Long-term trends in reef fish abundance in the Great Barrier Reef World Heritage Area

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Visual counts of a number of reef fish groups have been made in a wide range of Great Barrier Reef (GBR) sites since 1982. A variety of methods have been used but the majority of counts have utilised strip transects of either 50 x 20 m or 50 x 5 m (see Ayling and Ayling 1986a, 1996 for full descriptions of the count techniques). Counts have been made of all coral trout species *Plectropomus* spp., other fishing targeted groups such as lethrinids and lutjanids, and all chaetodontids. Long-term series of counts on the same reefs are available in a number of areas and can be used to investigate trends in reef fish abundance. The following paper discusses results from surveys made by the author only, with the emphasis on surveys of fishing target species. Some other long term studies of fish abundance have been made in the GBR region, notably by J.H. Choat on herbivorous fish species, but these are not discussed here.

The most comprehensive time series is available from three general use reefs off Townsville, where counts have been made on John Brewer, Lodestone and Davies Reefs on 11 occasions between 1983 and 1995 (Ayling and Ayling 1986b, 1996). Grand mean common coral trout (*Plectropomus leopardus*) density on these three reefs has fluctuated over the years but has shown no downward trend as might be expected if coral trout were being consistently over-fished (Fig. 1). The peak in abundance between 1993 and 1995 on these reefs was primarily due to several good recruitment events.

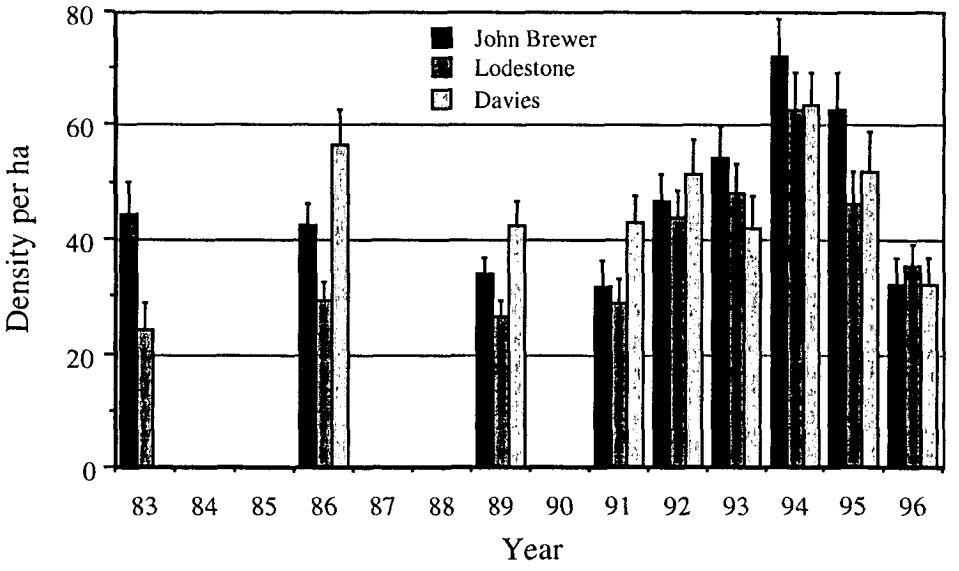

Figure 1. Coral trout density changes on three reefs off Townsville. Mean density per ha is shown from surveys made in the May-June period each year. Error bars are standard errors.

Over the past 13 years, repeat counts on the same reefs, or in the same limited area, have also been made in some other locations. In the Cairns Section, counts were made on twelve reefs in 1983 (Ayling and Ayling 1986b) and again in 1991 (Mapstone and Ayling unpublished data). Common coral trout density increased over this period (Fig. 2). Off the Whitsundays, on the

three reefs Hook, Line and Hardy, mean density of coral trout increased between 1984 (Ayling and Ayling 1986b), and 1988 (Ayling and Ayling 1989) and again between 1988 and 1994 (Ayling and Ayling 1994a). In the Hydrographers Passage area off Mackay counts were made on the back reef slope of three reefs in 1984 (Ayling and Ayling 1986b), and on the back of six reefs in the same area as part of the CRC Effects of Fishing experiment in 1995 and 1996 (A.M. Ayling unpublished data). Mean coral trout also increased in this area (Fig. 2). Toward the south end of the Great Barrier Reef, in the Pompey Complex counts were made on the back of four reefs in 1985 (Ayling and Ayling 1986a) and on the back of six reefs in the same area, including two of the same reefs, in 1995 and 1996 (Fig. 2). In all these cases, covering much of the length of the GBR, total density of the common coral trout has increased over the past 13 years.

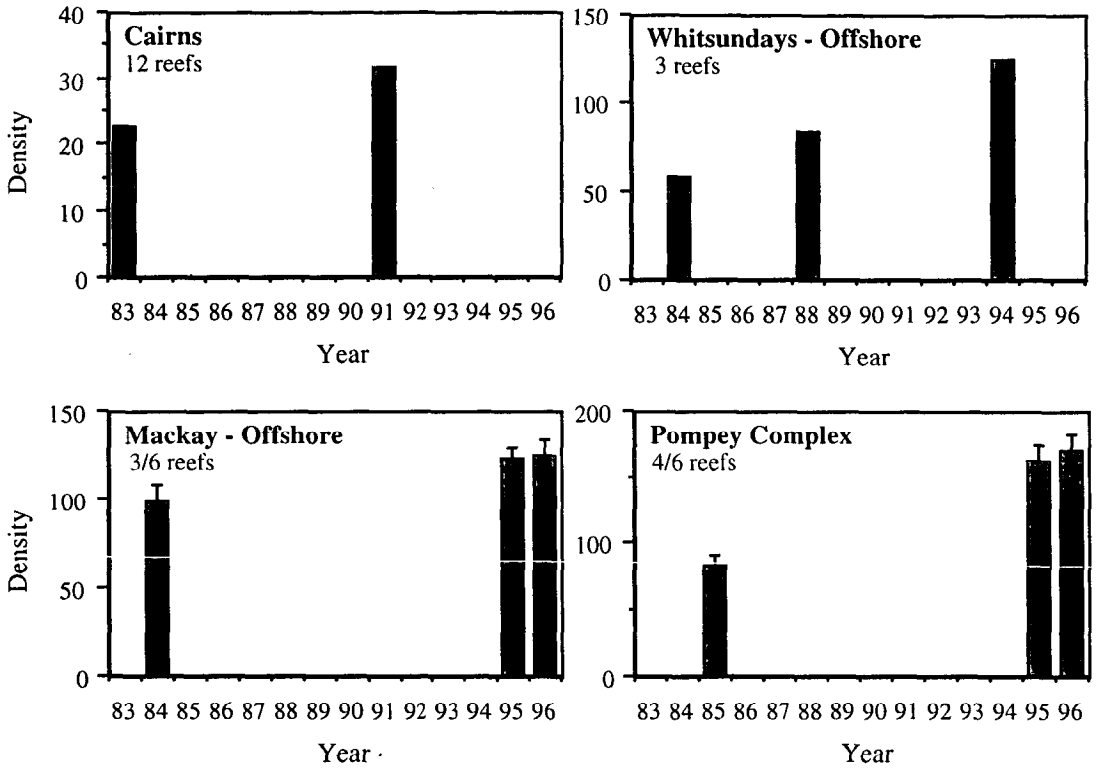

Figure 2. Long-term coral trout density changes from GBR locations. Graphs show grand mean density per ha from groups of 10 to 30 counts per reef. Error bars are standard errors. See text for sources.

Is the protection that has been afforded some reefs by Marine Park zoning preventing overall coral trout numbers from declining in the face of continuing fishing pressure? Counts that have been made on protected and fished reefs since 1986 suggest that this is not the case. In 1986, coral trout were counted on 12 reefs in the Capricorn-Bunker Group off Gladstone (Ayling and Ayling 1996a). Six of these reefs had been closed to fishing for an average of about five years, while the other six were open to fishing. There were more coral trout on the closed reefs than on the fished reefs but this difference was not significant (Table 1). In 1991 fish were counted on a large number of reefs in the Cairns Section (Dunk Island up to Lizard Island). Of these reefs, 29 were open to fishing and 18 had been closed to fishing for seven years. Coral trout density on the two groups of reefs was almost exactly the same (Mapstone and Ayling unpublished data). In 1992 another set of counts was made in the Cairns Section, using five different closed reefs and five fished reefs (Ayling and Ayling 1992). Once again there was no difference in density between the two groups of reefs (Table 1). The 1996 CRC Effects of

Fishing count of coral trout on 24 reefs between Lizard Island and the Swain Group, recorded fish numbers on 16 closed reefs and 8 fished reefs. This survey found more common coral trout on the fished reefs than on the protected reefs, but this difference was also not significant (Table 1).

Table 1. Summary of common Coral Trout density on closed and fished reefs. Figures show mean density per ha from between 10 and 30 transects per reef. For sources see text.

Location	Date	No. protected reefs	Protected density	No. fished reefs	Fished density
Capricornia	Jan 1986	6	57.0	6	49.0
Cairns	1991	18	33.9	29	34.6
Cairns	1992	5	28.4	5	27.8
GBR	1996	16	100.9	8	117.7

The level of protection currently offered by the GBR Marine Park is not having any effect on the density of common coral trout. This may either be because regular illegal fishing is still carried out on protected reefs or because coral trout populations are naturally resilient in the face of fishing pressure, or a combination of these two factors. In spite of this the overall density of this species is apparently increasing over much of the GBR region. The available evidence suggests that common coral trout populations are not being depleted by current levels of fishing. However, a recent study has shown that intensive fishing pressure has the potential to reduce adult coral trout numbers dramatically (Ayling and Ayling 1996). When the Bramble Reef replenishment area was opened to fishing in July 1995, after being closed for 3.5 years, 60% of the available adult coral trout were removed by fishermen within two months, and over 80% within 12 months. The fishing pressure in this case was severe, with 19 commercial fishing boats and a large number of private boats being present on the reef for the opening.

Although counts of lethrinids and lutjanids have only been made on some reefs over a six year period, numbers have been remarkable stable over that period (Ayling and Ayling 1996). A comparison is possible between counts of *Lethrinus miniatus* made on 11 reefs in the Swain Group and southern Pompeys in 1986 (Ayling and Ayling 1986a), and those made in the southern Pompeys as part of the CRC survey in 1996 (A.M. Ayling unpublished data). Mean density was 25.5 (s.e. 3.1) in 1986 and 22.9 (s.e. 2.5) in 1996. There has been some evidence from studies in the Innisfail to Townsville region that the red-throat sweetlip *Lethrinus miniatus* may be adversely affected by fishing pressure (Ayling and Ayling 1994b, 1996). However, recent counts of this species made on more southerly reefs where they are naturally more abundant (this species occurs very rarely on reefs north of about Innisfail and is found at relatively low densities north of the Whitsunday Islands) suggest that current protection regimes are also having no affect on the density of this species (A.M. Ayling unpublished CRC data). In 1996 the mean density of this species from the 16 protected CRC reefs was 14.4 per ha, compared with 14.3 on the eight fished reefs. Preliminary evidence suggests that lethrinids and lutjanids are also not being adversely affected by current fishing levels on the GBR.

Of the species for which long term data is available, only chaetodontids are not subject to fishing pressure, except for the negligible impact of aquarium fish collectors. Many chaetodontids are obligate hard coral feeders and the density of this group on any reef is always positively correlated with hard coral cover (Ayling and Ayling 1985, 1986a, 1996, Fig. 3). Hence densities of this group have fluctuated markedly on the reefs where long time series of

counts are available, a result of fluctuations in coral cover caused by crown-of-thorns outbreaks and subsequent recovery (Fig. 4).

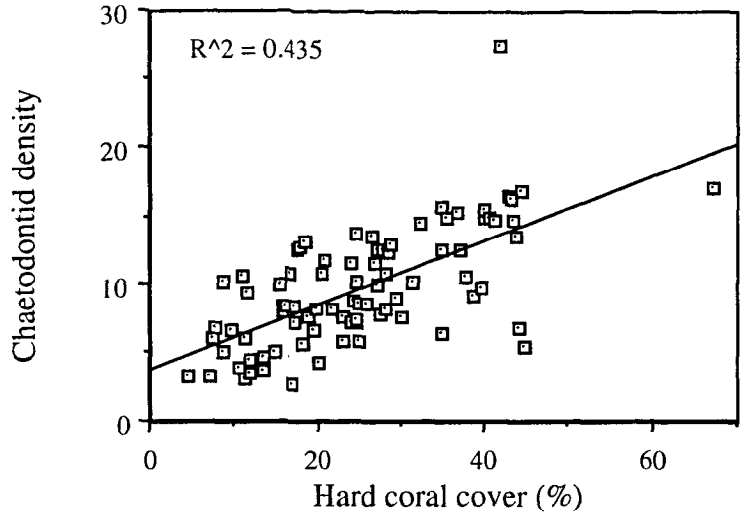

Figure 3. Relationship of chaetodontid density to hard coral cover. Data from May 1995 survey of seven reefs off Townsville, with 12 sites per reef and five transects per site. Relationship at the site level is shown.

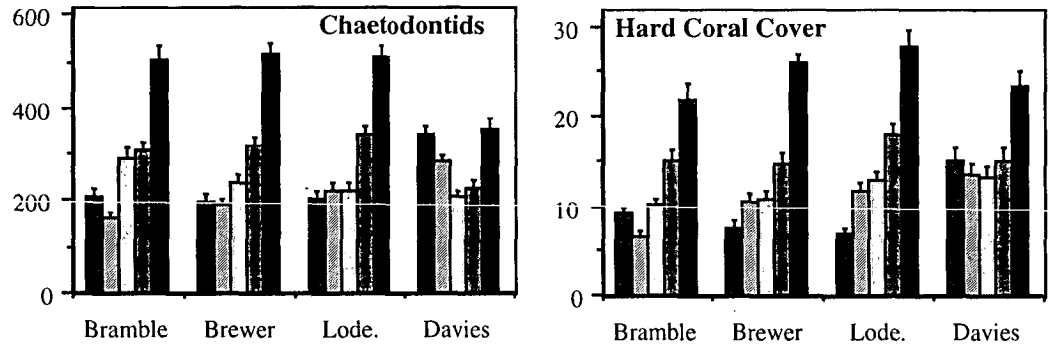

Figure 4. Changes in chaetodontid and hard coral cover on four reefs off Townsville: 1991-1995. Data from 12 sites of five transects on each reef. Error bars are standard errors.

There is concern that reef fish populations are being degraded by existing levels of fishing pressure. Although there is evidence that extreme fishing pressure can cause a rapid decline in targeted species, the available data suggest that populations of these species over the GBR region have not been reduced in the past decade by current exploitation levels. In the event that fishing pressure is, at some time, deemed to be a concern, the best management response in my view would be more effective enforcement of more concentrated and limited protected areas. The present system fails in having inadequate enforcement of widely scattered protected areas; regular fishing does take place on most supposedly protected reefs.

References

Ayling, A.M. and A.L. Ayling 1985. A biological survey of selected reefs in the Central Section of the Great Barrier Reef Marine Park. Unpublished report to the Great Barrier Reef Marine Park Authority.

Ayling, A.M. and A.L. Ayling 1986a. A biological survey of selected reefs in the Capricorn and Capricornia Sections of the Great Barrier Reef Marine Park. Unpublished report to the Great Barrier Reef Marine Park Authority.

Ayling, A.M. and A.L. Ayling 1986b. Coral trout survey data. Unpublished report to the Great Barrier Reef Marine Park Authority.

Ayling, A.M. and A.L. Ayling 1989. Hardy Reef walkway and pontoon complex development. Public Environmental Report to Hamilton Island Enterprises.

Ayling, A.M. and A.L. Ayling 1992. Effects of fishing pilot study: visual surveys on Cairns Cluster Reefs and closed reefs that will be opened under the new zoning plan. Unpublished report to the Great Barrier Reef Marine Park Authority.

Ayling, A.M. and A.L. Ayling 1994a. Hardy Reef - monitoring of the impact of the new Fantasea Cruises pontoon. Unpublished report to Fantasea Cruises and the Great Barrier Reef Marine Park Authority.

Ayling, A.M. and A.L. Ayling 1994b. Effects of fishing: effects of fishing resumption on a group of previously protected reefs in the Cairns Section. Unpublished report to the Great Barrier Reef Marine Park Authority.

Ayling, A.M. and A.L. Ayling 1996. Bramble Reef replenishment area - pre- and post-opening surveys. Unpublished report to the Great Barrier Reef Marine Park Authority.