The status of reef fishes on the Great Barrier Reef

H Sweatman, A Thompson, and A Cheal
Australian Institute of Marine Science, PMB No. 3, Townsville MC Qld 4810

Abstract

This paper synthesises information from the Australian Institute of Marine Science (AIMS) Long Term Monitoring Project (LTMP), which involves making annual visits to about 50 reefs from north of Cooktown to the Capricorn-Bunker Group. Visual censuses of fish assemblages on reef fronts show clear cross-shelf differences at the family level and some north-south differences. Taxa showing cross-shelf differences include lutjanids and siganids being more common inshore and acanthurids, scarids and zanclids increasing in number offshore. Acanthurids, scarids, lutjanids and zanclids decline in abundance from north to south. As a family, pomacentrids show different cross-shelf distribution patterns at different latitudes. This is also true of most of the constituent genera. Building on this, inshore, and offshore fish assemblages were identified, as well as a group with a general distribution. The existence of these groups should be reflected in conservation initiatives.

Reef fish assemblages have been shown to recover from major habitat losses due to storms or *Acanthaster planci* outbreaks, presumably through larval recruitment from unaffected areas. Recent research suggests that larval dispersal is more localised that has previously been accepted.

Introduction

Coral reef fishes must rank among the most studied of animal groups inhabiting coral reefs. A significant proportion of all studies are from the Great Barrier Reef (GBR), but few of them address the status of reef fish populations on the GBR in any direct way. Fish assemblages certainly constitute some of the 'superlative natural phenomena' of the region (UNESCO 1972). The status of populations of most reef fishes is unknown, so much of what follows is based on bio-geography, natural history and logic. Among the great diversity of fishes on the GBR are a few species that are subject to human exploitation in the form of commercial and recreational fishing (Ayling and Ayling 1994; Williams and Russ 1994; Russ et al. 1995; papers by Ayling, by Elmer and by Higgs in this volume). Another set of species are targeted by aquarium collectors (Butler 1991). We do not deal with these specific impacts in this review, rather we aim to:

1. Give a broad picture of the distribution of fish taxa across most of the GBR;
2. Identify coherent groups of species that tend to co-occur in the region;
3. Discuss some processes that will affect particular taxa at certain times.

Fish communities of the Great Barrier Reef

No authoritative estimate for the number of species that occur in the GBR region is available. We are indebted to Drs Jeff Leis and Doug Hoese of the Australian Museum, whose inspection of the Australian catalogue suggests that 1500-2000 described species is a realistic estimate, depending on the definition of the GBR province and whether species trawled from habitats between reefs should be included.

Table 1. Numbers of species recorded in each family counted in 50 x 5 m transects. Note that two groups of species are treated as single categories

Family	No. of Species	Notes
Acanthuridae	24	Incl. *Ctenochaetus* spp. grouped
Chaetodontidae	34	
Labridae	9	
Lethrinidae	13	
Lutjanidae	18	Incl. *Macolor* spp. grouped
Scaridae	25	
Serranidae	7	
Siganidae	9	
Zanclidae	1	
Sum	140	

Table 2. Number of species in each genus of Pomacentrids counted in 50 x 1 m transects

Genus	No. of Species
Acanthochromis	1
Amblyglyphidodon	3
Amphiprion	6
Chromis	17
Chrysiptera	6
Dascyllus	4
Dischistodus	4
Neoglyphidodon	3
Neopomacentrus	3
Plectroglyphidodon	3
Pomacentrus	17
Pomachromis	1
Premnas	1
Stegastes	3
Hemiglyphidodon	1
Sum	73

Geographic patterns of density of some taxa

The data in the previous section concerned the presence or absence of species on the sample reefs. This section considers patterns in density of taxa across the GBR. For analysis, the counts have been summed over 250 m of transect, giving an estimate of density from three sites in the one area of each reef. This seems an appropriate sampling scale for mobile organisms such as fishes. For initial presentation, larger species have been grouped to family (Fig. 2). Pomacentrids were counted on 1 m transects, they are included as a family in Fig. 2 and displayed by genus in Fig. 3. Two analyses of variance, each consisting of a series of contrasts, were used to examine whether there is systematic geographic variation in density of the groups that can be attributed to latitude or cross-shelf position. The geographic distribution of reefs along the GBR complicates such analyses: in the four northern sectors there are generally identifiable inner, mid- and outer shelf reefs, subject to progressively less coastal and more oceanic influences respectively. The Swains sector reefs can be expected to show a different pattern, for while the oceanic influence decreases from outer shelf Swain reefs to inner ones,

The results of the analyses are summarised in Tables 3 and 4. The first point to be made is that there are relatively few instances where a significant amount of variation could be attributed to some geographic factor. Since the analyses involve a large number of statistical tests 5% of which will show significance simply through variation among reefs which is unrelated to geography, any apparent patterns must be treated sceptically unless they have been confirmed by sampling other reefs in a similar design. Looking at the level of families, only lethrinids showed significantly different cross-shelf patterns at different latitudes. Only pomacentrids varied in density among sectors when all reefs in sectors other than the Capricorn-Bunkers were considered. When only outer shelf reefs were considered and the Capricorn-Bunkers were included, six of the ten families occurred at different densities at different latitudes. Since the pomacentrids as a family showed different cross-shelf patterns at different latitudes, it is not surprising that seven of the 12 pomacentrid genera did so as well. Of the remaining five genera, one showed variation in density both among latitudes and across the shelf. Another, *Dischistodus*, occurred at significantly lower densities on outer shelf reefs. When only outer shelf reefs were considered, nine of the 12 genera varied in density among latitudes.

There are certainly differences in the geographic distributions of individual species within taxa, for instance *Chaetodon aureofasciatus* is the most abundant butterflyfish on inshore reefs in northern and central regions of the GBR (Anderson et al. 1981, Williams 1982), but does not occur on outer shelf reefs, even though chaetodontids as a group show no clear cross-shelf pattern (Fig. 2). This is also shown among the pomacentrids by Williams (1982) who gives data for ten species of *Chromis* whose distributions vary from inshore to mid-shelf (*C. nitida*) to *C. chrysurus*, *C. iomelas* and *C. amboinensis* that were only recorded on exposed reefs.

The general conclusions are that cross-shelf patterns in abundance and probably species richness are more clear than any variation among latitudes. Previous workers have also found strong cross-shelf variation. Examining herbivorous fishes on outer slopes of reefs in the central GBR near Townsville, Russ (1984a) found that acanthurids showed increasing abundance with distance offshore, though Williams (1982) found that this was not the case for all species. Scarids were uncommon inshore compared with mid-shelf and outer shelf reefs (Russ 1984a) while siganids showed little change across the shelf. In a preliminary analysis, Williams (1983) demonstrated that north-south variability was less than cross-shelf variability in reef fish assemblages on five cross-shelf transects.

Are there distinct communities?

Multivariate ordinations provide a way to summarise geographic patterns in communities by integrating the distributions of numerous taxa. Principal components ordinations (using presence/absence of species having more than two individuals on at least three reefs) were used. Groups of reefs that support similar assemblages when the distributions of many species are considered simultaneously should map close together. As expected from the univariate analyses, there are indications of relatively strong cross-shelf patterns (inner , mid- and outer shelf reefs form groups with limited overlap) and weaker latitudinal ones (Fig. 4).

These analyses have followed the traditional approach of looking for cross-shelf and latitudinal patterns. In Figs. 2 and 3, several taxa show consistent cross shelf patterns, but while there are differences among sectors, few taxa show consistent latitudinal trends that might, for instance, indicate that climatic variables are the driving force. Cross-shelf position is also the sum of a number of factors balancing coastal and oceanic influences. A cursory look at a map indicates that the breadth of the continental shelf, which should be inversely related to terrestrial influence, and the integrity of the barrier (that might exclude oceanic influences) do not vary in a simple fashion along the length of the GBR.

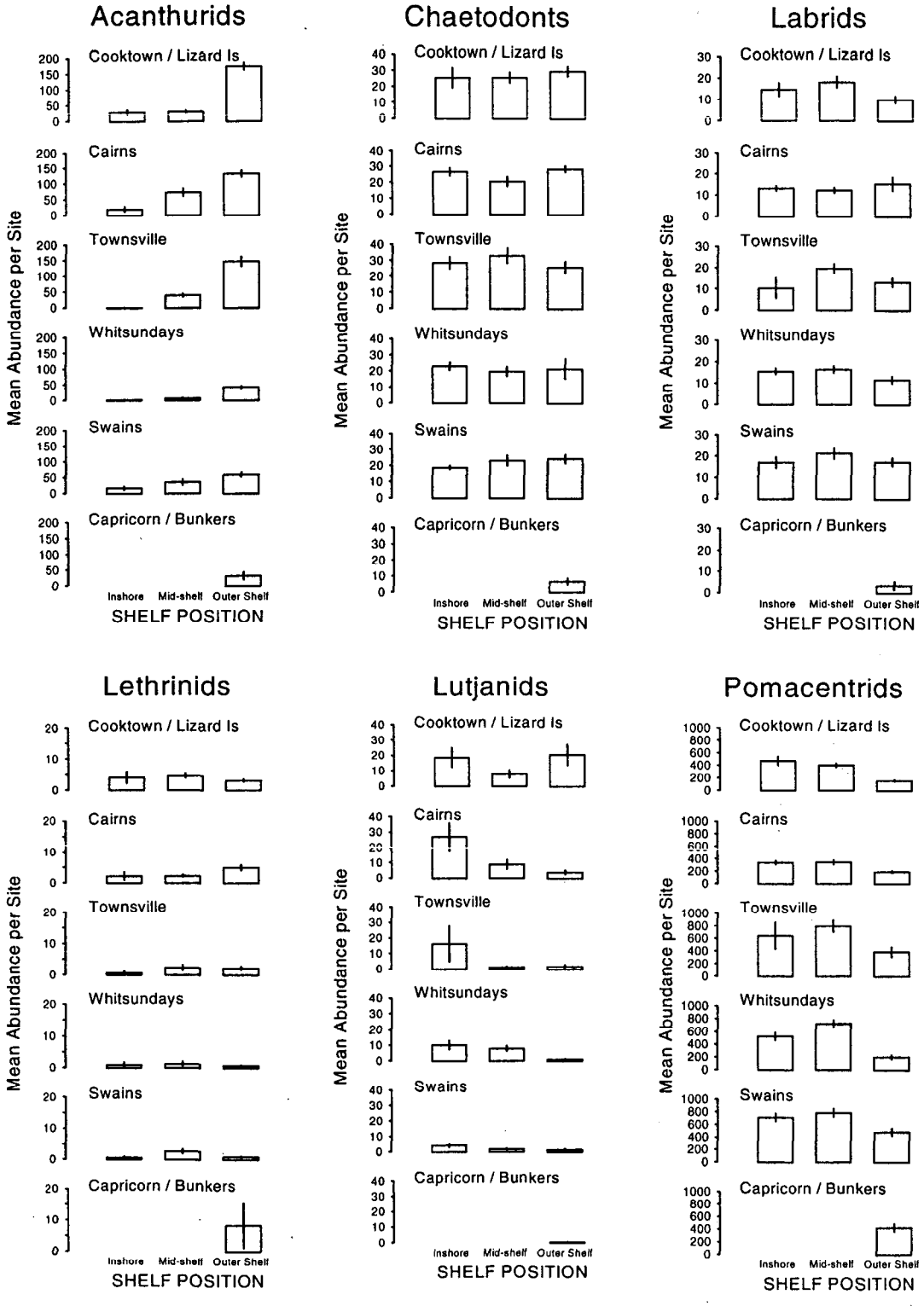
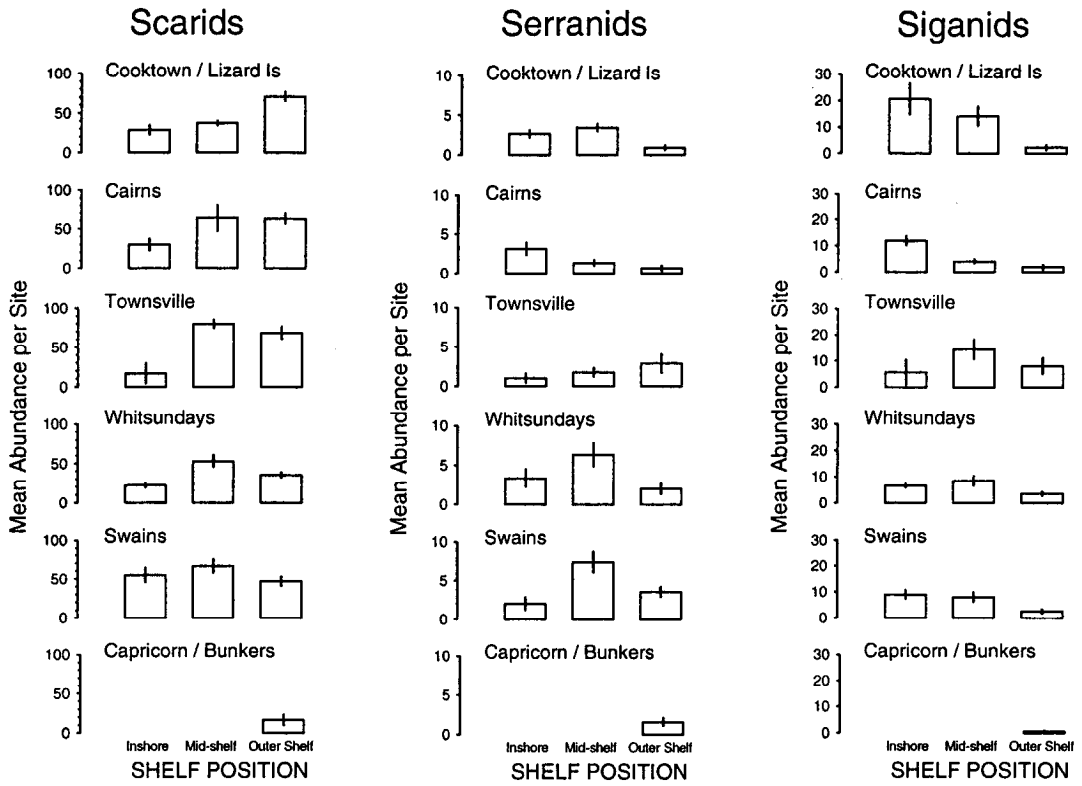
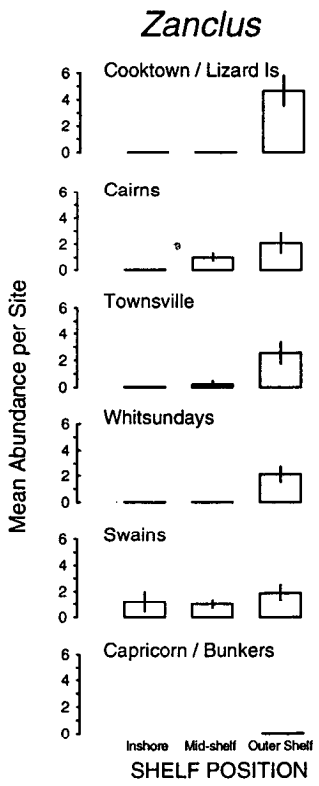


Figure 2. Mean number of individuals per site for nine families of larger fish counted on 5 m wide transects and pomacentrids counted on 1 m wide transects. Error bars are S.E.

Figure 2 cont.





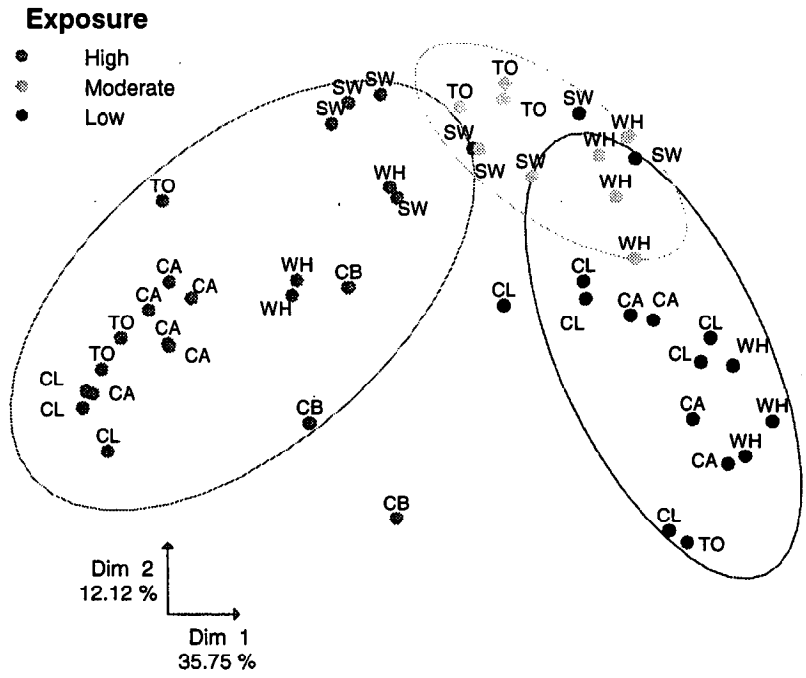


Figure 5. Principal component plots showing groupings by exposure. Plots are based on abundances of all species present as more than two individuals on three or more reefs. All data column centred to account for differences in abundance among species. Ellipses are 'confidence ellipses' which will on average include 80% of points in a group if the data are multivariate normal. Sector codes: CL = Cooktown-Lizard, CA = Cairns, TO = Townsville, WH = Whitsundays, SW = Swains and CB = Capricorn-Bunkers.

Patterns of endemism

In his review of one of the best-studied families of reef fishes, the damselfishes, Allen (1991) recorded 91 species on the GBR and identified only four species as endemic. These were: *Chromis nitida*, *Stegastes apicalis*, *Pomacentrus australis* and *Pomacentrus wardi*. All of these have southern distributions and occur on the New South Wales coast. *Chromis nitida* has been recorded at Lord Howe Island. *Chromis nitida* and *P. australis* are confined to the southern section of the GBR but *S. apicalis* and *P. wardi* occur at least as far north as Lizard Island (14°40'S). One salient species with a curious distribution is *Lethrinus miniatus*, a commercial species that is common in the southern GBR and on the reefs off Townsville but very rarely seen on reefs near Cairns or further north. In the context of the GBR itself, species belonging to a number of groups occur only in the north, but this is because the area is peripheral to more equatorial centres of distribution.