

Long-term monitoring of reef fishes: effects of crown-of-thorns starfish

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Adults of a diverse range of reef fishes have been monitored on the outer slopes of reefs in the central Great Barrier Reef off Townsville since 1980. A nearshore reef (Pandora), an outershelf reef (Myrmidon) and four mid-shelf reefs (Rib, John Brewer, Lodestone and Davies) were initially censused in 1980. All reefs except Davies were re-censused in 1983. Davies was re-censused in 1984, 1986 and annually since. Rib, John Brewer and Lodestone have been censused annually since 1983. Pandora and Myrmidon reefs, which have been unaffected by crown-of-thorns starfish and whose fish communities have been changing less than those on the mid-shelf reefs, have been re-censused three times since 1983.

A standard technique has been used for all censuses. Approximately 146 species are counted including all species of butterflyfish (Chaetodontidae) in the area, the majority of the common damselfishes (Pomacentridae), virtually all surgeonfishes (Acanthuridae) and parrotfishes (Scaridae) plus selected wrasses (Labridae), fusiliers (Caesionidae) and rabbitfish (Siganidae). A census dive involves a 45-minute SCUBA swim along the reef slope, swimming a zig-zag pattern up and down the reef face from the surface to a depth of 13 metres and recording the presence of species and their abundance (on a log five abundance scale) along oblique transects estimated 5 metres either side of the diver. Five censuses of non-overlapping areas of reef slope are made on each reef and each 45-minute swim covers approximately 150 metres of reef face. On each reef except Davies, three permanently marked sites are located within the areas censused for adults where recruitment of all species has been annually monitored since 1983.

During 1983 a crown-of-thorns starfish outbreak occurred on the mid-shelf study reefs (except Davies). Live coral cover prior to the outbreak, measured in the recruitment sites, was approximately 70% (e.g. Davies Reef, Fig. 1). Subsequent to the outbreak, this cover dropped to less than 10% over 1-3 years (depending on the reef). Coral cover changed little until about 1992 when it started to increase geometrically. By 1995 coral cover on the Rib and John Brewer sites was back to pre-crown-of-thorns starfish outbreak levels. These circumstances provide a unique opportunity to examine the response of reef fish communities to the impacts of a crown-of-thorns starfish outbreak.

Preliminary analyses clearly suggest that the very high loss in coral cover had a highly selective impact on the fish communities. Not surprisingly, densities of species that are obligate coral feeders, such as certain butterflyfishes, fell dramatically following the loss of live coral (e.g. *Chaetodon aureofasciatus*, Fig. 2). So too did the density of some species such as the damselfishes *Pomacentrus moluccensis* and *Chromis atripectoralis*. While the adults of these species appeared not to be directly affected by the loss of coral, recruitment of both species fell dramatically because new recruits only settle into live coral and subsequently adult densities fell dramatically as a result of natural mortality and very low recruitment. Many species appeared unaffected by the loss of coral including, for example some butterflyfishes that are not obligate coral feeders (e.g. *Chaetodon trifasciatus*, Fig. 3). The density of herbivorous fishes, expected to increase in numbers due to the very large increase in the amount of algae available on the dead coral, did not increase.

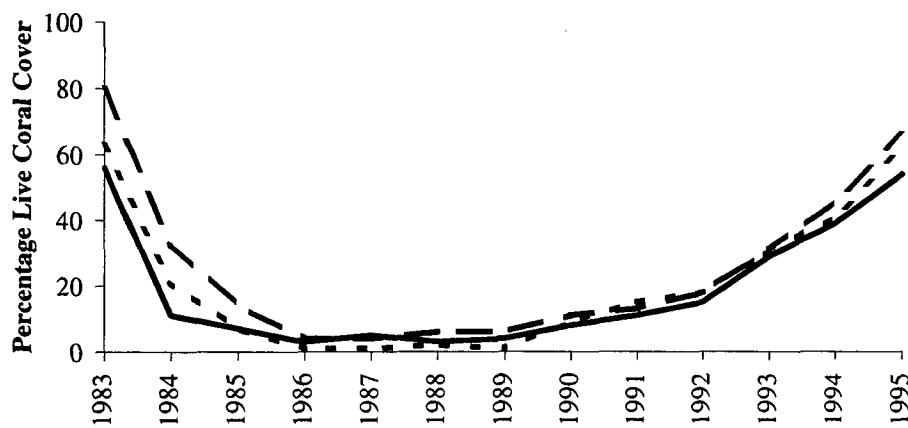


Figure 1. Trends in coral cover at three sites from Davies Reef

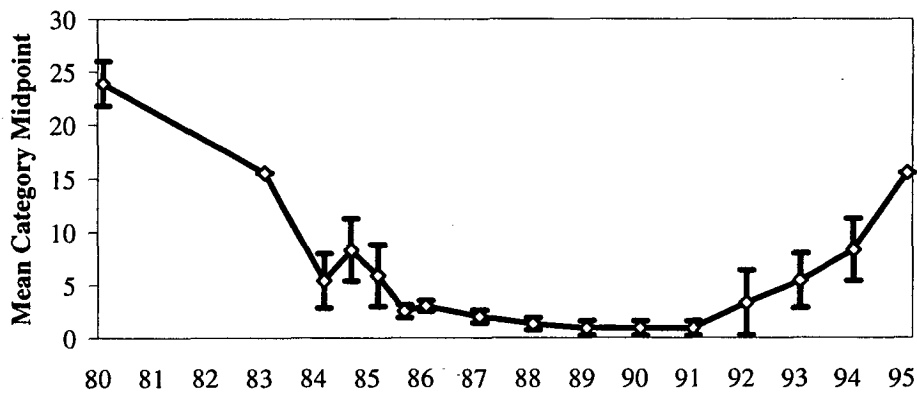


Figure 2. Abundance of *Chaetodon aureofasciatus* at John Brewer Reef

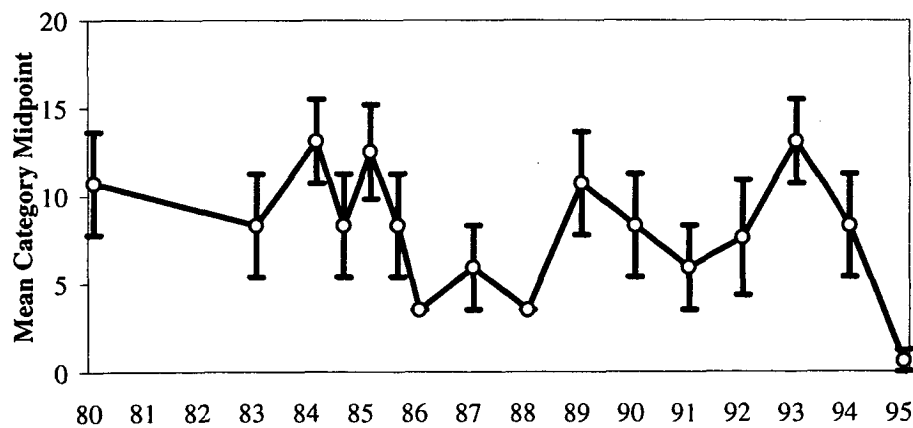


Figure 3. Abundance of *Chaetodon trifasciatus* at John Brewer Reef

Some of the species which showed a rapid decline in response to the crown-of-thorns starfish outbreak have returned to pre-crown-of-thorns starfish densities at a similar rate to the live coral recovery (e.g. *Chaetodon aureofasciatus*, Fig. 2). The same species on different reefs have not necessarily shown the same response. I hypothesise that the fish communities on the reefs examined may be highly resilient (at decadal time scales) to the effects of a crown-of-thorns starfish outbreak but only if recruitment is available from an external source, i.e. upstream reefs. More detailed analyses of these data sets are presently underway to test this hypothesis and to examine in more detail the response of the dynamics of the fish communities in response to large, reef-scale decreases and increases in live coral cover.