling Marine Center, Walpole, Maine 04573, USA

3School of Biology, Newcastle University, Ridley Bldg, Newcastle upon Tyne NE1 7RU, UK

4Wildlife Conservation Society, PO Box 768, 1755 Coney Drive, 2nd Floor, Belize City, Belize

5Marine Spatial Ecology Lab, College of Life and Environmental Sciences, University of Exeter, Exeter EX4 4PS, UK

The fishing down of marine food webs has been described in pelagic and demersal systems but rarely documented in coral reef environments. We recorded a rapid shift in fish community structure in Belize that accompanied a marked decline in grouper and snapper abundance and a switch towards smaller, less desirable, herbivorous parrotfishes. In a 6 to 7 yr period (2002–2008/09), observations of large-bodied grouper (*Serranidae*) declined significantly from an encounter probability of 21% per 200 m² transect to just 2%. The biomass of carnivorous snappers (*Lutjanidae*) underwent a 7-fold decline, primarily in the species *Ocyurus chrysurus*. During this period, the inclusion of parrotfish in fish catches at nearby Glover's Atoll increased from a frequency of 6% in 2004 to ~20% of speared individuals by 2008. Parrotfish biomass declined by 41% between 2002 and 2008/09, with a major decline in the large and dominant herbivore *Sparisoma viride*. No changes in parrotfish biomass were detectable in nearby marine reserves during this time. Several important indirect effects of fishing were observed. The biomass of mesopredators including *Cephalopholis fulvus*, *C. cruentatus*, and *Epinephelus guttatus* increased dramatically by 880% as compared to the 2002 levels. We putatively attribute this response to a release from predation and constraints to foraging behaviour imposed by large serranids. Further, we find that the density of adult damselfish of the species *Stegastes planifrons* and *S. partitus* decreased by ~45%. We attribute this decline to elevated predation by the increased densities of mesopredators, which have been shown to prey upon juvenile damselfish. No change in damselfish densities was found at 2 control locations where fishing was prohibited. The decline in parrotfish in the central Mesoamerican barrier reef likely accounts for recent anecdotal observations of *Halimeda tuna* spreading to microhabitats that have previously been grazed intensively. While these results imply that the resilience of these reefs may be seriously impaired, the Belize Government has recently enacted new legislation to improve the management of grouper and outlaw harvesting of most herbivorous fish.

Mumby PJ, Steneck RS, Edwards AJ, Ferrari R, Coleman R, Harborne AR, Gibson JP (2012) Fishing down a Caribbean food web relaxes trophic cascades. *Marine Ecology Progress Series* 445:13-24
doi: 10.3354/meps09450