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Coral Sea Biodiversity Review: Sharks and Fish

Compiled by Andy Dunstan for WWF-Australia May 2008

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Executive Summary

The Australian portion of the Coral Sea is an example of a diverse group of oceanic seamounts with special features, endemic fauna and relatively healthy populations of many marine animals that are increasingly endangered and vulnerable through other portions of their range. The unique underwater features associated with coral seamounts rising from depths of above 2000 metres, include deep sea fauna and flora, caves, historic wrecks and geological and palaentological features.

The region is virtually unexplored and therefore a range of sources of information and personal observations were used to conduct this review, focusing on sharks and fish, and threatened or endangered species in the Coral Sea region. Where possible, general comparisons were made with other similar habitats throughout the Indo-Pacific and within the Great Barrier Reef Marine Park, for species richness, endemism and current status of populations.

The major conclusion was that populations of apex predators such as large shark species, maori wrasse, billfish and tuna were reported to be at high levels at notable Coral Sea sites such as Osprey and Middleton Reefs. The major fish species listed by the IUCN Red List as species of concern were also recorded at healthy levels in the Coral Sea reefs where data was available. Key species of interest are whitetip, grey reef and hammerhead sharks, manta rays, maori wrasse, coral trout, bumphead parrotfish and groupers. A comparison of surveys also showed that the reef fish assemblages observed in the Australian portion of the Coral Sea were relatively unique compared to those found on the Great Barrier Reef and that iconic molluscs such as the chambered nautilus and a range of clam species are still present in healthy numbers in the Coral Sea. By contrast many of these species are locally extinct, rare or in rapidly decline in places such as the Philippines, Indonesia and Papua New Guinea.

The main conclusion from this data is that the Coral Sea provides one of the few healthy preserves for many key coral reef species and populations. However, many species inhabiting the Coral Sea oceanic reefs are genetically endemic to individual reefs, with little or no dispersal options. Their life history characteristics coupled with the often isolated occurrences, makes the sustainability of many Coral Sea populations highly susceptible to human impacts. If populations of a species were to be reduced below a critical level, local extinction could occur, such has been demonstrated by the demise of populations of grey reef sharks, nautilus, maori wrasse and numerous other commercially sought after species on many Indo-Pacific reefs.

Introduction

Seamounts are undersea mountains that rise steeply from the seabed and are characteristic of the reefs of the Coral Sea. Many of the Coral Sea reefs are exposed at low tide and a number have significant coral cay islands. It has been well demonstrated that seamounts have a significant effect on oceanic circulation with the formation of eddies and upwellings of nutrient rich water at their margins resulting in increased productivity in surface waters (Leis, 1994).
This creates an ideal habitat for reef associated fauna. It also provides a feeding and reproduction focal point for many open-ocean and deep sea species of fish, sharks, sea-turtles, marine mammals and seabirds. Such feeding and reproduction aggregation events make these species highly vulnerable to over-exploitation (Worm et al, 2003, O'Shea, 2007).

Oceanic reefs are poorly understood and there is limited data available. This report accesses data from a number of surveys conducted in the Coral Sea at Coringa-Herald, Lihou, Elizabeth and Middleton Reefs by the Australian Institute of Marine Science (Whitley, 1937, Oxley et al, 2004, Sweatman et al, 2001, Oxley et al, 2003, Oxley et al, 2003). It also uses data from long-term studies at Osprey and Shark Reefs by Undersea Explorer and James Cook University (O'Shea, 2007).

The IUCN Red List of threatened and endangered species was referenced to provide global status of species of populations of major relevance in the Coral Sea (www.iucnredlist.org).

Methods

Data and observations were collated from the following sources.

Australian Institute of Marine Science surveys

The methods for data collection by AIMS surveys are outlined within the referenced publications. The rapid visual census method was used to count fish from a list of over 200 species, representing 10 families, on three 50m transects within each reef zone. All species in the list were largely noncryptic, easily identified underwater, and included both commercial and non-commercial taxa with juveniles excluded. Large mobile fish and damselfish were counted separately on transects 5m and 1m wide, respectively. This method provided species composition data and crude abundance estimates of the fish communities. Species richness and fish abundance were compared between the different regions surveyed. Extensive surveys of coral abundance and diversity were also carried out and this data is presented where linked with diversity and abundance of the species covered in this report (Osborne and Oxley, 1997, Oxley et al, 2004, Sweatman et al, 2001, Oxley et al, 2003, Oxley et al , 2003).

Undersea Explorer surveys

A visual census was conducted for a species list of target organisms (See Appendix 1) on dive sites of the Great Barrier Reef's Ribbon Reefs and Osprey Reef in the Coral Sea between May 2001 and July 2004. During this period a total of 1,800 dives were conducted with corresponding data records. Species, location, abundance and behaviour were recorded for all target species during each dive by at least one scientist. Additional observations were recorded for any major fish aggregations, spawning activity or unusual species sightings.

Undersea Explorer nautilus population studies at Osprey Reef

Eight years of capture, mark and recapture studies have been conducted at Osprey Reef with limited sampling in other Coral Sea and Great Barrier Reef locations. Growth rates of individual nautilus and broad population estimates for Osprey Reef populations have been investigated.

Osprey Reef and Great Barrier Reef Ribbon Reef cleaner station fish census

(O'Shea, 2007).

This study was conducted between March and June 2007. Sampling took place within six reefs of the northern Great Barrier Reef, with two sites at each reef, separated by 1km to 100km. The reefs sampled were The Agincourt complex, Ribbon Reef # 5, Ribbon Reef # 9 and Ribbon Reef # 10. At Osprey Reef, two sites were sampled. Data was collected by diver observations and the use of digital video equipment. At each site, cleaning stations were located at each depth strata (<10m and >10m). Each dive comprised at least one deep and one shallow observation, but most comprised two deep and two shallow observations.
Remote observations were also made using a video camera fastened at a vantage point to a cleaning station, for periods not less than one hour and up to 12 hours at Osprey Reef, which was avoided for the duration of its recording (O'Shea, 2007).

IUCN Red List of Threatened Species

The IUCN Red List is a comprehensive summary of threatened species throughout the world. The detailed process, criteria and categories for the Red List can be accessed via www.iucn.org/themes/ssc/redlist.htm

Results

Australian Institute of Marine Science surveys

Great Barrier Reef and Coral Sea reef comparisons

Sites on the north-east flanks of Coringa-Herald, Lihou and reef slopes of Elizabeth-Middleton reefs have lower densities of selected large reef fish and Damselfish and a lower cover of live hard coral than comparable north-east flank sites on northern and southern Great Barrier Reef reefs. These patterns were maintained across all reef zones with Great Barrier Reef north-east flank communities showing higher coral cover, fish density and species richness than any reef zone on the Coringa-Herald reefs (Oxley et al, 2004).

In addition to overall lower density and species richness, the community structure of reef fish on these Coral Sea reefs is distinct from that observed on outer shelf Great Barrier Reef reefs (Oxley et al, 2004).

Table 1. Summary of data from AIMS surveys of Great Barrier Reef and Coral Sea reefs 2001-2004.

Location	Large reef fishes / ha	Damselfishes / ha	Species richness Fish sp. / site	% Coral cover
GBR	1842	17118	44	30
Coringa Herald Group	1181	9150	22	4.5
Lihou Reef	1935	13081	26	7.9
Elizabeth-Middleton Reefs	583	n/a	n/a	25

*n/a – Not applicable

Figure 1: Fish species richness comparison between northern Great Barrier Reef, Coringa-Herald Reserve and Lihou Reef Reserve (Oxley et al, 2003).

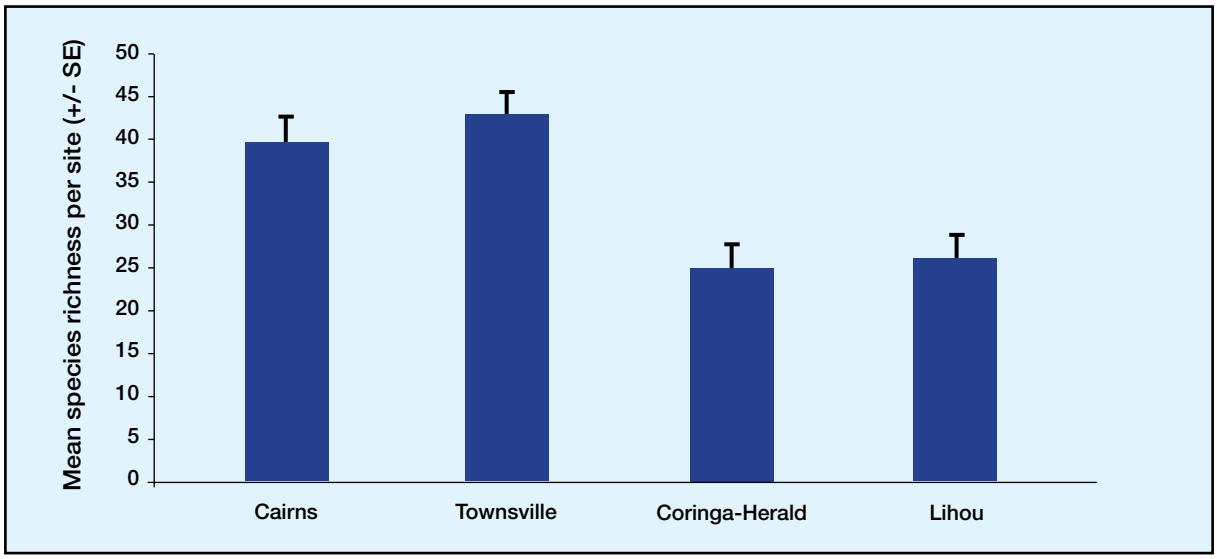


Figure 2: Fish Species Richness comparison between the Great Barrier Reef north-east flanks and all zones in the Coringa-Herald and Elizabeth Reefs. Error bars indicate Standard Errors (Oxley et al, 2004).

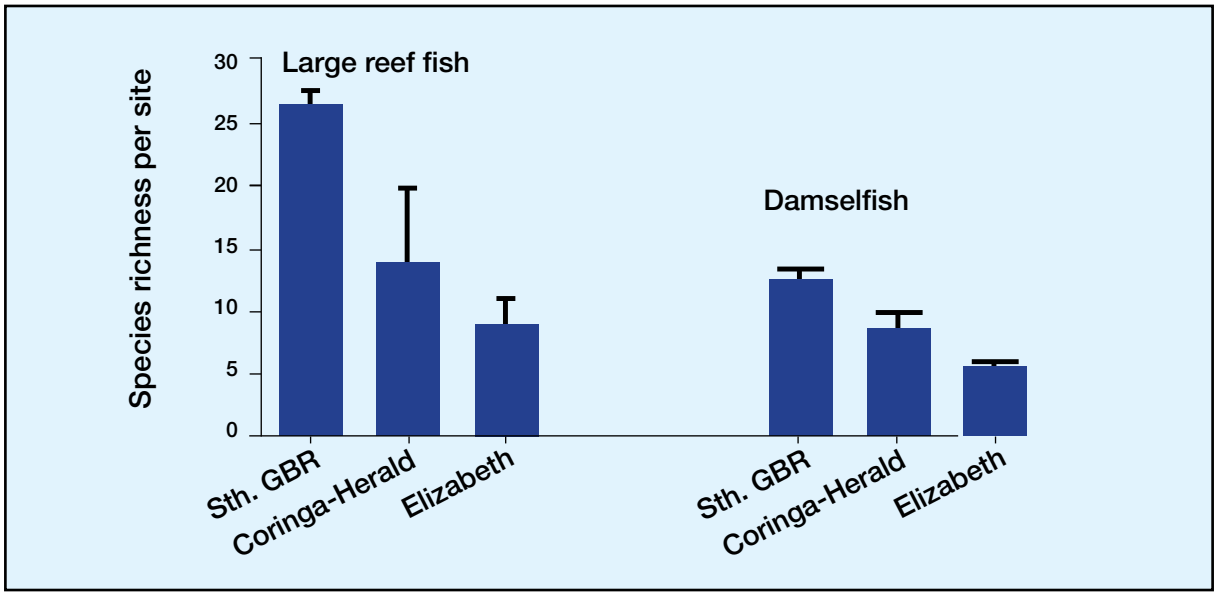
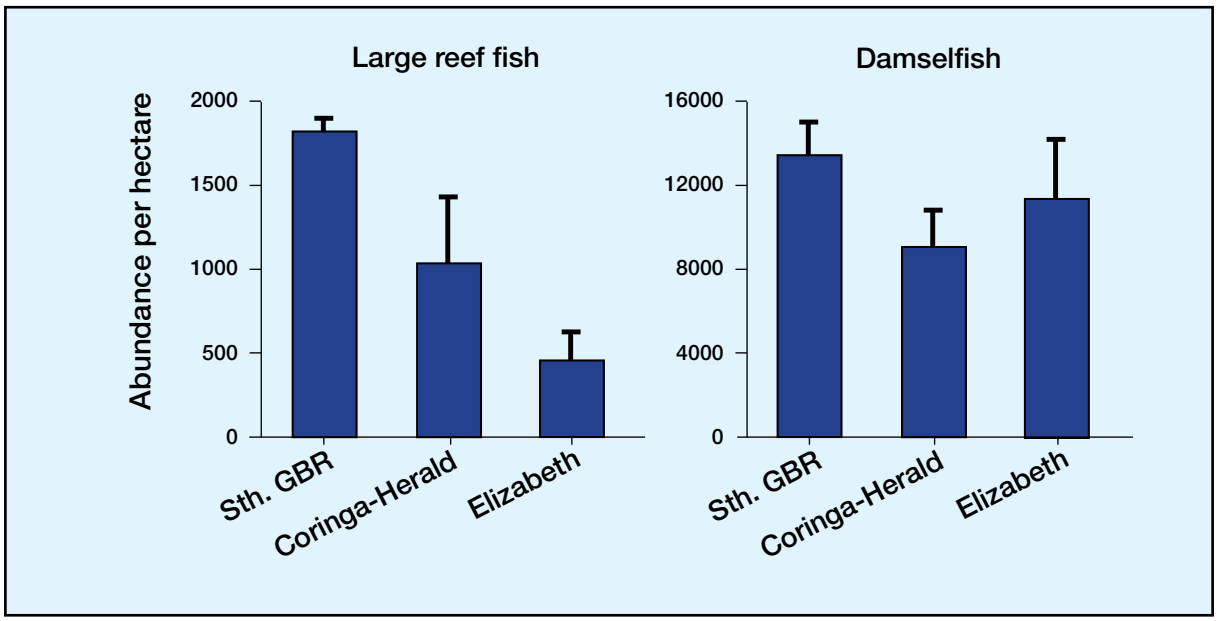


Figure 3. Comparisons of mean reef fish abundance (+ one standard error) between the southern Great Barrier Reef north-east flanks, Coringa-Herald Reserve north-east flanks and reef slope sites at Elizabeth Reef based on transect data using comparable species (Oxley et al, 2004).



The between-reef variation in species richness and abundance is high. The data below highlights the different characteristics and individual nature of reefs in the Coral Sea, for both fish and coral communities.

Multivariate analysis has revealed that the fish community at Lihou Reef Reserve was very similar to that encountered at the Coringa-Herald Reserve in 2003. However, this 'Coral Sea' community was quite distinct from the community encountered at Elizabeth Reef in 2003. This separation was largely driven by the presence of several temperate water species at Elizabeth Reef, most notably Prionurus maculatus, Chromis hypsilepis and Chrysiptera notialis (Oxley et al, 2004).

Figure 4. Differences in proportions of higher taxonomic groupings of reef fish between Lihou Reef Reserve, Coringa-Herald Reserve and the northern Great Barrier Reef (Cairns and Townsville sector outer reefs)(Oxley et al , 2003).

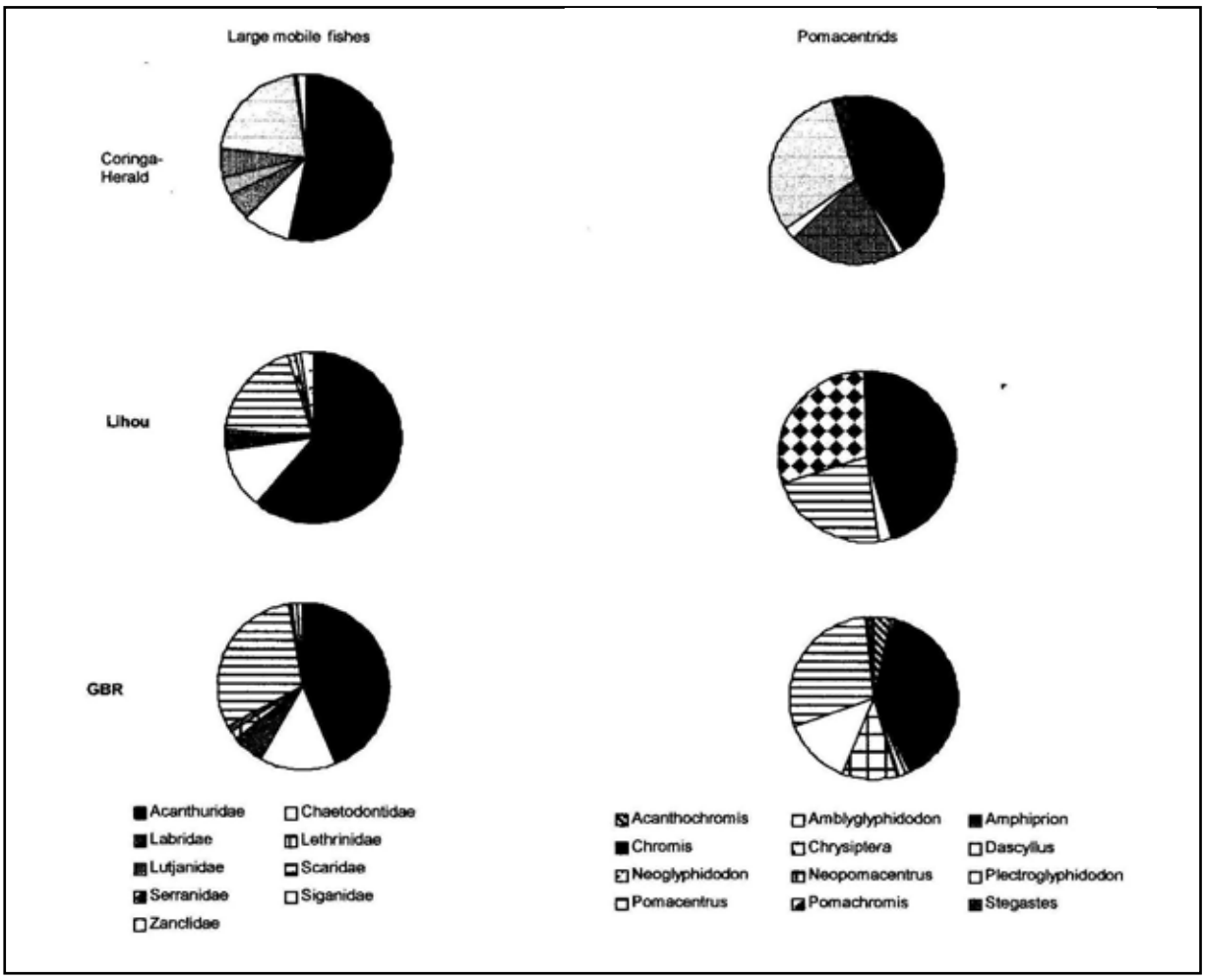
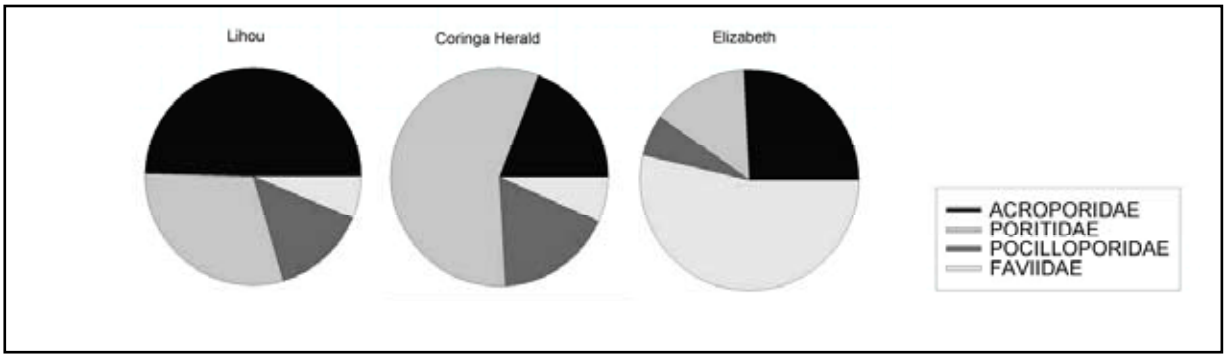


Figure 5. Pie Charts showing the top four coral families at Lihou Reef Reserve, Coringa-Herald Reserve and Elizabeth Reef in the Elizabeth Middleton Reserve. Pie slices are the percentage of the total cover of the four families at each of the locations (Oxley et al, 2004).



The between-site data for surveys of Coringa-Herald reefs, Lihou and Elizabeth-Middleton Reefs demonstrate the variation in species richness and abundance between reefs separated by only small distances.

Figure 6. Fish abundance from transect surveys at all sites at Elizabeth Reef. Dark blue bars represent reef slope sites, light grey bars indicate channel sites and the lagoon site is shown in white (Oxley et al, 2004).

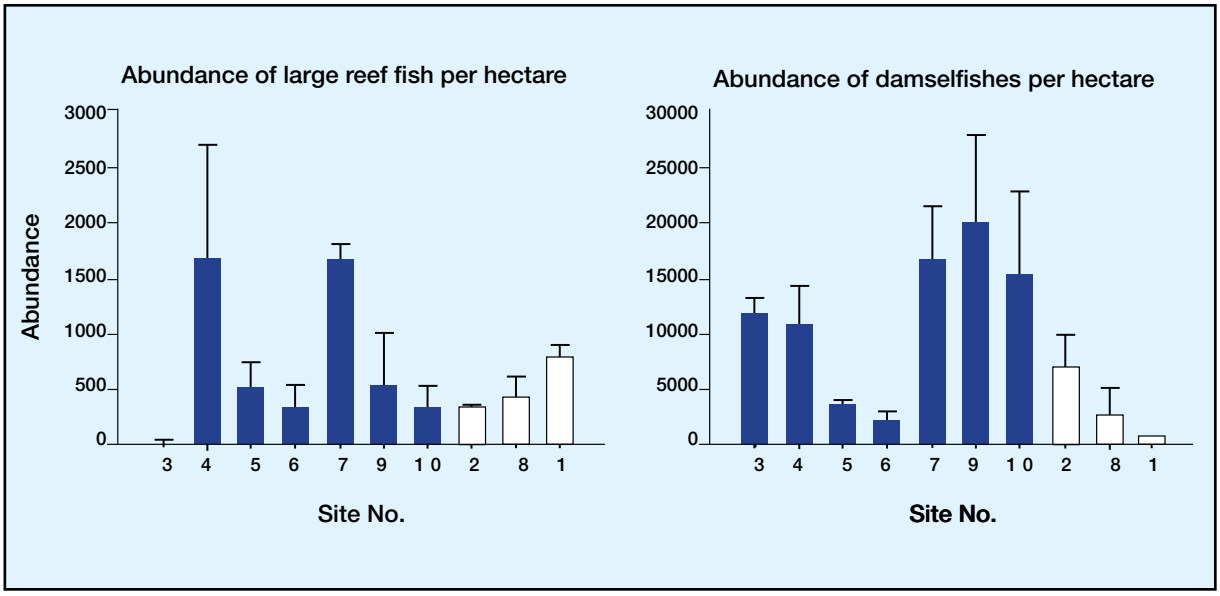
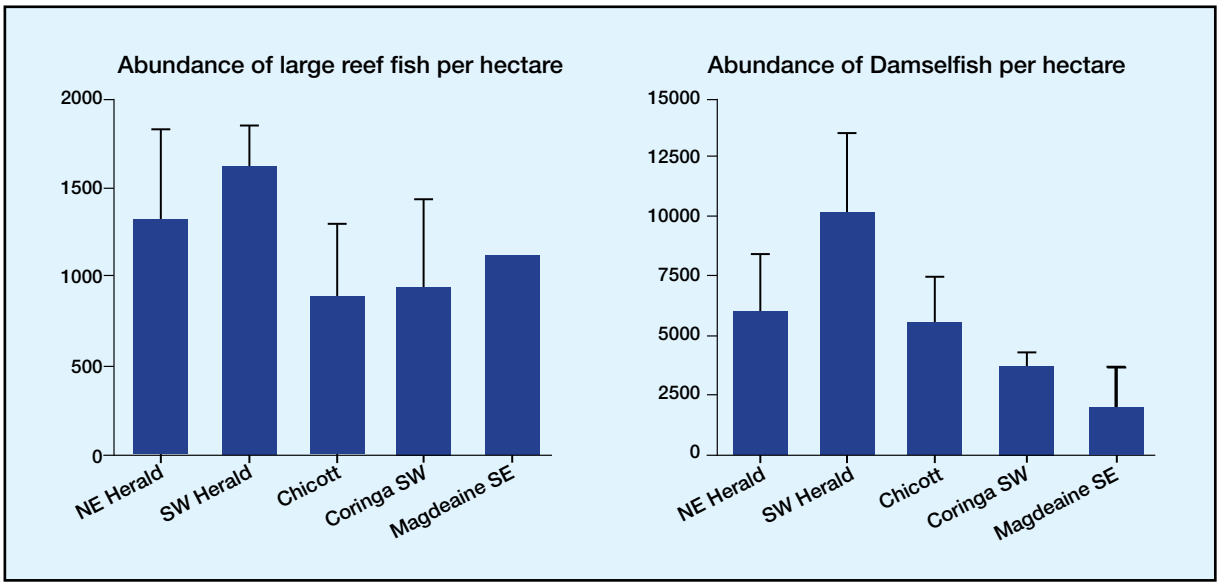


Figure 7. Fish abundance per hectare compared between reefs within the Coringa-Herald Reserve. Error bars indicate Standard Errors (Oxley et al, 2003).



Main conclusions from AIMS surveys

- The structure of reef fish assemblages on Coringa-Herald Reserve, Lihou Reef Reserve and Elizabeth-Middleton reefs are unique from those observed anywhere on the Great Barrier Reef, even taking into account the likely disturbance effects of coral bleaching and cyclones.

- Many species common to the Coral Sea are rare or absent from the Great Barrier Reef, (e.g. Chrysiptera taupou and Pomacentrus imitator). Conversely, species that are abundant or common on the Great Barrier Reef are absent or rare on reefs of the Lihou Reef Reserve (e.g. Pomacentrus lepidogenys and Pomacentrus philippinus).

- As currents flow predominantly east to west through the Coral Sea, it is unlikely that fish larvae from the Great Barrier Reef would be able to settle in the Coral Sea.
- Coral Sea reefs separated by only small distances have significantly different fish and coral community structures.

- High numbers of Galapagos sharks (Carcharhinus galapagensis) were observed at Elizabeth Reef, especially in the lagoon. Their size suggests the reef lagoon is an important nursery area for Galapagos sharks. The presence and behaviour of these sharks in the reserve is very significant as this species is unlikely to be present at other Australian-governed reef systems (excluding Lord Howe Island). Their presence has been reported in previous studies at Elizabeth Reef dating back to the 1920's (Whitley 1937). On the Great Barrier Reef, similar numbers of grey reef whaler sharks were seen 15-20 years ago (a personal observation), but have since declined in most locations. It is likely that the inquisitive Galapagos sharks are easy prey for fishermen and although there is little available information on the use of this shark as a food source, it is reputed to have potential for for human consumption (from Florida Museum of Natural History, Ichthyology (www.flmnh.ufl.edu).

- The reefs of the Lihou Reef National Nature Reserve and Coringa-Herald National Nature Reserve are under significant pressure, especially from the effects of coral bleaching and cyclones.

Key points

- The fish and coral communities of Coral Sea reefs, Coringa-Herald Reserve, Lihou Reef Reserve and Elizabeth-Middleton Reefs are characterised by isolation from recruitment sources and a high disturbance regime.

- Recent studies indicate that genetic exchange between isolated coral reef populations is much lower than previously thought (Ayre and Hughes 2004), and suggests natural rates of re-colonisation of lost species from other reef systems may be very slow.

- The dramatic changes in abundance of some species over the 20 years between the current survey and surveys by Ayling in 1984 may point to high variability in recruitment from local populations as well. While this isolation has resulted in the unique nature of the communities observed, it also adds to the vulnerability of populations to both natural and human impacts such as rapid climate change.

Survey recommendations for protection

Given the nature of Elizabeth Reef and presumably also Middleton Reef, there are three compelling reasons why high levels of protection should be afforded to the fish and coral communities of both reefs:

1. Population replenishment from other reef systems is likely to be unreliable and inconsistent, therefore the stability of the ecosystem may be reliant on the longer term presence of resident species.
2. Although there is no information on self-recruitment, it is possible that a substantial proportion of post-larval recruits may have been spawned from local breeding populations. Adopting the precautionary principle, it is wise to assume that self recruitment is important at these isolated reefs.
3. Recent research has concluded that low diversity locations are vulnerable to losing whole families or functional coral groups by chance alone and that this has 'the potential to severely compromise ecosystem function, resilience and stability' (Bellwood and Hughes 2001). Clearly, any activities that increase the chance of community disturbance should be avoided.

The Undersea Explorer Surveys

The Undersea Explorer is a vessel that conducts scientific surveys in the Coral Sea, with a focus on Osprey Reef, and also takes paying customers who assist science efforts. Whilst aboard, surveys and daily logs are kept that constitute a long term survey of the more notable species in the Coral Sea and which show consistently high numbers of species which are threatened and/or vulnerable in most other reef areas of the world. For this study, records were accessed from periods ranging from 4 years to 10 years and which demonstrated stable populations of some of the most iconic species associated with coral reefs. It must be emphasised that this data does not constitute an exhaustive survey of the Osprey Reef marine fauna, but does provides evidence of an almost pristine oceanic reef community, which is increasingly rare in today's oceans. The fact that dive tourism has been conducted over two decades at this reef is evidence of the sustainable nature of these activities. Fishing, while permitted at Osprey Reef, has been extremely limited and is now restricted by a Memorandum of Understanding between tourism operators and the permitted fishers.

Whitetip reef sharks – Triaenodon obesus

The records of whitetip reef shark (WTRS) observations highlight the continued strong populations of this species at Osprey Reef in comparison to the northern Great Barrier Reef reefs as detailed below (Table 2). Far northern reefs, although low in survey numbers, still showed stronger shark numbers.

Of the 54 sightings of 10+ WTRSs, only two were not recorded at Osprey Reef. Both of these observations were from Bouganville and Shark Reefs also in the Coral Sea. Five WTRS or more were recorded 248 times, 14 times in the Great Barrier Reef area, and the remaining in the Coral Sea. These 14 records include two at Raine Island and one at Wishbone Reef, both in the Far Northern zone. The remaining eleven observations were made on the Ribbon Reefs and include five at Ribbon Reef #10.

The percentage of zero sightings for Great Barrier Reef reefs highlights the paucity of this species in the area.

Table 2: Whitetip reef shark sighting data from Osprey Reef and the Great Barrier Reef (GBR)

	Osprey Reef	Northern GBR reefs	Far North GBR
Number of dive surveys	493	642	15
Average no. T.obesus per dive	4.85	1.02	2.33
Max number T.obesus per dive	30	8	6
% zero sightings	3.1	37.1	20.0

Grey Reef Whaler - Carcharhinus amblyrhynchos

The records of grey reef whaler observations mirrored the data for WTRS populations at Osprey Reef when compared to the northern and far northern Great Barrier Reef. Of the 130 sightings of 10+ GRWs only two were not recorded at Osprey Reef. Five GRWs or more were recorded 207 times, of these only twice in the northern Great Barrier Reef and three times in the far north Great Barrier Reef. The very high number of zero sightings in the northern Great Barrier Reef area is indicative of the low numbers of GRWs in this area.

Table 3: Grey reef whaler sighting data from Osprey Reef and the Great Barrier Reef (GBR)

	Osprey Reef	Northern GBR reefs	Far North GBR
Number of dive surveys	398	437	21
Average no. C.amblyrhyncos per dive	6.93	0.29	2.19
Max number C.amblyrhyncos per dive	31	30	10
% zero sightings	16.1	84.9	33.3

Scalloped hammerhead - Sphyrna lewini

Of the 45 sightings of scalloped hammerhead, only three occurred elsewhere than at Osprey Reef. These corresponded to single individuals sighted at Agincourt Reef, Ribbon Reef #10 in the northern GBR and Mantis Reef in the far northern Great Barrier Reef.

More than two individuals were sighted only six times. Two or more were seen 13 times. All the observations of multiple individuals took place at Osprey Reef. A school of 25 individuals were seen in mid-September 2002 and a school of 60 sharks one month later. Observations prior to and subsequent to this data have recorded schools of up to 100 scalloped hammerheads on four occasions and numerous sightings of schools of more than five individuals.

Table 4: Scalloped hammerhead shark sighting data from Osprey Reef and the Great Barrier Reef (GBR)

	Osprey Reef	Northern GBR reefs	Far North GBR
Number of dive surveys	245	425	16
Average no. S.lewini per dive	0.63	0.005	0.06
Max number S.lewini per dive	60	1	1
% zero sightings	82.9	99.5	94

Maori wrasse - Chelinus undulatus

Osprey Reef hosts the largest and most repeated aggregations of maori wrasse. This has been observed at two main reef point sites where spawning behaviour and actual spawning observations were recorded. Over 273 records, sightings of up to twenty individuals were recorded in North Horn and Rapid Horn. No more than six individuals have ever been seen on other reefs.

The maximum number seen was recorded at Osprey Reef during a spawning aggregation of twenty-one females and four males. Of the 527 dive observations in the northern Great Barrier Reef, there were only two records of 5+ maori wrasse seen at one time (0.4%). Osprey Reef recorded five or more individuals on twenty-one occasions (7.6%) while the far northern reefs had five or more individuals sighted on one occasion (4.8%).

Table 5: Maori wrasse sighting data from Osprey Reef and the Great Barrier Reef (GBR)

	Osprey Reef	Northern GBR reefs	Far Nth GBR
Number of dive surveys	275	527	21
Average no. C.undulatus per dive	1.66	0.69	1.24
Max no. C.undulatus per dive	25	1	1
% zero sightings	45	49	38

Table 6: General Undersea Explorer nature diary logbook sighting records – 1995-2006 – Osprey Reef

Common name	Sighting frequency	No. individuals
Silvertip shark	>100	1 - 10
Great hammerhead	>10	1
Small eyed thresher shark	10	1
Tawny nurse shark	>20	1-4
Whale shark	4	1
Tiger shark	4	1
Silky shark	>20	15+
Manta ray	>100	1-8
Loggerhead turtle	>10	1-2
Bumphead parrotfish	>100	50-100
Queensland groper	5	1
Potato cod	>100	2-3
Chevron barracuda	>100	50 - 1000+
Bigeye trevally	>100	100 - 500
Giant trevally	>100	10 - 40
Dogtooth tuna	>100	1 - 25
Yellowfin tuna	>20	100 - 1000
Wahoo	>20	1 - 3
Oceanic coral trout	>100	1 - 10
Green jobfish	>20	1 - 40
Sailfish	7	1
Black marlin	6	1
Killer whale	1	10+
Sperm whale	4	10+

Manta rays – Manta birostris – numerous sightings around Osprey Reef with increasingly consistent sightings at Entrance Point as more knowledge of movement patterns is gained. At certain tide phases there are commonly 1-6 mantas present at a major cleaner station.

Bumphead parrotfish - Bolbometapon muricatum – numerous sightings of 50-100 schooling individuals at North Horn, Osprey Reef. These are commonly seen aggregated on the reef shallows and moving off to the reef wall. During the early morning they can be observed aggregating closely in a shallow cave in the reef wall.

O'Shea cleaner station survey at Osprey Reef and Northern Great Barrier Reef

Over a seven week period, (nested within three months), 97 elasmobranchs were observed as clients of a cleaner station at Osprey Reef. The manta ray Manta birostris accounted for 45% of these clients, while sharks belonging to the Carcharhinidae and Sphyrnidae made up the remaining 55%. The dominant species of Carcharhinid was the grey reef whaler, Carcharhinus amblyrhynchos, which accounted for 71% of observations. Silvertip whalers, Carcharhinus albimarginatus, made up 23% and Triaenodon obesus, whitetip reef sharks, accounted for 4% of the total. There was only one species and one individual of Sphyrnid which was the scalloped hammerhead, Sphyrna lewini, making up the final 2%.

In total, 41 manta rays were observed and 19 individuals recorded through the identification of ventral skin pigmentation. (O'Shea, 2007)

Conclusion

This report shows the distinctly different nature of coral reef communities throughout the Coral Sea from those in the adjacent Great Barrier Reef Marine Park. They range from large reefs with low coral cover; to large shallow plateau reefs with vegetated sand cays, nesting bird and turtle populations but less rich underwater coral and fish life; to the permanently submerged reefs, both expansive and 'pinnacle-like', with abundant and diverse coral, fish and shark populations. They range from semi-tropical Elizabeth–Middleton reefs to the low latitude Boot and Ashmore Reefs adjoining Papua New Guinea waters.

While many of the species of the Coral Sea reefs are widely distributed throughout the Asia Pacific and even world oceans, many are in serious decline throughout most other areas. Many of the species are also genetically endemic to their isolated reef locations even though the general species is widely distributed. The debate on definition of speciation and the planet's genetic pool of diversity is still underway. A cautious approach is required to ensure population genetics and diversity are not undermined at this early stage of knowledge. (Bellwood and Hughes, 2001, Leis, 1994)

Many of the coral reefs' iconic species which are threatened or vulnerable are found in healthy numbers in the Coral Sea. These include stable shark stocks of whitetip, grey reef, silvertip and hammerhead sharks. Other species also in low numbers world-wide also have a current refuge in Coral Sea reefs and include maori wrasse, humphead parrotfish, potato cod, coral trout, manta rays and most of the world's endangered turtle species. Other species which have been documented as being in decline in most other reef areas include holothurians, clams, nautilus and crayfish. It would seem that populations of these species are also healthy. The vast majority of fish and invertebrate species has limited or no population assessment data and no knowledge of their status on reefs worldwide. Due to the relatively pristine nature of Coral Sea reefs it is probable that the community structure of these reefs is relatively intact.

The current and potential threats to the Coral Sea reefs include reef targeted fishing by line, trap and hand collection. It also includes long line fishing in open-ocean and near reef areas of the Coral Sea. There are also significant commercial and recreational impacts on fish populations through game fishing and spear fishing activities. It has been shown that a short targeted effort of fishing on the limited populations of sharks and resident fish such as maori wrasse can have devastating long term loss of these species. This is especially true in isolated reef locations where populations are genetically endemic and recolonisation from distant sources unlikely. Tourism may also be a threat to Coral Sea reefs unless it is managed sustainably. At present there is a set of self imposed guidelines for operators and long term studies, including Reef Check programs, which are able to monitor the impact of these activities.

The 2004 Status of Coral Reefs of the World Report highlights the plight of coral reefs and details the drastic decline in fish, shark, clam, holothurians and other key coral reef groups throughout the world. While applauding the contribution Marine Protected Areas (MPAs) can make to reef recovery, the report highlights the lack of capacity of many countries to both implement and enforce MPAs. Australia has a unique opportunity and a world responsibility to ensure oceanic reefs within its jurisdiction are given the protection they deserve. This may also give many vulnerable species at least one stronghold for viable populations.

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Appendices

Appendix 1: Undersea Explorer target species list

General Group	Species
Whales	Minke
Dolphins	
Sharks	Whitetip reef shark
	Grey reef whaler
	Silvertip whaler
	Scalloped hammerhead
Other	
Rays	Bluespot
	Manta
	Mobula
Sea turtles	Green
	Hawksbill
Sea snakes	
Nudibranchs	Notodoris minor
Maori Wrasse	
Coral Trout	
Potato Cod	
Other Cod	
Titan Triggerfish	
Moray Eels	
Mackeral	
Trevally	Giant trevally
	Bigeye trevally
	Bluefin trevally
Cuttlefish	
Octopus	
Barracuda	Chevron barracuda
	Great barracuda
	Yellowtail barracuda
Red Bass	
Crown of thorns starfish	

Appendix II

Threatened and endangered species and population levels

The IUCN Red List of Threatened Species provides the best assessment of the status of individual species (www.iucnredlist.org). The Coral Sea reefs host viable populations of the following species which are seriously threatened in many other coral reef locations. The presence and abundance data from the Coral Sea is presented previously in this results section. The status of many of the groups and species are reported in the Status of Coral Reefs of the World reports (AIMS) and in greater detail in the referenced publications.

This is by no means an exhaustive list and is skewed to the more commercial, charismatic and larger marine fauna. Smaller species of no commercial value or special interest have in general had minimal study efforts. Impacts on the benthic environment, in particular coral cover and diversity can adversely affect the populations of species which are not commercial target species. Fisheries and a change in fish community structure can also adversely affect non-target species.

Galapagos shark - Carcharhinus galapagensis

– Near Threatened

Carcharhinus galapagensis has a widespread, but patchy distribution, occurring at many widely separated island and some coastal sites in the Pacific, Atlantic and Indian Oceans. Populations at many of these sites may be subject to high levels of fishing pressure (tuna longline fisheries, targeted drop-line fishing, recreational/tourism-based angling). Evidence of severe reductions/extirpations exists for this species around Central America (Pacific and Atlantic Oceans). As the species has a limited intrinsic rebound potential, and there is no data on recruitment to isolated sites, such local depletions could lead to loss of populations at specific localities. Continued fishing pressures throughout its range will result in further declines and populations require monitoring (Bennett et al, 2003). The species is classified as Data Deficient in Australia and Oceania.

Grey reef shark - Carcharhinus amblyrhynchos

– Lower Risk Near Threatened

This widespread social species was formerly common in clear tropical coastal waters and oceanic atolls. Its restricted habitat choice, site fidelity, inshore distribution, small litter size, relatively late age at maturity and increasing unmanaged fishing pressure suggests that this species may be under threat. More fisheries data is required. Although caught in tropical multi-species fisheries, it has considerably greater value if protected for dive tourism (Smale, 2000).

Whitetip reef shark - Triaenodon obesus

– Lower Risk Near Threatened

This small shark is widely distributed in warm shallow Indo-Pacific waters and is closely associated with coral reefs. Its restricted habitat, depth range, small litter size and moderately late age at maturity suggest that, with increasing fishing pressure, this species may become threatened (Smale, 2000).

Whale shark - Rhincodon typus

– Vulnerable

Catches have declined and populations have apparently been depleted by harpoon fisheries in several countries targeting localised concentrations of this huge, slow-moving and behaviourally-vulnerable species and there is incidental capture in other fisheries. Directed fisheries, high value in international trade, a K-selected life history, highly migratory nature, and low abundance make this species vulnerable to exploitation (Norman, 2000).

Thresher shark - Alopias vulpinus

– Data Deficient

This widely distributed continental shelf species is an important economic species in many areas, and has been taken in large numbers as a targeted species and landed bycatch. The California drift gill net fishery provided strong evidence that A. vulpinus is highly vulnerable to overfishing in a short period of time, with the sub-population having an estimated reduction of over 50% over

three generations. A lack of fisheries data from other locations, incomplete knowledge of stock structures, and uncertainty over life history parameters makes it impossible to determine population size or fluctuations elsewhere. Nonetheless, the high value of the species and its exploitation by unmanaged fisheries, combined with its biological vulnerability, indicates that at least some, if not most, subpopulations in other parts of the world are likely to be equally or more seriously at risk than that in California and, unlike the Californian stock, are not the subject of management enabling the population to rebuild (Goldman et al, 2007).

Silky shark - Carcharhinus falciformis
– Lower Risk Least Concern
This common, large, semi-pelagic coastal and oceanic shark of continental shelf and slope waters is discontinuously distributed in all tropical ocean basins. This species of shark is caught in large numbers as bycatch in oceanic fisheries, but is often unreported or misidentified, and landed for meat and fins by multi-species shark fisheries. Its reproductive capacity is limited (annual rate of population increase is estimated as 4%). Despite a lack of population size estimates, observations of trends, or indices of abundance for any stock (studies of fisheries impacts are a high priority), the silky shark is considered to be susceptible to over-exploitation by analogy in comparison to better known carcharhinids (Bonfil, 2000).

Oceanic whitetip shark - Carcharhinus longimanus
– Vulnerable
This formerly widespread and abundant large oceanic shark is subject to fishing pressure virtually throughout its range. It is caught in large numbers as a bycatch in pelagic fisheries, with pelagic longlines, probably pelagic gillnets, handlines and occasionally pelagic and even bottom trawls. Its large fins are highly prized in international trade although the carcass is often discarded. Fishery pressure is likely to persist if not increase in future. Outside of the areas detailed below, this species is under similar fishing pressure from multiple pelagic fisheries, there is no data to suggest that declines would and have not have also occurred in these areas, given there are similar fisheries throughout the range.

The oceanic whitetip shark is assessed as Critically Endangered in the north-west and western central Atlantic because of the enormous declines that have been reported. Declines of 70% over 8 years in the north-west and western central Atlantic regions and 99.3% over a forty year time period in the Gulf of Mexico highlight this species' vulnerability (Baum et al, 2006).

Scalloped hammerhead - Sphyrna lewini
– Lower Risk Near Threatened
This large hammerhead is widely distributed and common in warm temperate and tropical seas, occurring from the shore and surface over continental and insular shelves to adjacent deep water. Pups occupy shallow coastal nursery grounds, often heavily exploited by inshore fisheries. This widely distributed species is extremely commonly taken in fisheries, both as a target species and as utilised bycatch (fins are highly valued). Lack of data on population trends makes it difficult to assess whether the high level of catches of this species at all life stages is having an effect on stocks, but some declines are reported (Kotas, 2000).

Great hammerhead - Sphyrna mokarran
– Endangered
A large, widely distributed, tropical hammerhead shark, largely restricted to continental shelves. Sphyrna mokarran is highly valued for its fins (in target and incidental fisheries), suffers very high bycatch mortality and only reproduces once every two years, making it vulnerable to over-exploitation and population depletion. It is generally regarded as solitary, and is therefore unlikely to be abundant wherever it occurs. Previously observed from Mauritania to Angola, the absence of recent records give cause to suspect a decline of at least 80% in the past 25 years. Endangered in the north-west Atlantic and Gulf of Mexico, based on a suspected decline of at least >50% over the past 10 years. In the south-west Indian Ocean this species is assessed as Endangered based on a continued decline in catch rate of 79% reported for the period 1978 to 2003. A large increase in the

illegal, unregulated and unreported (IUU) fishing in northern Australia in the last few years points to great concern that this species is being increasingly targeted for its valuable large fins. Recent risk assessments of northern Australian elasmobranchs indicate that it may be at high-risk however, due to a lack of data to form the basis of an accurate assessment, the species is considered Data Deficient in Australia at the present time. Further investigation of its status there is required. Given its vulnerability to depletion, low survival at capture and high value for the fin trade this species is considered to meet the Globally Endangered criteria based on the available evidence for declines of >50%. There is an urgent need for data collection in other parts of its range, but considering the high value of its fins and high fishing pressure in other parts of its range, similar declines are likely to have occurred elsewhere (Denham et al, 2007).

Tassled wobbegong - Eucrossorhinus dasypogon
– Near Threatened

This species is possibly a common reef wobbegong with a wide distribution across northern Australia, Indonesia and Papua New Guinea. In Australia, there are no targeted fisheries and it does not appear in commercial shark or trawl fisheries. A considerable section of its habitat is protected in the Great Barrier Reef Marine Park. However, throughout the rest of its range this species is threatened by extensive coral reef habitat destruction (pollution and dynamite fishing), as well as expanding fisheries. This wobbegong is assessed as Near Threatened due to suspected significant population declines having occurred and predicted to continue within a large proportion of its range (Pillans, 2003).

Tiger shark - Galeocerdo cuvier
– Lower Risk Near Threatened

This large omnivorous shark is common world-wide in tropical and warm-temperate coastal waters. It is a relatively fast growing and fecund species, and caught regularly in target and non-target fisheries. There is evidence of declines for several populations where they have been heavily fished. Continued demand, especially for the valuable fins, may result in further declines in the future, but this species can withstand a higher level of fishing activity than many other species of shark. Additionally, juvenile survivorship increases where adult tiger shark populations have been depleted by fisheries and predation of young is lessened (Simpfendorfer, 2000).

Longfin mako - Isurus paucus
– Vulnerable

The longfin mako Isurus paucus is a widely distributed but rarely encountered oceanic tropical shark. This species is known to be caught as bycatch in tropical pelagic longline fisheries for tuna, swordfish and sharks and in other oceanic fisheries, which operate throughout its range. Since longfin makos are often caught in the same fishing gear as the shortfin mako which has significant population declines, populations are considered also likely to have declined. In addition to the inferred declines, this is a species of conservation concern due to its apparent rarity, large maximum size (>4 m), low fecundity (2 to 8 pups/litter) and continued bycatch in intensive oceanic fisheries (Reardon et al, 2006).

Tawny nurse shark - Nebrius ferrugineus
– Vulnerable

A widely distributed continental and insular shelf species of the Indian, west and central Pacific Oceans. Restricted to a narrow band of shallow water habitat (5 to 30m, occasionally to 70m) that is heavily fished throughout all its range except Australia. Taken in inshore fisheries (demersal trawls, floating and fixed bottom gill nets and baited hooks) in Indonesia, Thailand, Philippines, Pakistan and India. Although there are limited data on population declines in these areas, reports of local extinctions in India and Thailand, combined with its narrow habitat range, apparently limited dispersion and low fecundity, indicate that the species is highly susceptible to local inshore fisheries and has declined in a large proportion of its range. Within Australia it is assessed as Least Concern because it is widely distributed and abundant, captured only in very small numbers in gill nets and beach meshing (Pillans, 2003).

Manta ray - Manta birostris

– Near Threatened

Manta birostris is widely distributed in tropical and semi-tropical shelf waters, around oceanic islands and other areas of upwelling, such as seamounts. Population declines have been observed in the Philippines, Mexico, Sri Lanka/India, and Indonesia. Although catch data are not available in many of the areas where manta rays are fished, small population size and limited migration increases the risk of local extinction with limited potential for populations to re-establish themselves.

The existence of anthropogenic pressures (e.g. direct/indirect fisheries, pollution, and exploitation of coastal environments) in areas supporting critical habitats like breeding, birthing, and nursery grounds (e.g. Mozambique, Bora Bora, French Polynesia) is yet another threat to populations which congregate in mass numbers in these areas or use them as refuges for their young. Increased densities of individuals during certain seasons, combined with their ease of capture and the lack of regulated fishing management, may result in unsustainable fishing pressure during these times.

Some populations of mantas, like those in the Hawaiian Islands and the Island of Yap have a closed population structure, with high site fidelity and little to no migration away from island groups. Other studies on populations with year-round sightings and high re-sighting rates reveal that a portion of the population is resident while a subset of the population appears to engage in larger migrations. In a few sites, mantas have been well documented to be seasonal. Because different populations show differences in movement habits and site fidelity, management for this species needs to be site specific (Marshall et al, 2006).

Maori wrasse - Cheilinus undulatus

– Endangered

The humphead wrasse is widely distributed but is nowhere common, naturally. Densities rarely exceed 20 fish per hectare in the preferred habitats of outer reefs; more typically not more than 10. Wherever it is fished, even if only moderately, density quickly declines to 25% or less of peak densities recorded at no fishing. It appears to be extirpated from several edges of a range of locations. It is particularly heavily exploited (e.g. high levels of fishing pressure) at the centre of its range in southeastern Asia where its coral reef habitat is most abundant, and particularly in key supply countries for the live reef fish trade, Malaysia and Indonesia, and out of Palawan, its stronghold in the Philippines. In these countries all available fishery-dependent and trade-related data suggest declines over 10–15 years in exploited areas of 10–fold or more with fish now considered rare in areas where once it was common. Some spawning aggregations have been noted to decline or have disappeared in eastern Malaysia and Australia. It is severely reduced anywhere that it is fished unless a) it is effectively managed, b) there is no export trade or night spearfishing, and c) it is not included in marine protected areas. It only remains abundant where protected or not fished at all, however protective legislation in most places appears to be ineffective due to illegal fishing (Russell, 2004).

Bumphead parrotfish - Bolbometopon muricatum

– Vulnerable

B. muricatum was common or abundant throughout much of its range historically. This species is now considered rare globally, with local densities negatively correlated with fishing pressure across six Indo-Pacific locations, and with suspected local extinctions at some localities. Underwater surveys across its range in suitable habitats, even at remote localities, have either failed to detect this species or have detected only rare individuals. Otherwise, it is abundant only on the Great Barrier Reef and at Rowley Shoals in northwestern Australia. Juvenile B. muricatum appear to be very rare in the Great Barrier Reef, Australia (Bellwood and Choat 1989) but adults achieve their highest abundance on the Great Barrier Reef (mean = 31 fish per hectare) over the recorded range of this species (J.H. Choat pers. comm). Based on rapid visual census from a series of transects of 50x5m at depth of 12m on individual reefs at Coringa-Herald National Nature Reserve (located east of Cairns, Australia), the abundance of B. muricatum was estimated to range from 1 to 25 fish in northeast and southwest Herald (Oxley et al. 2003).

Elsewhere, it is relatively abundant in the Solomon Islands, Papua New Guinea, and a few other oceanic islands, and is common locally at Samoa, Sipidan Island (Malaysia), Wake Island, the Red Sea and New Caledonia. At other locations, it is now uncommon or rare, and is virtually extinct in Guam, Marshall Islands, parts of Fiji and East Africa, and is declining rapidly in Palau. This species is naturally rare in some parts of its range (e.g. Christmas Island, Amirantes and Farqhuar Atoll, Seychelles, and elsewhere in the Indian Ocean), a fact which cannot be attributed to over-fishing. B. muricatum was rare around most the US Pacific Islands and was seen typically only at one or two islands of a region (Chan et al, 2007).

Coral trout - Plectropomus leopardus

– Near Threatened

The leopard coral grouper is declining on the Great Barrier Reef, Australia (Ayling et al. 2000), and this problem is further aggravated by the increasing harvest in that country. Due to the declining trend of populations in different countries, the fish may be classified as Near Threatened and with more data may need to be reclassified as Vulnerable under criterion A2d (Cornish and Kiwi, 2004).

Blacksaddled coral grouper - Plectropomus laevis

– Vulnerable

Although this species is widespread, it is listed as Vulnerable (VU) because of its natural rarity, the heavy fishing pressure being experienced throughout its range, particularly the targeting of juveniles, and because it has shown declines in abundance of at least 30% (mature individuals) over the past 30 years (three generations). This trend is expected to continue into the future (Choat et al, 2007).

Brown marbled grouper - Epinephelus fuscoguttatus

– Near Threatened

Epinephalus fuscoguttatus is inherently vulnerable to fishing and heavily sought for the live reef food fish trade. More information is needed to understand stock status (Cornish, 2004).

Green turtle - Chelonia mydas

– Endangered

Analysis of historic and recent published accounts indicate extensive sub-population declines in all major ocean basins over the last three generations as a result of over exploitation of eggs and adult females at nesting beaches, juveniles and adults in foraging areas, and to a lesser extent, incidental mortality relating to marine fisheries and degradation of marine and nesting habitats.

Green turtles exhibit particularly slow growth rates, and age to maturity for the species appears to be the longest of any sea turtle. Estimates of reproductive longevity range from 17 years to 23 years. Based on the actual and extrapolated changes in subpopulation size at the 32 Index Sites, it is apparent that the mean annual number of nesting females has declined by 48% to 67% over the last three generations. Because many of the threats that have led to these declines are not reversible and have not yet ceased, it is evident that green turtles face a measurable risk of extinction (Seminoff, 2004).

Leatherback turtle - Dermochelys coriacea

– Critically Endangered

Decline in nesting has been documented to be much greater than 80% in most of the populations of the Pacific, which has been considered the species' major stronghold. In other areas of its range, the observed declines are not as severe, with some populations showing trends towards increasing or stable nesting activity. Analysis of published estimates of global population sizes (Pritchard 1982, Spotila et al. 1996), suggest a reduction of over 70% for the global population of adult females in less than one generation. The populations in the Pacific Ocean, the species' stronghold until recently, have declined drastically in the last decade, with current annual nesting female mortalities estimated at around 30% (Sarti et. al. 1996, Spotila et al. 2000). In some areas, formerly abundant rookeries have almost disappeared (Sarti, 2000).

Killer whale - Orcinus orca

– Lower Risk Conservation Dependent

Extract from Reeves et al. (2003, pp. 43): "The Killer Whale has a cosmopolitan distribution, but there is much geographical variation in its morphology, behavior, and ecology" (Dahlheim and Heyning 1999). Further research may justify recognition of more than one species (Rice 1998, Baird 2000). Although killer whales are fairly abundant and widespread on a global scale, regional populations can be small and highly specialised, and therefore vulnerable to over-exploitation and habitat deterioration. Another well-established and growing concern is depredation by killer whales (and other species such as false killer whales and sperm whales) on commercial longlines. Such interactions result in direct retaliation by fishermen and calls for organised control measures (Cetacean Specialist Group, 1996).

Sperm whale - Physeter macrocephalus

– Vulnerable

As a species, the Sperm Whale is not immediately threatened, but some regional populations require close evaluation and monitoring. For example, in the Mediterranean Sea, deaths from ship strikes and entanglement occur relatively frequently, and in the eastern tropical Pacific the most recent phase of whaling was particularly intensive and current birth rates are low (Cetacean Specialist Group, 1996).