National Environmental Research Program

TROPICAL ECOSYSTEMS hub

A Synthesis of NERP Tropical Ecosystems Hub Project 8.1, 8.2 & 8.3 Research Outputs 2011-2014

Compiled by RRRC

Figure 1. Map of Great Barrier Reef Marine Park showing spatial zoning.

Spatial Zoning of the Great Barrier Reef Marine Park

Coral reefs are an iconic component of the Great Barrier Reef ecosystem, though they only make up about 7% of the Marine Park area. The remainder is a made up of a variety of habitats, ranging from shallow inshore areas, such as seagrass beds, mangroves, sand, algal and sponge gardens, and inter-reefal communities to deep oceanic areas more than 250 km offshore.

More than 130 varieties of sharks and rays, 600 types of soft and hard corals, more than 30 species of whales and dolphins, over 100 species of jellyfish, and 3,000 types of molluscs live in the Great Barrier Reef. The ecosystem also includes 1,625 types of fish of which there are several species of coral trout, an iconic predatory fish that is targeted in both commercial and recreational fisheries on the Great Barrier Reef.

In 2004, the Great Barrier Reef Marine Park was re-zoned providing for a range of uses. The re-zoning was part of the Representative Areas Program and was primarily designed to increase the protection of biodiversity within the Marine Park. It allocated a minimum of 20% of each of 70 identified bioregions (such as seagrass beds, mangrove communities, deep-water shoals and coral reefs) into highly protected, no-take reserves called ‘Green Zones’. All extractive activities, including fishing, are prohibited in Green Zones and ultimately 33% of the Marine Park was included within these no-take zones.

Research funded by the Australian Government National Environmental Research Program (NERP) examined the effectiveness of the Great Barrier Reef Marine Park Zoning Plan 2003 a decade after it came into effect.

Photos: RRRC & GBRMPA

Coral Trout on the Great Barrier Reef

Coral trout is the collective name for several species of reef fish within the grouper (Seranidae) family, including common, blue spot and barred-cheek coral trout.

Coral trout are targeted by both commercial and recreational fishers in the Marine Park as they are prized for their exceptional table qualities and high prices in both domestic and international seafood markets. Coral trout dominate catches in the Coral Reef Finfish Fishery, with a total recorded catch of 725 tonnes in 2011-12. Additionally, it is estimated that approximately 179,000 coral trout were caught by recreational fishers in Queensland between October 2010 and September 2011.

Significant increases in coral trout abundance have been recorded on reefs within Green Zones since the Zoning Plan and fisheries management arrangements came into effect in 2004.

Preliminary stock assessments by the Queensland Government indicate that zoning protects a significant portion of the coral trout population and that fishing in open areas is currently at biologically sustainable levels. The effectiveness of zoning in maintaining coral trout populations is due to the spill-over of adult and juvenile fish from no-take zones into nearby areas open to fishing.

Effects of Marine Park Zoning on Coral Trout Populations

Surveys started in 2004 of reef fish and benthic communities on fished and unfished (Green Zone) reefs by James Cook University and the Australian Institute of Marine Science in both inshore and offshore reefs. They found that since the 2004 re-zoning of the Marine Park there were clear increases in the density, length and biomass of coral trout on Green Zone reefs relative to fished reefs. On average, coral trout were 12% and 7% larger on inshore and offshore Green Zone reefs respectively, compared with reefs that were open to fishing.

NERP-funded research has further documented increases to the number and size of coral trout on Green Zone reefs relative to similar reefs that remained open to fishing. On inshore reefs open to fishing, coral trout biomass has remained stable since the 1980s. Results suggest that coral trout were already locally depleted on inshore reefs prior to the 1980s, while stocks were lightly exploited on offshore reefs at that time. These results reflect the long history of fishing on inshore reefs as well as the expansion of both the commercial and recreational reef fisheries on offshore reefs since the 1980s.

The differences in coral trout density and biomass between Green Zone and open reefs indicates that spatial management is having a positive effect with important implications for coral trout populations and fishery recruitment. Larger fish produce more eggs and whilst it has long been assumed that larvae produced by fish in Green Zones would disperse to fished areas and enhance juvenile recruitment and boost fish stocks, this effect has only recently been demonstrated in the field.

Photo: Phil Woodhead

Green Zones Supplying Future Coral Trout Generations

Genetic parentage analysis has been applied to track the spread of coral trout larvae and shows that Green Zone reefs are providing a valuable source of juveniles to fished reefs. In a 1,000 km^2 study area, resident coral trout populations in three Green Zones exported 83% of offspring to fished reefs, with the remainder having recruited to their natal (birth) Green Zone reef or other Green Zones in the region (Figure 1).

It was estimated that Green Zones, which accounted for just 28% of the reef area within the study region, produced about 50% of all juveniles that recruited to both Green Zone and fished reefs within 30 km. The results provide compelling evidence that effective networks of no-take reserves can make a significant contribution to the replenishment of fish populations.

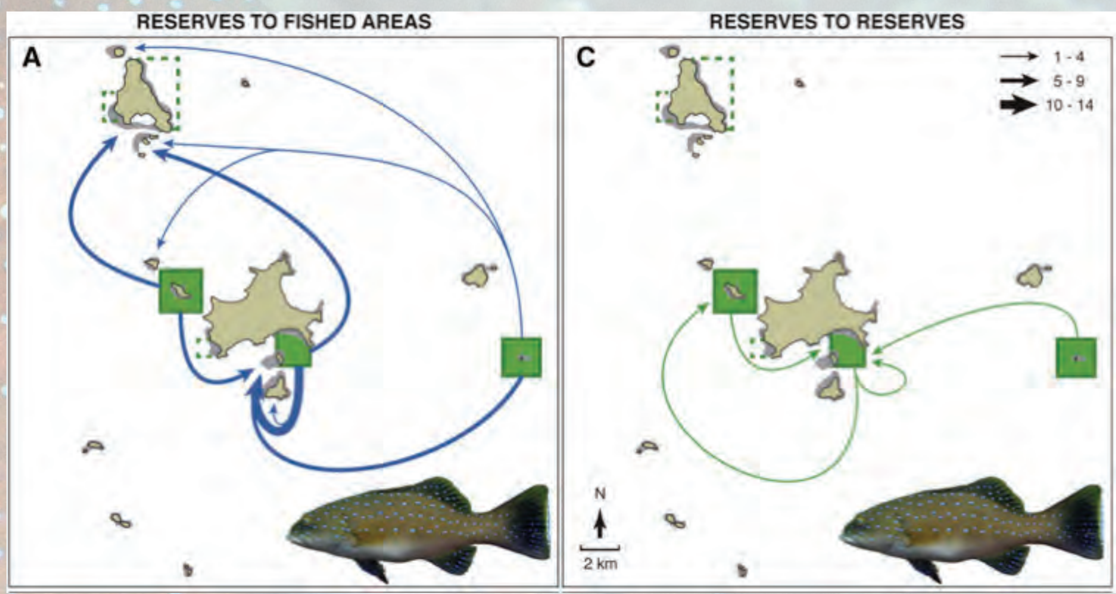

Figure 1. Dispersal Patterns of juvenile coral trout (Plectropomus maculatus) from a network of Green Zones in the Keppel Island group in the southern Great Barrier Reef Marine Park.

Management Implications

Green Zones established during the 2004 re-zoning of the Great Barrier Reef Marine Park have yielded significant benefits for populations of coral trout on both inshore and offshore reefs within the first decade of protection. Substantial increases in the average density, body size and biomass of fished species were consistently recorded on Green Zone reefs, while there were few obvious changes on reefs that remained open to fishing.

Importantly, there was no indication that the density, size or biomass of targeted fish species was reduced on fished reefs as might occur from the displacement and concentration of fishing effort following the establishment of the Green Zone network.

Genetic parentage analysis has provided a breakthrough in tracking the dispersal of larval fish. Zoning the Great Barrier Reef Marine Park for the conservation of biodiversity was assumed to also have a spill-over effect for the recruitment of targeted fish species into commercial and recreational fisheries in areas open to fishing. NERP-funded research provides evidence for this and the findings will help to inform the design of spatial management that aims to promote biodiversity conservation and fishery sustainability.

The study shows that adult fish on no-take reefs exported a significant proportion of their offspring to nearby fished areas. Importantly, about 17% of larvae either returned to their 'birth' Green Zone reef or dispersed to another Green Zone reef, demonstrating an effective network.

Green Zones have effectively increased the number and size of coral trout on the Great Barrier Reef with more adult coral trout on inshore reefs now than in the 1980s. This translates into the increased production of larval fish by populations per unit area of reef. It is now known that Green Zone reefs are supplying larval fish to nearby reefs, providing recruitment subsidies to areas that are open to fishing.

In the context of the current outlook for the health of the Great Barrier Reef, this research supports the spatial management approach applied in 2004. However, although Green Zones increase populations of targeted fish and, in some circumstances, may enhance coral health and protect biodiversity, they cannot prevent reef degradation from a range of other disturbances such as cyclones, floods, coral bleaching, and declining water quality. These stressors must be addressed through effective coastal catchment and water quality management, shipping regulations and decisive global action on climate change.

Further Reading

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