

Ecological assessment of the Queensland Marine Aquarium Fish Fishery

A report to the Australian Government Department of Environment and Heritage on the ecologically sustainable management of the Queensland marine aquarium harvest fishery



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August 2005

EXECUTIVE SUMMARY

In 1992, Australian Commonwealth, State, Territory and local governments committed to an ecologically sustainable development (ESD) approach to the use of natural resources (COAG 1992). Fisheries resources were (see Green et al. 1991) and still are (see Fletcher et al. 2003) considered to be one of many specific natural resource foci that fall squarely under the ESD umbrella. Queensland's commitment to managing fishery resources under ESD principles is embedded in the *Fisheries Act 1994*:

- 1) The main purpose of the Act is to provide for the use, conservation and enhancement of the community's fisheries resources and fish habitats in a way that seeks to -
 - a) apply and balance the principles of ecologically sustainable development; and
 - b) promote ecologically sustainable development.
- 2) In balancing the principles, each principle is to be given the relative emphasis appropriate in the circumstances.

To prompt continued progress towards ESD, the Commonwealth Government introduced the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act 1999)* and the *Environment Protection and Biodiversity Conservation Amendment (Wildlife Protection Act) Act 2001*. Following these legislative changes, in order for harvested fish species to remain exempt from export controls fisheries management agencies must demonstrate (through ecological assessment submissions) that their fishery management regimes comply with the objectives of ecologically sustainable development. The Australian Government Department of the Environment and Heritage (DEH) is the Commonwealth Government department currently auditing the fishery management agency submissions (unless states have in place accredited alternative audit processes). All submissions must be based on and satisfy the Australian Governments 'Guidelines for the Ecologically Sustainable Management of Fisheries', which are publicly available at <http://www.deh.gov.au/coasts/fisheries/assessment/guidelines.html>. The guidelines cover a number of individual objectives broadly relating to impacts to target species; bycatch and byproduct species; endangered, threatened and protected (ETP) species; ecologically threatened communities; and the marine ecosystem generally.

This document represents the Queensland Government's ecological assessment submission to DEH for the Queensland Marine Aquarium Fish Fishery (referred to throughout as the MAFF). The Department of Primary Industries and Fisheries (DPI&F), has prepared this ecological assessment with the assistance of stakeholders in the fishery. Broadly, the document comprises two parts:

- 1) Fishery Description - providing a detailed description of the MAFF; and
- 2) Ecological Assessment - detailing the assessment of the MAFF against DEH's Guidelines.

The document is divided into sections based on these guidelines, preceded by an introductory description of the fishery. More detailed descriptions of various aspects of the fishery are presented in the Appendices.

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ACRONYMS AND ABBREVIATIONS

AIMS	Australian Institute of Marine Science
AMCS	Australian Marine Conservation Society
CFISH	Commercial Fisheries Information System
CRFFF	Coral Reef Fin Fish Fishery
DPI&F	Queensland Department of Primary Industries and Fisheries
GBRMP	Great Barrier Reef Marine Park
GBRMPA	Great Barrier Reef Marine Park Authority
GBRWHA	Great Barrier Reef World Heritage Area
LTMP	Long Term Monitoring Program.
MAC	Management Advisory Committee
MAFF	Marine Aquarium Fish Fishery
NRIFS	National Recreational and Indigenous Fishing Survey
OCS	Offshore Constitutional Settlement
QBFP	Queensland Boating and Fisheries Patrol (part of DPI&F)
QDEH	Queensland Department of Environment and Heritage
QFMA	Queensland Fisheries Management Authority (now part of DPI&F)
RAP	Representative Areas Program
RFISH	Recreational Fishing Information System
REEF CRC	Cooperative Reef Research Centre for the Ecologically Sustainable Development of the Great Barrier Reef World Heritage Area.
ReefMAC	Reef Line Fisheries Management Advisory Committee
SCUBA	Self contained underwater breathing apparatus
SOCI Logbook	Species of conservation interest logbook
WWF	World Wide Fund for Nature

DOCUMENT DESCRIPTION

This document should be read in conjunction with relevant Queensland fisheries legislation in order that all management arrangements applied to the fishery are fully considered.

Relevant legislation

Specific mention of the following terms: '*Fisheries Act*' and '*Regulations*', make reference to the following respective Queensland Government legislation:

Fisheries Act 1994

Fisheries Regulation 1995

The Queensland Government Legislative documents mentioned above can be accessed via: www.legislation.qld.gov.au/Legislation.htm

Discussion Paper

Mention of the Marine Aquarium Fish and Coral Collecting Discussion Paper (1999) makes reference to the following respective Queensland Government document:

Queensland Fisheries Management Authority Queensland Marine Aquarium Fish and Coral Collecting Fisheries discussion paper No. 10. July 1999.

This document is only available in hard copy and can be found at various DPI&F library locations.

Management Plan

In this assessment, mention of the *Fisheries (Coral Reef Fin Fish) Management Plan 2003* makes reference to the Queensland Government legislative document that can be accessed via:

www.legislation.qld.gov.au/Legislation.htm

QUEENSLAND GOVERNEMENT LEGISLATION AND MANAGEMENT

The Department of Primary Industries and Fisheries (DPI&F) manages the Queensland Marine Aquarium Fish Fishery (MAFF) under the *Fisheries Act 1994 and Regulations*. The objectives of the Act were amended in September 2002 to more accurately reflect current interpretations of the ESD principles adopted by Queensland and all Australian governments in the *National Strategy for ESD* (COAG, 1992). The listed objectives of the Act are outlined below.

1. *The main purpose of the Act is to provide for the use, conservation and enhancement of the community's fisheries resources and fish habitats in a way that seeks to -*
 - (a) *apply and balance the principles of ecologically sustainable development; and*
 - (b) *promote ecologically sustainable development.*

2. *In balancing the principles, each principle is to be given the relative emphasis appropriate in the circumstances.*

'Ecologically sustainable development', 'the principles of ecologically sustainable development' and 'the precautionary principle' are all defined in detail in the *Fisheries Act 1994*. The *Fisheries Act 1994* sets the direction for fisheries management while allowing for flexibility in management through subordinate legislation (Management Plans and Regulations) to deal with specific fishery management needs.

The *Fisheries Act 1994* sets the direction for fisheries management while allowing for flexibility in management through subordinate legislation (Management Plans and Regulations) to deal with specific fishery management needs.

The Marine Aquarium Fish and Coral Collecting Discussion paper (1999) outlined a number of issues that needed addressing, including:

1. Species to be included in this fishery
2. Localised depletion
3. Species vulnerability
4. Latent effort
5. Use of closures
6. Recreational fishery management
7. Aquaculture and brood stock collection
8. Other impacts on fish
9. Compliance, enforcement and education
 - a. Fisheries Inspectors
 - b. Voluntary fisheries liaison officers
 - c. Education
10. Licensing arrangements and training schemes
11. Conflict with other user groups
12. Black marketing
13. Serious fisheries offences

The Queensland Marine Aquarium Fish and Coral Collecting Fisheries Discussion Paper as well as the results of public comments received from the paper, helped identify proposed amendments to management arrangements for the fishery, some of which have been implemented. These included addressing latent effort within the fishery with the introduction of five Special Management Areas (SMAs).. The discussion paper is one of the first steps taken to develop a management plan for the MAFF.

FISHERY DESCRIPTION

The Marine Aquarium Fish Fishery (MAFF) is a harvest fishery that is focussed on a diverse suite of species that also have significant value to other users of the marine environment. Active users include commercial and recreational fishers that collect marine aquarium fish species for display in either private or public aquariums. Passive users of the fish stocks include divers and others viewing fish stocks either recreationally or as part of non-manipulative research or commercial tourism activities.

SCUBA and hookah apparatus are used by commercial collectors, and recreational harvesters cannot legally use SCUBA or hookah apparatus, but may use a mask and snorkel. Collecting is usually carried out in shallow water due to the limited time that a diver can spend underwater and the need to decompress fish as they are brought to the surface.

The MAFF deals with the operations of authorities to take under an 'A1' or an 'A2' fishery symbol. The fishery operates along the east coast of Queensland within the bounds of the Australian Fishing Zone (Figure 1). The fishery area also comprises five SMAs that can only be accessed by holders of an A1 symbol. Authority to access to these areas is based on historic participation in the region and an A1 authority holder may be granted access to one or more areas. The remainder of the fishery area is open to both A1 and A2 authority holders. Fishers endorsed with an 'A2' fishery symbol have possession limits of 10 fish comprising not more than 2 fish of the same species. These fishery symbols were introduced in September 2003 to address latent effort and localised depletion concerns in the fishery.

The MAFF is focussed upon a wide variety of marine species principally associated with shallow and deeper water coral reef and inter-reef habitats. A list of species that are harvested in the MAFF is shown in Appendix 1, and sorted by proportion of commercial catch in Appendix 2. This list comprises about five families of fish that represent more than 60 percent of all fish commercially harvested. Fish targeted in the MAFF belong to the families:

- Pomacentridae – damselfish and anemone fish (genera *Amphiprion* and *Premnas*);
- Chaetodontidae - butterflyfish;
- Pomacanthidae - angelfish
- Labridae - wrasses;
- Gobiidae - gobies;

Over the last decade, the advent of new technologies has significantly improved marine specimen husbandry techniques. Knowledge of filtration systems, light requirements and food requirements has led to an increase in demand for a high diversity of organisms for marine aquaria. Further, the evolution and popularity of 'mini-reef' displays has required collectors to provide an increasingly diverse range of live animals. Coral shrimp, small non-commercial colourful sea cucumbers (including fish of the following species; *Bohadschia graeffei*; *Calachrius crassus*; *Cucumaria miniata*; *Euapta godeffroyi*; *Holothuria hilla*; *Holothuria edulis*; *Opheodesoma spp*; *Pentacta anceps*; *Pentacta lutea*; *Pseudocolchirus violaceus*; *Stichopus noctivagus*; *Synapta maculata*), nudibranchs, gastropods and other molluscs, sponges and ascidians are all targeted by aquarium fish harvesters for trade.

Other Invertebrates include:

Phylum	Porifera	Sponges
	Bryozoa	Moss animals
	Brachiopoda	Lamp shells
	Phoronida	Phoronid worms

Subphylum	Urochordata	Tunicates
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Phylum	Echinodermata
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Class	Asteroidea	Sea stars
	Crinoidea	Father stars
	Echinoidea	Sea urchins
	Holothuroidea	Sea cucumber (non-commercial species only)

Miscellaneous crustacea

Cleaner shrimp
 Coral banded shrimp
 Gastropoda
 Nudibranchs
 Mantis shrimp
 Decorator crabs

Other Vertebrates include:

Class	Ascidiacea	Sea squirts
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Distribution

While most of the species important to the MAFF have broad distributions and are found throughout the Indo-Pacific area and in coral reef systems throughout the world, some species are endemic to Australia and in some cases may only be found in one area. Most of these species occur on the Great Barrier Reef. These species are particularly important in the aquarium fish trade and are highly prized on international markets.

Some species are naturally rare and not abundant anywhere even though they may be widely distributed. Others may be quite abundant (temporally or spatially) but restricted to special habitats. Most marine aquarium fish inhabit warm shallow tropical waters around reef situations

Biology and ecology

There are differences in the population abundance, characteristics of spawning and other life history parameters that impact on biological diversity and reproductive success of MAFF species. A general overview is given below (taken from the Marine Aquarium Fish and Coral Collecting Fisheries discussion paper, 1999).

Biological Characteristics

Because of their small body sizes, coral reef fishes are often assumed to be short lived. However, research into their demography (life tables) has shown otherwise. Damselfish of less than 70 mm may live for 20 years on the southern GBR (Doherty and Fowler 1994), while the same species may turn over much more quickly on the northern GBR (Sweatman 1985). A number of medium-sized, unexploited species have been shown to live for long periods. Parrotfishes have been aged to 50 years (Choat et al. 1997), while one species of surgeonfish has been aged to 70 years (Choat and Axe 1996). However, none of these extreme examples are in much demand as specimens for display in marine aquaria.

Bony fish have indeterminate growth, which means that they never stop growing completely although growth slows remarkably once they start reproducing, owing to the heavy energetic burden of producing gametes (females) or securing matings (males). With females, fecundity (egg production) increases disproportionately to body length so that a single large female may spawn the same number of eggs as many small ones (Sale 1991). Furthermore, there is no evidence that bony fish stop spawning with advancing age, although all individuals accumulate challenges from parasites and pathogens. The net effect of the high turnover of inexperienced juveniles and the reproduction value of the large adults is that the latter are more valuable components of the population.

Reproduction

The most universal attribute of coral reef fishes is that they reproduce through offspring that are dispersed by ocean currents, but they achieve this through a wide variety of mating systems (Thresher 1984). Some species (for example, parrotfishes) live in large foraging groups and mate promiscuously. Males and females dash high in the water column to launch small buoyant eggs and sperm above the reach of most of the potential egg predators. The fertilised spawn then drifts away from the reef. Some species congregate at mass spawning sites, usually along the edge of the reef, where mates can choose among partners, or groups of fish may spawn together, and fertilised eggs are flushed efficiently into the sea. Many smaller fishes cannot bear the cost of migration and have evolved different strategies. For example, male damselfish establish nests and court local females to leave eggs with them. Male cardinalfish engulf the fertilised egg bundle and hold it in their mouth for several days, foregoing eating. Male pipefish incubate their eggs in a special brood pouch on the abdomen. Despite many variations, the common effect of these strategies is that the eggs are protected from predation for a few days, while the embryos inside them develop into larvae possessing eyes, a mouth and some swimming ability. In this primitive state, they hatch synchronously after sunset; again to avoid predators. The tiny larvae measuring just a few millimetres wriggle to the surface, attracted by moonlight, where they are flushing off the reef by wind and wave-driven currents.

Marine fish stand out among vertebrates for the small amount of parental investment given to the care of their offspring. Instead, like marine invertebrates, bony fishes spawn vast numbers of eggs that are dispersed widely, and their larvae must feed themselves during this period. The big exceptions are the cartilaginous fishes (the sharks and rays), which have developed internal fertilisation. These fish produce small clutches of very large eggs that are not dispersed. Instead, they may be attached to the bottom, inside protective egg cases, or they may be held inside the female body, resulting in live births. In either case, the developing embryos do not require external foods and hatch as fully formed juveniles that simply disperse into the parental environment.

Just as their mating systems are highly variable, bony fish also show unusual plasticity in their sexuality. Some species are gonochoristic, which means having individuals that are permanently male or female. In some gonochores, the sex of an individual may be determined environmentally, typically by temperature, although it is usually determined genetically. In many species, however, sexual status is not fixed and is determined socially. Hermaphroditism is often associated with harem mating systems, in which a single large individual attempts to monopolise the spawnings of a group of the opposite sex. With anemone fishes, which live in small colonies, the largest individual is a female and new recruits start as males. When the female is removed, the largest male will change sex and become the dominant individual. With banded humbugs or pigmy angelfishes, which live in larger groups, the dominant individual is a male who attempts to suppress sex change within a harem of females. As groups get larger, perfect control may not be possible and multiple males may coexist. Sex change is common among larger species that congregate on mass spawning sites (for example cods, parrotfishes, and emperors) where competition for matings favours female to male hermaphroditism.

The effects of fishing are significantly different for species that change sex compared with gonochoristic species. In hook and line fisheries, the largest individuals are removed first. This, therefore, impacts disproportionately on one sex. Although compensation occurs, with sex change starting at smaller sizes, limits on this process mean that hermaphroditic stocks are more vulnerable to overfishing. A number of stocks covered by the aquarium fishery are hermaphroditic and harem. However, the selective nature of the dive collection methods provides more potential to harvest these groups in ways that are sympathetic to their social structure, thus minimising impacts on future reproduction. Also, it is general industry practice that smaller individual fish are preferentially collected by operators in the MAFF. This reduces population impacts by leaving larger fish that are less prone to predation and individuals that are likely to have greater egg production.

Larval Dispersal and Recruitment

After developmental periods in the ocean ranging from 1-12 weeks (Sale 1991), reef fish larvae need to return from the plankton to suitable nurseries to continue their life cycle. At this stage, though still transparent to escape detection by planktonic predators, they have fully developed fins and are properly called pelagic juveniles. These animals are strong swimmers and can detect reefs from kilometres away, probably by cueing on underwater sound. After assembling near coral reefs, these pelagic juveniles wait until dark and then swim rapidly to the reef where they search for their juvenile habitat. Their requirements are variable. Generalists simply need hard bottom that will give them suitable refuges from predators. Specialists may need seagrasses, corals, anemones or other specific hosts. Some of the species that live in colonies (for example anemone fishes, banded humbugs) seek them out by detecting the water-borne scents of conspecifics (belonging to the same species) or the host.

Because ocean currents from the Coral Sea affect those along the Queensland coast (Wolanski 1994) most pelagic juveniles do not return to the coral reef from which they were spawned. The significance of this inter-reef dispersal is that fish stocks on a single coral reef cannot be managed in isolation. The replenishment of fish stocks on a given reef will depend upon the number and strength of connections to upstream spawning sites and the status of spawning populations at those sites. Research has shown that recruitment has very strong influences on the future abundance of stocks.

Some reefs are naturally starved of replenishment, either chronically or occasionally, simply by their position with respect to potential upstream spawning sources. Consequently, fish populations on such reefs will be less resilient to harvesting than reefs that receive strong and/or regular recruitment. Some reefs that receive good replenishment do not contribute much to future generations. Again, this is most likely to happen because they are not well positioned for their spawn to be carried to reefs downstream. Reefs in this category (sinks for larval supply, but not sources of larval supply) are theoretically ideal places on which to fish with least impact on fish stocks. Equally, reefs that are strong sources of supply for other reefs will be sites with high conservation value. Research is in progress to determine whether these properties can be determined for coral reefs in the GBRWHA, but there is no model available yet that allows connectivity to be used as the basis for distributing fishing effort.

Larval dispersal patterns among reefs will vary from one time to another because ocean currents, to some degree, depend on the weather. Climate also affects recruitment through different mechanisms that operate over longer time-scales. The outcomes are manifest as unusually strong or weak year-classes in populations that can be traced back to unusually strong or weak recruitment episodes (Russ et al. 1996). Where this happens on a small number of reefs within a region, it can be simply the result of fortuitous patterns in dispersal. Where it happens across a large proportion of the reefs simultaneously, however, it must be because spawning has been more or less successful. One possibility is that egg quality of the average spawn is higher or lower than usual, owing to better or worse food supply to the adult females. Another possibility is that larval survivorship is altered through changes in the abundance of larval foods and/or planktonic predators.

While the mechanisms are still the subject of research, the impacts on populations are quite clear. Strong and weak year-classes of recruitment are stored in the population and translate directly into larger and smaller spawning stocks in the future (Doherty and Fowler 1994). Consequently, species that will be most vulnerable to overfishing are those where spawning stocks depend on infrequent inputs from occasional strong year-classes of recruitment. This vulnerability will be compounded if the species also has a limited spatial distribution.

The Fishery

The Fishery Area

Figure 1 shows the boundary of the Queensland MAFF along the east coast of Queensland. The fishery area comprises all tidal waters south of latitude 10°41' south and east of longitude 142°31'49" east.

Aquarium fish species occurring in the Gulf of Carpentaria and in other Queensland waters west of Cape York are managed jointly by the Commonwealth and Queensland governments through the Queensland Fisheries Joint Authority under Queensland law and do not form part of this assessment.

Under Offshore Constitutional Settlement (OCS) arrangements between the Commonwealth and Queensland governments, management of the aquarium fish species throughout most of the Australian Fishing Zone adjacent to the east coast of Queensland falls under Queensland law. Excluded are those stocks in offshore waters of the Coral Sea that are managed by the Commonwealth Government under exploratory and developmental fisheries policy. (Specific details of the boundaries of Queensland jurisdiction on the east coast, and in the Gulf of Carpentaria and the Torres Strait are contained in the *Queensland Government Gazette* of 10 February 1995 on page 455). Within the OCS arrangements, aquarium fish of the east coast of Queensland south of 10°41' are managed under Queensland law by the DPI&F.

Aquarium fish species in Torres Strait Protected Zone waters are managed collectively by the Commonwealth, the State of Queensland and Torres Strait Island Communities through the Protected Zone Joint Authority and under the *Torres Strait Fisheries Act 1984* (Cth).

The assessment of the Queensland Marine Aquarium Fish Fishery (MAFF) deals with the operations of authorities to take under an 'A1' or an 'A2' fishery symbol.. The fishery has five SMAs (Figure 1) within its bounds that can only be accessed by holders of an A1 symbol. Authority to access to these areas is based on historic participation in the region and an A1 authority holder may be granted access to one or more areas. The remainder of the fishery area is open to both A1 and A2 authority holders. Fishers endorsed with an 'A2' fishery symbol have possession limits of 10 fish comprising not more than 2 fish of the same species.. These fishery symbols were introduced in September 2003 to address latent effort and localised depletion concerns in the fishery.

Additionally, some areas of the fishery are subject to closures to fishing through general fisheries closures and through the Great Barrier Reef Marine Park Zoning established under the Commonwealth *Great Barrier Reef Marine Park Act 1975* and the Queensland *Marine Parks Act 1982*. This area has now increased with the introduction of the new GBRMP Zoning Plan 2003, implemented on July 1st 2004. The proportion of the Marine Park closed through green zones has now increased to approximately 33 percent. The RAP was also developed to protect the biodiversity of 70 bioregions identified within the GBR region (GBRMPA 2001b). Fishing for aquarium fish within the Great Barrier Reef Marine Park can only occur in general use and habitat protection zones. Harvesting can also occur in conservation park zones however restrictions apply. Figure 1 also shows the area closed to harvesting for aquarium fish within the GBRMP. .

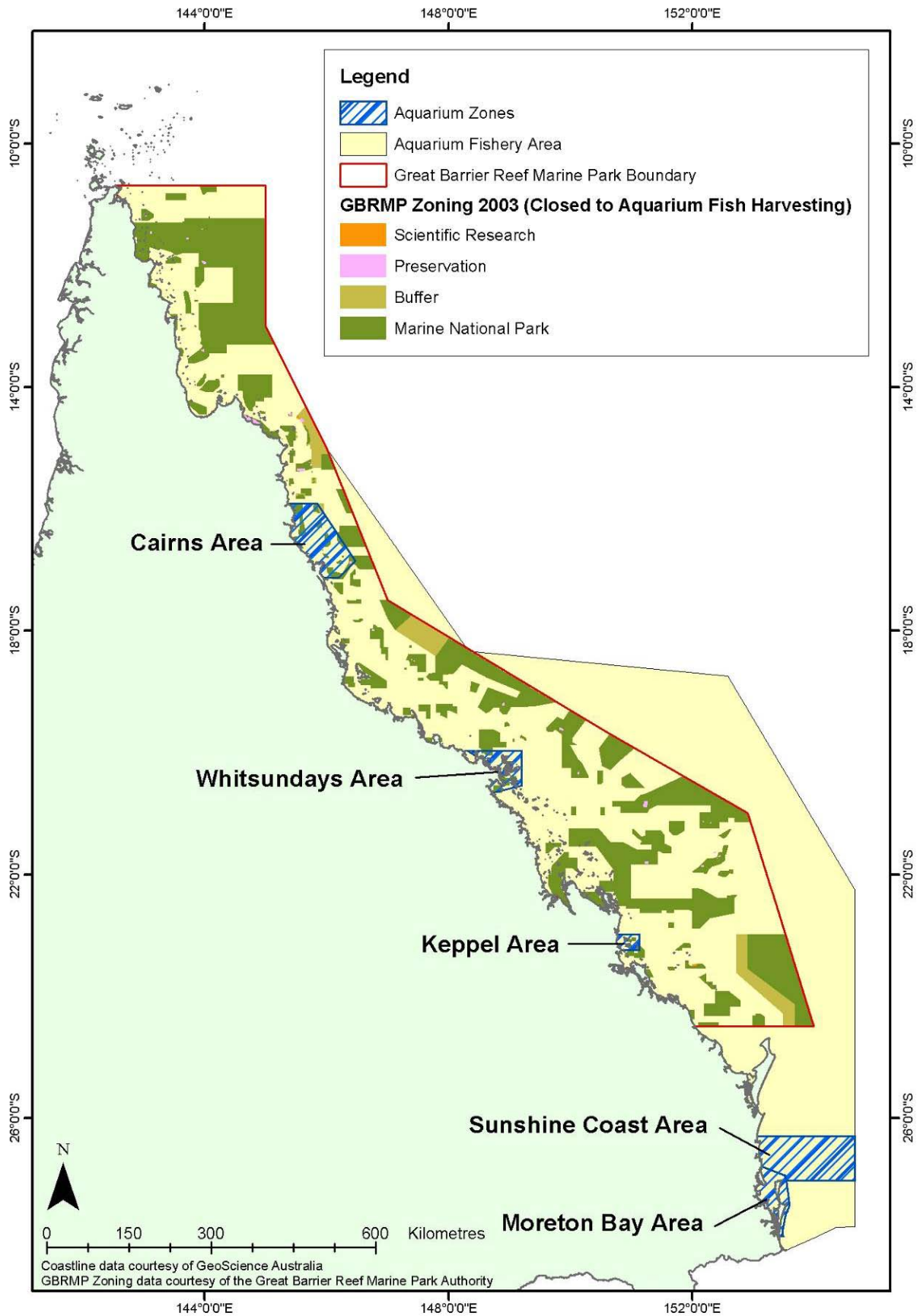


Figure 1. Area of the Queensland Marine Aquarium Fin Fish Fishery indicating the 5 Special Management Areas (marked as Aquarium Zones) and areas closed to harvesting within the Great Barrier Reef Marine Park.

Harvesters of aquarium fish in Queensland rely on air transportation for both domestic and global markets. Consequently, Cairns and Brisbane are the two major centres of aquarium fish harvesting in Queensland. For this reason, much of the harvesting occurs near these centres, and fishing effort in Moreton Bay, Sunshine Coast, Gold Coast and reef adjacent to Cairns is much higher than other areas. Further, travelling time to the reef and suitable harvesting locations are much shorter off Cairns and south east Queensland.

Fishing gear and methods

The commercial aspect of the MAFF is a dive fishery, and usually requires the use of underwater viewing apparatus. Commercial harvesters are able to use self-contained underwater breathing apparatus (SCUBA) or surface-supplied air from hookah apparatus, which provides extended underwater time and increased mobility for fish harvesting. Fish may only be taken by hand or by using fishing lines or cast, scoop or seine nets. A single barbless hook must be used when using a fishing line. A herding device (for example a rod) may also be used when taking fish. The figure on the front cover of this assessment shows a commercial operator using a barrier net to limit the movement of fish being collected.

A cast net may be used only if it is not more than 6 m in diameter and has a mesh size of not more than 28 mm. A scoop net may be used only if it is not more than 2 m in any dimension and has a mesh size of not more than 25 mm and a handle or shaft not longer than 2.5 m. A seine net may be used only if it is not longer than 16 m and has a mesh size of not more than 28 mm and a drop of not more than 3 m. A person using the net under an authority must be within 100 m of it.

Recreational harvesters cannot legally use SCUBA or hookah apparatus, but may use a mask and snorkel. Harvesting of fish may also occur in shallow intertidal areas or in estuaries where underwater viewing is not required. Regulations limit the effort in the recreational fishery by preventing efficient harvesting of fish; excluding deeper-water species of fish from harvest; and providing a deep water refuge for many popular species (QFMA 1999).

A small number of collectors and public aquariums are able to target larger fish specimens specifically for large public aquarium displays. This activity is covered by a general fisheries permit (See **Criterion 1.1.7** for more detailed information).

Usually fish that are taken from deeper waters are brought to the surface slowly to ensure that they are not affected by the decreasing pressure. Fish are handled very carefully during all stages of the harvesting operation to decrease the mortality of specimens. Fish that are stressed or lose scales during harvesting become more susceptible to disease and infection and may not survive transport or export. Damaged or unhealthy specimens are of little commercial value.

Historical and Current Management Arrangements in the MAFF Fishery

The primary legislation affecting the management of the MAFF is the *Fisheries Act 1994*, and subordinate regulation included in the *Fisheries Regulations 1995*. The MAFF is also subject to various provisions of the Queensland *Nature Conservation Act 1992* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. As the MAFF operates within the boundaries of the Great Barrier Reef Marine Park, provisions of the Commonwealth *Great Barrier Reef Marine Park Act 1975* also apply to the fishery.

The management of the MAFF uses a variety of management controls to regulate the level of take within the fishery. The current management arrangements for the MAFF are outlined below:

- Control of the species that may be taken – Under the *Fisheries Regulation 1995*, the species of fish able to be harvested include fish other than barramundi, beche-de-mer (except non-commercial species), shell grit, star sand, and any species of coral, oyster, pearl shell or trochus.

This definition provides for the commercial harvest of echinoderms (starfish, sea urchins); molluscs (shells, octopus, nudibranchs); crustaceans (shrimp, prawns, crayfish); sponges; ascidians and polychaete worms; but excludes soft corals including anemones and some sea cucumber species. A complete list of species included in the MAFF is attached as Appendix 1.

- Bag limits applying to commercial and recreational operators – commercial fishers endorsed with an 'A2' fishery symbol are restricted with possession limits of 10 fish comprising not more than 2 fish of the same species. In addition to size, take and possession limits for some species as detailed under the *Fisheries Act 1994* and subordinate legislation, all coral reef fin fish species have a combined take and possession limit of 20.
- Gear restrictions for commercial and recreational fishers – commercial fishers in the MAFF may only take fish by hand or by using fishing lines, or cast, scoop or seine nets. Underwater breathing apparatus may also be used when taking fish. A herding device (for example, a rod) may also be used when collecting fish. Recreational fishers are not permitted to use SCUBA or hookah apparatus for collection.
- Limited entry (commercial) - Limited entry arrangements for the MAFF commenced in 1997 according to the Limited Entry Policy Guidelines. Under these arrangements no new authorities for this fishery have been issued. The number of endorsements has decreased from 63 in 1998 to 49 in July 2004.
- Closed waters - Schedules 2 and 3 of the *Fisheries Regulation 1995* outlines a range of waters closed to all fishers or to commercial or recreational fishers. The GBRMPA also administers zoning arrangements throughout the GBR marine park. 'A1' and 'A2' authorities collecting coral reef fin fish species are also subject to closure conditions under Chapter 2 of the *Fisheries (Coral Reef Fin Fish) Management Plan 2003*.

The recently implemented Coral Reef Fin Fish Management Plan (the Plan) has a significant affect on the MAFF. All catches of CRFF species in Queensland East Coast waters, whether by commercial, recreational or charter fishers, are managed under the CRFFF Management Plan. Key aspects of the Plan that affect the MAFF include:

- Closed Waters – A seasonal closure for all Coral Reef Fin Fish (CRFF) species, covering waters east of longitude 142°31.82' east between latitude 10°41.00' south and latitude 24°50.00' south, is in place to protect CRFF each year. For 2005 the closure dates are from 27 September to 5 October; from 27 October to 4 November; and from 25 November to 3 December. Grey nurse shark protection area closures are also in place.
- Size limits (all sectors) - Following the implementation of the CRFFF Management Plan size limits have been introduced for some species. There is however an exemption for the holder of, or a person acting under, an 'A1' or 'A2' authority. This person may take or possess a prescribed fish, other than hussar (pink hussar) and spanish flag (stripey), that is less than the minimum size stated in schedule 4, part 2 of the *Fisheries (Coral Reef Fin Fish) Management Plan 2003*.
- Fish regulated by species – The taking or possessing of barramundi cod, chinamanfish, humphead Maori wrasse, paddletail, potato cod, Queensland grouper and red bass is prohibited.
- Possession limits (recreational fishers) – A combined possession limit of 20 CRFF species applies to all recreational fishers, though fishers on long charter tours have some exceptions.

Greater detail on the management arrangements applicable to the MAFF is provided in criterion 1.1.7.

The Commercial Fishery

Management arrangements allow for 49 commercial operations to access the aquarium fish fishery. Of these, 48 commercial operators are currently active. All participants hold an '*authority to take fish for trade or commerce*' endorsed for the aquarium fish fishery ('A1' or 'A2' fishery symbol). Currently there are 44 commercial operators authorised with an 'A1' fishery symbol and 5 commercial operators issued with an 'A2' fishery symbol.

The assessment of the Queensland Marine Aquarium Fish Fishery (MAFF) deals with the operations of authorities to take under an 'A1' or an 'A2' fishery symbol. The fishery symbols are

designed to address latent effort whilst the SMAs address localised depletion concerns in the fishery.

Both A1 and A2 authority holders have access to the fishery outside the SMAs. A1 authority holders may have additional access to operations in one or more of the five SMAs. The number of SMAs an A1 holder has access to is determined by the authority holder's historical participation in the region.

A2 authority holders have limited access to the fishery through the implementation of an in possession limit of 10 fish comprising not more than 2 of any given species. A2 authority holders are not allowed to fish within the SMAs.

Fish may only be taken by hand, or by using fishing lines or cast, scoop or seine nets. Underwater breathing apparatus may also be used when taking fish. A herding device (for example, a rod) may be used while collecting fish. No more than 3 person may take fish at the same time under the authority. Only the boat identified in the authority and 1 other boat may be used to take fish in the same location.

Each of these operations may use a mothership and one other boat to fish at the same location and utilise up to two divers plus the authority holder/nominee to work on each authority. Fish must not be taken for human consumption.

Beyond aquarium fishery regulations, collectors must also obey regulations applicable for other fisheries and by other departments. The GBRMPA authorises, through permits issued under QPWS, marine aquarium fish collecting in general use, habitat protection and conservation park zones within the marine park. Commercial fishers are required to obtain a permit from QPWS or the GBRMPA to collect in these zones.

Figure 2 shows that the majority of effort in the MAFF is concentrated around regions with effective and reliable transport systems, particularly air transport. The Cairns region experiences the highest levels of fishing effort from the MAFF.

The Recreational Fishery

Recreational fishing for small colourful reef fish for personal home aquariums has long been a popular pastime. Recreational aquarium fishers usually take only a few specimens of each species for domestic displays. Recreational fishers cannot legally use scuba or hookah apparatus for collection; so recreational harvest is usually limited to shallow areas to a depth of about 5 metres.

There is virtually no information available on the level of recreational harvest of marine aquarium species. Hobby aquarists do catch some marine aquarium species however the number of fish taken is believed to be very small in comparison to the commercial marine aquarium fish fishery (Phil Gaffney, DPI&F, pers. comm., 2003).

While the Recreational Fishers Diary logbook (RFISH) system does record catches for marine aquarium fish, the catches are included with other species which makes it difficult to determine whether the fish are collected for the aquarium fishery. The RFISH survey is not suitable for estimating recreational catches for the MAFF.

There are limits placed on a variety of species caught by recreational fishers as detailed under the *Fisheries Act 1994* and subordinate legislation. The take and possession of Hump-headed Maori wrasse, Potato cod, Barramundi cod, Queensland groper, Red bass, Chinaman fish and Paddletail are prohibited in Queensland waters under the *Fisheries (Coral Reef Fin Fish) Management Plan 2003*. Under this plan and in addition to individual take and possession limits, all coral reef fin fish species have a combined take and possession limit of 20.

The Indigenous Fishery

There is no information available on the indigenous harvest of marine aquarium species. Marine aquarium species are not believed to be of high value to indigenous fishers.

Passive users of fish stocks

While all fisheries in Queensland are important to passive users, small reef fish are particularly attractive to these users. Passive uses of fish include underwater viewing, snorkelling, diving and photography. Many commercial operations rely on the aesthetic values of coral reefs and on the diversity and colour of marine fish and invertebrate life.

GBRMPA information shows that about 1.5 million people visit the Great Barrier Reef each year. They participate in a variety of tourist activities, including snorkelling and diving. The passive users of these coral reef resources also have a stake in managing aquarium fish resources.

There is potential for interaction between the MAFF and non-fishing uses such as commercial tourism to occur. Anecdotal evidence suggests that conflict between these stakeholder groups may exist in high use areas such as Cairns (Kung, 2000). Kung (2000) suggest that conflicts may arise as a consequence of resource allocation, from the perception by tourism operators that collecting practices of the MAFF damages the substratum, or from the reduction in visual amenity by removal of coral reef fishes. Since the introduction of the new GBRMP Zoning, 33% of the marine park is now designated as marine protected areas, which should reduce conflict to some extent.

A number of large public aquaria displays are available for the general public to access and enjoy. In Australia they include the Cairns Aquarium, Great Barrier Reef Wonderland in Townsville, Underwater World in Mooloolaba, Sydney Aquarium and Perth Underwater World. More than three million people visit Australia's major public aquariums each year. Further, many aquarium fish commercially collected from Queensland end up in major international aquariums. While many people access the Great Barrier Reef Marine Park to observe and enjoy these fish many people (particularly schoolchildren, the elderly and the disabled) rely on public aquarium displays to observe, enjoy and learn about fish, and other marine organisms and the environment.

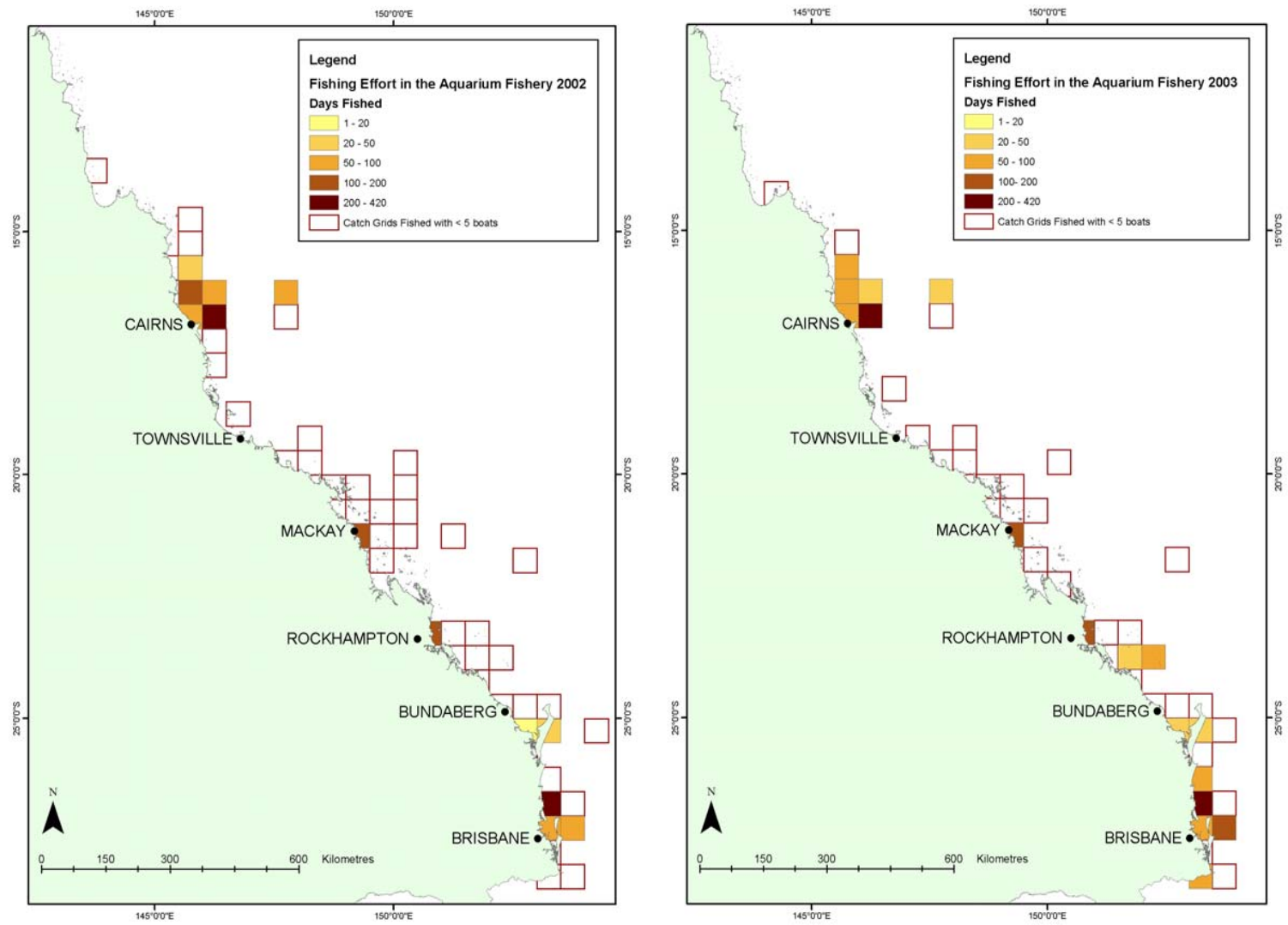


Figure 2. Geographic variation in total annual effort in the Queensland Marine Aquarium Fish Fishery for 2002 and 2003.

Marketing

Although fish are sold on the domestic market both in Queensland and interstate, the majority of the harvest is exported mainly to the USA, Asia and Europe (Kung, 2000). A representative price list for all marine aquarium species collected in the MAFF is provided in Appendix 3.

Currently about 45 countries supply the marine ornamental fish trade market. The most important suppliers are Indonesia and the Philippines, with Brazil, Maldives, Vietnam, Sri Lanka and Hawaii also supplying significant quantities (Wood, 2001). Australia's contribution to the marine ornamental fish trade is small in comparison.

Research and Monitoring Program

The general status of reef fish stocks, including some species of importance to the Queensland MAFF are monitored by reef surveys conducted by the Australian Institute of Marine Science (AIMS) as part of an extensive Long Term Monitoring Program (the AIMS LTMP). The AIMS LTMP provides long-term surveys of the status of fish, including species harvested in the MAFF, and corals on up to 180 coral reefs. Results from the AIMS LTMP should allow local depletions to be detected as it provides for a time series of data, but the results reveal that no local depletions have appeared to date. For further information on the AIMS LTMP see **Criterion 1.1.1**.

It is expected that the introduction of the five SMAs has reduced the potential for localised depletion to occur.

Any research that involves the collection of marine aquarium fish is issued under a General Fisheries Permit.

ASSESSMENT OF THE MARINE AQUARIUM FISH FISHERY AGAINST PRINCIPLE 1.

A fishery must be conducted in a manner that does not lead to overfishing, or for those stocks that are overfished, the fishery must be conducted such that there is a high degree of probability the stock(s) will recover.

Objective 1.

The fishery shall be conducted at catch levels that maintain ecologically viable stock levels at an agreed point or range, with acceptable levels of probability.

Information requirements

1.1.1 There is a reliable information collection system in place appropriate to the scale of the fishery. The level of data collection should be based upon an appropriate mix of fishery independent and dependent research and monitoring.

The Department of Primary Industries and Fisheries (DPI&F) has developed and maintains a range of both fishery dependent and independent data collection systems for providing up to date information on fish stocks, fish species taken and the level and distribution of fishing effort and fish catches. This information is used by managers to make decisions about maintaining sustainable harvests of principal species and ensuring provisions of the Queensland *Fisheries Act 1994* are met. It is also used by researchers in making scientific assessments about the status of these species and bycatch and by analysts monitoring and interpreting spatial and temporal changes and trends in fishing activity and catch levels.

A comprehensive compulsory daily logbook program for Queensland's commercial fisheries was introduced in 1988. Logbooks were introduced primarily as a performance and compliance tool for the fishery. Logbook entries are recorded daily and reported monthly. The Commercial Fisheries Information System (CFISH) database was established in 1988 to manage the large flow of data from fishers and provide access to fishery dependent data for fisheries research and management.

(Note: Criterion 1.1.1, details the information collection systems in place for the Marine Aquarium Fish Fishery. The actual estimates of catch, effort and other statistics for the various sectors of the fishery are outlined in criterion 1.1.4).

Fishery-dependent Information

Commercial Fishery

In 1986, the DPI&F introduced a quarterly catch record which fishery participants filled out and submitted to the DPI&F each year. The DPI&F maintained these records until 1995, when responsibility of management of the fishery was transferred to the QFMA. These records provided quarterly information on the permit holder, vessel, location of fishing activities, number of assistants, total days and the number of specimens of fish. QFMA continued the quarterly record requirement until February 1998 when a new daily logbook recording system, CFISH – the Commercial Fisheries Information System, was introduced into the fishery.

Fishery-dependent data from the commercial sector of the fishery is now collected via CFISH. Since its commencement in 1988, CFISH has collected daily data from commercial fishers about their commercial fishing activity through the use of compulsory logbooks. The logbook used in the Queensland MAFF is the 'Aquarium Fish Trip Logbook' – AQ03 (see Appendix 4). For the MAFF, the data provided to CFISH via the logbook program must include daily information on location of collection, number of divers/assistants, time spent collecting, harvest method used and the number of specimens of fish collected

There are proposed changes to the format of the logbook used in the MAFF to enable catches to be reported using major families and key species within most major families and to standardize the common name used for reporting marine aquarium species. This will enable DPI&F to get more accurate reports of aquarium fish harvest on a more specific basis and eliminate the reporting of the same species under different names. The Aquarium Working Group, which is a sub-group of HarvestMAC, is responsible for developing the new logbook format. These logbook changes are still under review and are anticipated to be introduced late 2005.

All commercial fishers in Queensland have a legal obligation to provide information about their fishing activity. Section 118 of the *Fisheries Act 1994* (the Act) and Section 109(1)(b) of the *Fisheries Regulation 1995* (the Regulation) require that all holders of primary commercial fishing boat licences and holders of authorities to take, possess or sell fish must keep detailed statistical records about their fishing activities and provide such records to DPI&F. Section 118 of the Act clearly outlines that any person who fails to comply with an obligation to keep and provide the logbook or other information about fisheries required by DPI&F is liable to prosecution for an offence against the Act.

For the MAFF, the data provided to CFISH via the logbook program must include daily information on location of collection, number of divers/assistants, time spent collecting and the number of specimens of fish collected.

Given the minimal chance for interaction with endangered, threatened or protected (ETP) species, DPI&F believes that a 'Species of Conservation Interest logbook' (SOCI) would be of only moderate value in the MAFF. However, DPI&F is committed to implementing SOCI logbooks progressively across all fisheries to allow comprehensive reporting of protected species interactions in Queensland fisheries.

Fishers are also required under legal obligations to report interactions with ETP species during fishing operations to the relevant conservation agency. The Queensland Environmental Protection Agency should be advised of any interactions with 'dugongs, whales and dolphins in state waters. DEH should be advised of any interactions with EPBC Act listed 'threatened', 'migratory' or 'cetacean' species in any location, including in State waters. Interactions with 'listed marine species' need only be reported to DEH when they occur in the Commonwealth Marine Area.

Catch and effort information on the MAFF will assist in monitoring the status of the fishery, and specific effort on particularly important locations and key species of fish. The CFISH logbook data is one of the primary bases for the stock assessments and analyses that DPI&F conducts on the MAFF.

No recreational, charter vessel or indigenous catch is recorded for the MAFF therefore direct take is restricted to commercial aquarium collectors. There are other commercial fisheries, which occur in the same area or are associated in various ways with the MAFF. Some collectors, authorized to take marine aquarium fish, hold other licences or permits for other fishing operations (Couchman and Beumer 1992). The other fisheries, which may be associated with the collection of aquarium fish, are coral collection, line and net fisheries, beche-de-mer and oyster collection (Couchman and Beumer 1992). There is a limited number of species that can be collected by other commercial fisheries such as reef line and trawl fisheries however there is very minor overlap due to the different families of fish targeted.

Fishery-independent Information

Limited fishery independent research has been undertaken on aquarium fish harvesting in Queensland. This is due partly to the high diversity of species that can be collected, the geographical spread of the fishery, and its relatively low economic value (QFMA, 1999).

A 1986 study commissioned by the Great Barrier Reef Marine Park Authority (Whitehead *et al.* 1986) suggested that the aquarium fish collecting industry was expanding, but was locally underdeveloped. The study provided some information on popular harvest areas and approximate

numbers of commercial operators, and commented on localised impacts to the target species and non-target species. The information on the numbers of target species was insufficient to distinguish between natural population fluctuations, and fluctuation due to collecting.

There are a limited number of studies focused on the direct ecological effects of collecting aquarium fishes (Butler, 1991; Nolan, 1978; Samoily, 1988; Samoily and Green, 1990). These studies have compared populations from fished and unfished reefs using underwater visual survey techniques. The following is an overview of these studies (taken from Samoily and Green 1990).

Nolan (1978) used visual census surveys to monitor the population densities of the five most heavily collected species in Hawaii, over a two and half year period. He surveyed an area, which was heavily collected and an area where collecting pressure was low. In both areas the populations of these fish actually increased over the study period; thus Nolan concluded that collecting was not detrimental. A similar conclusion was drawn by Samoily (1988) who used visual census surveys to measure the population densities of 48 reef fish species collected for the aquarium trade in Kenya. No differences in the densities of these species were detected between a heavily collected reef and a reef protected through National Park legislation.

Samoily and Green (1990) provided a preliminary assessment of the use of underwater visual census techniques for measuring the impact of aquarium fish collection on fish populations of the northern GBR. The Chaetodontidae and Pomacanthidae were used as indicator families because local collectors target them heavily. Very few pomacanthids were counted on both reefs, suggesting that the transect size was unsuitable for this family. A significantly lower density of chaetodontids were detected at Arlington Reef than that at Michaelmas reef, although there is currently no evidence to suggest the difference is due to collecting.

It has been suggested by Skewes and Trendall (1987) that anemone fish (*Amphiprion spp.*) are likely to be useful and sensitive indicators of the effects of aquarium fish collecting, because they are one of the more heavily exploited groups in the Cairns area; they are easily identified and observed in the field; and they are particularly vulnerable to fishing because they are restricted to anemones, which can be removed by coral collectors. These factors suggest that anemone fish may be more prone to over-exploitation. Butler (1991) studied the effects of collecting anemone fish from the northern and central GBR for the aquarium trade. Butler (1991) concluded that collection was not detrimental and that the collecting of anemone fish had not depleted the local populations when compared to those reefs protected from harvesting.

These studies are however inconclusive because each used only a limited number of study sites. Kung (2000) studied the economic implications of policies on behaviour and profitability of the MAFF. This study is the first comprehensive study of the MAFF within the GBRWHA and provides information of the background of the fishery and the operators. Kung (2000) explored industry dynamics specifically looking at behavioural characteristics of collectors in the MAFF including the motivation, outlook and attitudes of the operators. The study comprised an interdisciplinary approach, drawing from economics, sociology and fisheries science, to examine the implications of management policies on the behaviour of fishing firms (Kung 2000).

In addition to the above fishery independent studies, DPI&F and several other organisations (e.g. AIMS, CRC Reef Research Centre, GBRMPA) have collected an extensive body of research on the life history, biology and ecology of a wide range of coral and rocky reef species and communities, and on the dynamics of the fisheries focussed on them. This information can be applied to a limited extent to species targeted in the MAFF, however the majority of this research has focussed on coral reef species and habitats, and on the coral reef fin fish fishery operating within the GBR marine park. The relatively limited information available for some key species in the MAFF is largely a reflection of the higher research priority afforded to the CRFFF and its target species due to the significantly greater catch and effort, and economic value.

Australian Institute of Marine Science Long Term Monitoring Program

As mentioned previously, the Australian Institute of Marine Science (AIMS) has an extensive Long-term monitoring Program, which has been designed to detect changes in reef communities over time at a regional scale. The program was initiated in 1992 based on previous sampling programs as a “concerted attempt to assess a range of ecological variables across most of the GBR” (Sweatman *et al.* 2001). In 1993, the AIMS LTMP became a task of the Reef CRC (Sweatman *et al.* 2001). The specific objectives of the AIMS LTMP are:

- To monitor the status and changes in distribution and abundance of reef biota on a large scale
- To provide environmental managers with a context for assessing impacts of human activities within the GBR Marine Park and with a basis for managing the GBR for ecologically sustainable use (Sweatman *et al.* 2001).

The coverage across the GBR includes three positions across the shelf (inner, mid and outer) as well as six latitudinal sectors. The AIMS LTMP focuses its monitoring effort on benthic organisms and reef fish species, including species that are taken in the MAFF Fishery. The MAFF species that are monitored include surgeonfishes (Acanthuridae), butterflyfishes (Chaetodontidae), wrasses (Labridae), parrotfishes (Scaridae), rabbitfishes (Siganidae), moorish idol (Zanclidae).

The AIMS LTMP surveys 48 reefs on an annual basis, with fish and benthic organisms sampled at three sites on the “north-east” flank of each reef. Reef fish are counted and video transects of corals are recorded at each of five 50 metre transects, with the entire perimeter of the reef surveyed by manta tow¹ to survey crown of thorns starfish and reef-wide coral cover. An additional 35 reefs are surveyed using manta tow only on an annual or triennial basis.

Information collected in the AIMS LTMP from 1992 onwards is freely available on the AIMS website (<http://www.aims.gov.au/monmaps/methods/methods.html>). The results are periodically included in comprehensive reports (for example, see Sweatman *et al.* 2001).

The abundance of damselfishes has increased over the past five years in the south and the Cairns and Cooktown/Lizard Island area. The increase in the abundance of damselfishes in the Capricorn Bunkers is most likely due to increases in coral cover. In the Swains region, the damselfish genera that showed any trend all declined over the past five years. The genera that showed a decline were mainly in midshelf reefs in regions where crown of thorns starfish (*Acanthaster planci*) are active (Sweatman *et al.* 2001).

An analysis of the results from the AIMS LTMP from 1992 to 2003 reveals that no local depletions in MAFF species have been detected.

Assessment

1.1.2 There is a robust assessment of the dynamics and status of the species/fishery and periodic review of the process and the data collected. Assessment should include a process to identify any reduction in biological diversity and /or reproductive capacity. Review should take place at regular intervals but at least every three years.

Although no stock assessment model has yet been developed, DPI&F have assessed the status and sustainability of the MAFF based on the fishery-dependent and independent information available (outlined in **Criterion 1.1.1**).

Assessment of the logbook returns over the last five years indicates that none of the groups of species harvested in the MAFF would appear to be under biological threat due to collecting activity.

¹ Manta towing involved towing a snorkel diver behind a boat with a board that enables the diver to reach and sustain depths while travelling at speed, enabling rapid surveys of large areas to be covered in relatively short period.

Fluctuations in numbers reported in logbooks may also reflect market requirements as well as catchability of fish, site accessibility due to weather conditions and experience of collectors.

There is a body of evidence collected from international reviews that indicate that few impacts have actually resulted from commercial collection of marine aquarium fish on a global scale (Wood 2001, Sadovy and Vincent 2002). Sadovy and Vincent (2002) and Wood (2001) have highlighted selective fishing, both in terms of particular species and particular size/colour/sex forms and overfishing of particular local areas as the predominant threats in live reef fish fisheries such as the MAFF. The GBR contains more than 2000 reefs and shoals. The immensity of this available habitat and the interconnectivity of fish populations, provides a large element of insurance against adverse effects of the ornamental fishery (QFMA, 1999). However, important points are that not all of these fish will be equally available or equally attractive to the industry and that the effects of collecting have to be viewed not in terms of their global impact but their potential to deplete particular species or locations (QFMA, 1999). This information was an important factor in the development of new management arrangements for the fishery in 2003, including the introduction of SMAs, to primarily address the issue of potential localised depletion.

In the MAFF there is one operator that in addition to being able to take species under an Authority to Take ('A1' or 'A2' fishery symbol), the operator, has a permit to use specific apparatus to take particular species (restricted by number) for supply to certain public aquaria. This operator is required to submit a written report to DPI&F each year of the permit outlining the number of fish taken, location where the fish were taken, apparatus used and days fished.

With regards to stock assessments based on fishery-independent data, the AIMS LTMP has produced status reports since 1995, with the latest (No. 5) being released in 2001 (Sweatman *et al.* 2001). These status reports summarise temporal trends on LTMP survey reefs general trends for geographic sector and the GBR as a whole. Greater detail on the AIMS LTMP can be found in **Criterion 1.1.1.**

1.1.3 The distribution and spatial structure of the stock(s) has been established and factored into management responses.

While most of the species important to the MAFF have broad distributions and are found throughout the Indo-Pacific area and in coral reef systems throughout the world, some species are endemic to Australia and in some cases may only be found in one area. Most of these species occur on the Great Barrier Reef. These species are particularly important in the aquarium fish trade and are highly prized on international markets.

Some species are naturally rare and not abundant anywhere even though they may be widely distributed. Others may be quite abundant (temporally or spatially) but restricted to special habitats. Only the later are likely to be threatened by inappropriate harvesting (QFMA, 1999).

The GBRMP contains more than 2000 reefs and shoals. The immensity of this available habitat and the interconnectivity of fish populations provide a large element of insurance against adverse effects from this small input-limited fishery (QFMA, 1999). A single coral reef of average size may support about ten million fish (conservative assumptions: perimeter of 30 kilometres providing just 100 metres of hard bottom and an average density of just three fish a square metre) (QFMA, 1999). The total annual harvest of fewer than 200 000 fish in 2003 is relatively low considering the relative abundance of marine aquarium fish species on a single coral reef.

New limitations came into force from 1 September 2003 when the previous 'A' fishery symbol was replaced by the issue of two new symbols A1 and A2 (the legislative provision for these fishery symbols came into place in December 2002 but took effect from 1 September 2003). These symbols have been granted to existing authority holders based on historic participation in the fishery. The symbols redress previous latent effort and localised depletion concerns in the fishery. The zoning scheme is used to prevent detrimental impacts in localised areas and prevent any increase in effort in any region.

The GBRMPA has also recently implemented significantly more protective zoning arrangements in the GBRMP, and these too explicitly consider the species and habitats upon which the MAFF is based. As part of the rezoning process the GBRMPA identified 70 bioregions (areas of similar habitats, communities and physical features) and committed to protecting a minimum 20% of all 70 in order to ensure the protection of the biological diversity of the marine parks organisms, communities and ecological processes.

1.1.4 There are reliable estimates of all removals, including commercial (landings and discards), recreational and indigenous, from the fished stock. These estimates have been factored into stock assessments and target species catch levels.

Commercial Fishery

In assessing the sustainability of the harvest of marine aquarium species there are a number of pertinent factors to consider. Obviously the total number of fish harvested and the total effort applied are important. However, considering the broad distribution of the majority of collected species (Randall et al. 1990, Wabnitz et al. 2003) and the high productivity of reef ecosystems generally (Sale 2002), the QFMA (1999) suggested that the effects of collecting marine aquarium fish should be viewed not in terms of the global impact on all collected species but rather the potential to deplete particular family groups and species, and/or particular locations. A number of international reviews of the marine aquarium trade (Wood 2001, Sadovy and Vincent 2002) have supported such an approach, further citing the relatively restricted focus of the international trade on a limited range of family groups in many areas (including Queensland) as an exacerbating factor. Sadovy and Vincent (2002) have highlighted selective fishing, both in terms of particular species and particular size/colour/sex forms, and overfishing of particular local areas as the predominant threats in live reef fish fisheries such as the MAFF.

Accordingly, this criterion 1.1.4, detailing the catch and effort dynamics in the MAFF, will include an overview of the total catch and effort, an analysis of the catch of the primary family groups, and a spatial breakdown for each.

The commercial harvest of marine aquarium fish in Queensland is documented through CFISH – the Commercial Fisheries Information System. A detailed description is provided in criterion 1.1.1. Prior to 1998, commercial aquarium fishers were only required to provide quarterly estimates of their fishing operations, however since 1998 daily logbook recording has been in place in the fishery. The post-1998 daily records are considered more accurate and reliable than the earlier quarterly estimates (QFMA 1999). Accordingly, the fishing statistics presented in the following section focus almost exclusively on the operation of the MAFF since 1998. However, summaries of the earlier catch and effort trends (sourced from the 1999 QFMA Discussion Paper) are provided in Appendix 5.

Total catch and effort in the MAFF

Figure 3 and Table 1 provide a summary of the total annual catch and effort recorded in the Queensland MAFF in recent years. Catch and effort have followed a similar trend over the reporting period. Catch peaked at approximately 248 000 fish in 1998, steadily decreased to just under 200 000 fish by 2000, and has remained relatively stable since. Likewise, fishing effort peaked in 1998 at approximately 2700 fishing days, decreased by approximately 25% to 2000 fishing days by 2000, and has since remained relatively stable.

Anecdotal information provided to HarvestMAC by collectors in the fishery suggests the declining catch and effort trends reflect changing market demand for certain species and a reduction in the number of licensed fishers rather than any real decline in marine aquarium fish abundance. Table 2 illustrates the extent of licence restriction and latent effort removal that has occurred in the MAFF over the past 15 years, with the number of authorities decreasing from a maximum of 160 in 1990 to 49 at present.

Analysis of the monthly catch data indicates a seasonal pattern in landings in recent years, although harvesting clearly continues year-round with the minimum monthly harvest dropping

below 10 000 fish only twice in Figure 4. There appear to be three important harvesting periods for marine aquarium species; an early peak in February/March, a mid-year peak around July, and a peak towards the end of the year in October and November. Comments from MAFF fishers suggest that these trends reflect climatic seasonal variations (for example site accessibility), natural fluctuations in species populations due to environmental conditions and variations in market demand.

While the MAFF total annual catch has decreased by approximately 20% since 1998, Figure 5 shows that the distribution of the catch has also changed. The shaded grids represent the major harvesting areas and the clear grids represent areas in which less than 5 boats operated during the fishing year. DPI&F can only release limited information for the 'less than 5 boats' areas due to confidentiality considerations, however for both years the 'less than 5 boat' areas contribute less than 25% of the total catch. It is interesting to note in Figure 5 that although the distribution of the total collection area has contracted slightly since 1998 (shown by the lower number of collection grids in 2003), the almost exclusive concentration of important collection areas in the Cairns and Moreton Island regions has eased slightly (shown by the greater distribution of shaded grids in 2003). In 2003, important collection areas existed in the Cairns, Mackay, Keppels and Gladstone regions, and extended almost continuously from Fraser Island south to the border.

Table 1. Summary of annual commercial catch and effort in the Marine Aquarium Fish Fishery.

Year	Boats	Days Fished	Number of specimens harvested	Hours
1998	49	2706	247799	18926
1999	50	2099	230025	15297
2000	45	2008	198339	12218
2001	45	2145	197000	13056
2002	37	2069	194175	12271
2003	59	2053	197669	11850

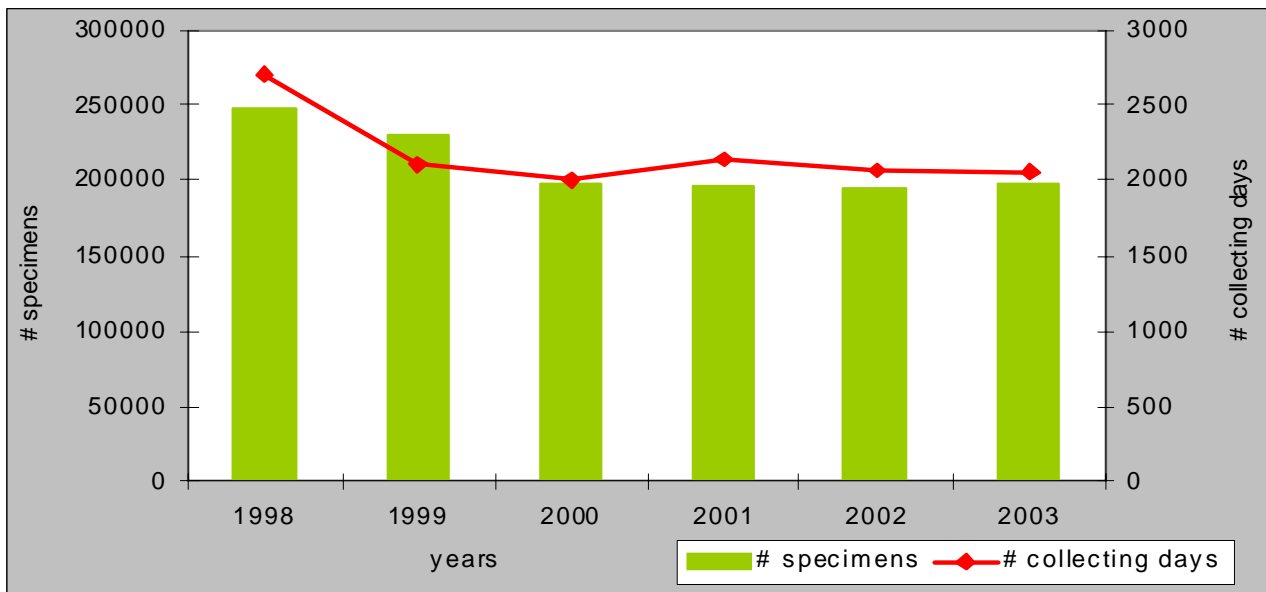


Figure 3. Total catch and days fished in the Marine Aquarium Fish Fishery from 1998 to 2002.

Table 2. Number of Aquarium fishery Authorities: 1986 to present.

Year	1986	1988	1990	1992	1994	1996	1998	2002	2004
Number of Authorities	30	120	160	76	72	65	63	56	49

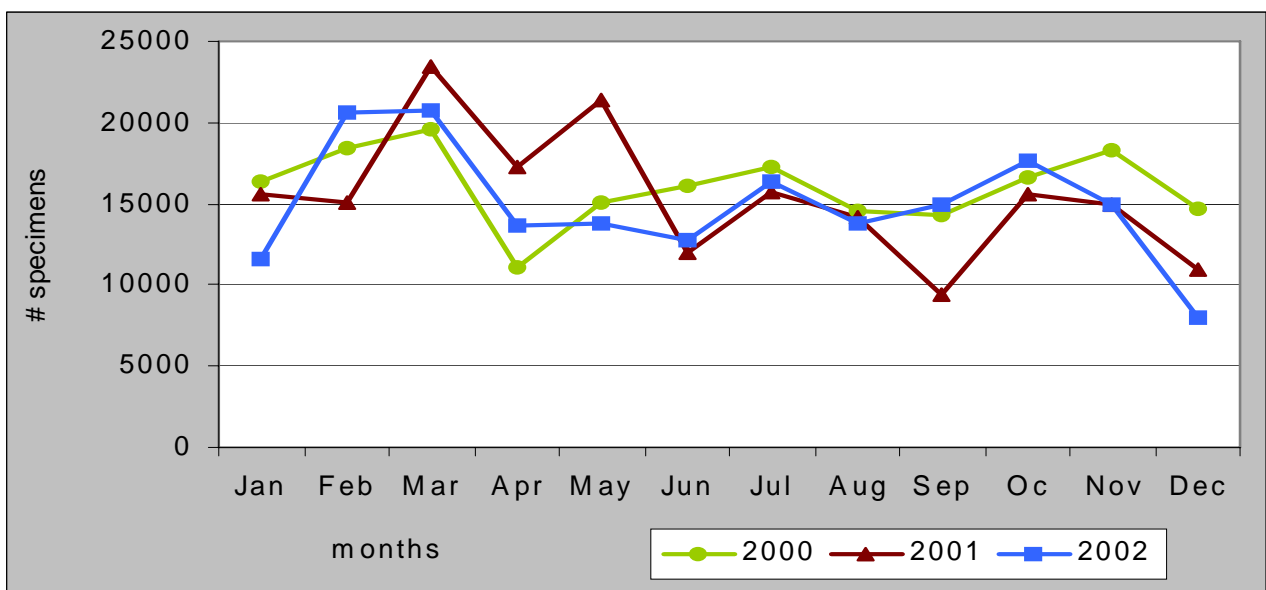


Figure 4. Monthly catch trends in the Queensland MAFF: 1999-2002.

Despite this expansion, the spatial distribution of the MAFF catch is still restricted. The Cairns region remains the most important collection area in the MAFF, followed by the coastal zone from Fraser Island to the border. To illustrate, the highest commercial catch grid in the State (shown as '1' in Figure 6) contributed approximately 35% of all marine aquarium specimens harvested in 2003. Indeed, the top four MAFF collection grids in 2003 were all located in the Cairns region. Cumulatively, the collection areas offshore from Cairns (depicted in Figure 6) contributed 62% of all marine aquarium fish caught in Queensland in 2003, approximately 122 000 specimens. The second most important region, the coastal waters from Fraser Island south to the border (primarily reefs and shoals off the Sunshine Coast, the Gold Coast and the Moreton Bay region), contributed eight of the top twenty collection grids, and contributed 27% of all marine aquarium fish caught in Queensland in 2003, approximately 52 000 specimens.

The high dependence of the MAFF on these two areas is a direct reflection of the marketing requirements of the industry (Kung 2000). Harvesters of marine aquarium fish in Queensland rely on air transportation to service both domestic and international markets. As Cairns and Brisbane are the two primary airports in Queensland, the industry has developed in close proximity. The fact that suitable marine aquarium fish habitats are found near to both is a happy coincidence, however with the Great Barrier Reef stretching along almost three-quarters of the Queensland coast there are many other areas with suitable habitats that lack the necessary infrastructure. Beyond air transportation, travelling time to the reef and to suitable harvesting locations is much shorter off Cairns and southeast Queensland (QFMA 1999).

In considering the impacts of the MAFF harvest on the target species and ecosystems in the major catch areas, it is important to put into perspective the small scale of the Queensland MAFF. Since the year 2000, the total annual harvest has not exceeded 200 000 specimens. Based on conservative assumptions (a reef perimeter of 30 kilometres providing just 100 metres of hard bottom and an average density of just three fish a square metre) the QFMA (1999) estimated that a single coral reef of average size might support about 10,000,000 fish. The GBRMP contains more than 2000 reefs and shoals. Certainly, not all fish will be equally available or equally attractive to the industry, however it remains that the sheer immensity of the available habitat and the interconnectivity of fish populations provide a large element of insurance against any adverse effects from the small input-limited MAFF.

The recent rezoning of the GBRMP through the representative areas program (RAP; implemented on July 1st 2004) significantly strengthens the validity of this argument. A considerable area of the major MAFF fishing grounds off Cairns has been closed to all fishing (Figure 6). In rezoning the marine park, the GBRMPA set aside approximately 33% of all bioregion types, meaning that at least 25% of all the habitat types used by MAFF collectors have been closed to collecting and all forms of fishing. Coupled with the range of DPI&F management arrangements and the considerable practical limitations to harvesting explained in criterion 1.1.2, the likelihood of negative impacts to the target species is minimal. To emphasise once again, international reviews of marine aquarium fisheries suggest that for well-managed fisheries such as the Queensland MAFF, the effects of collecting should be viewed not in terms of their global impact on all species but for their potential to deplete particular family groups and species, and/or particular locations (Wood 2001, Sadovy and Vincent 2002, Wabnitz et al. 2003). The following section will outline the catch dynamics for the primary family groups.

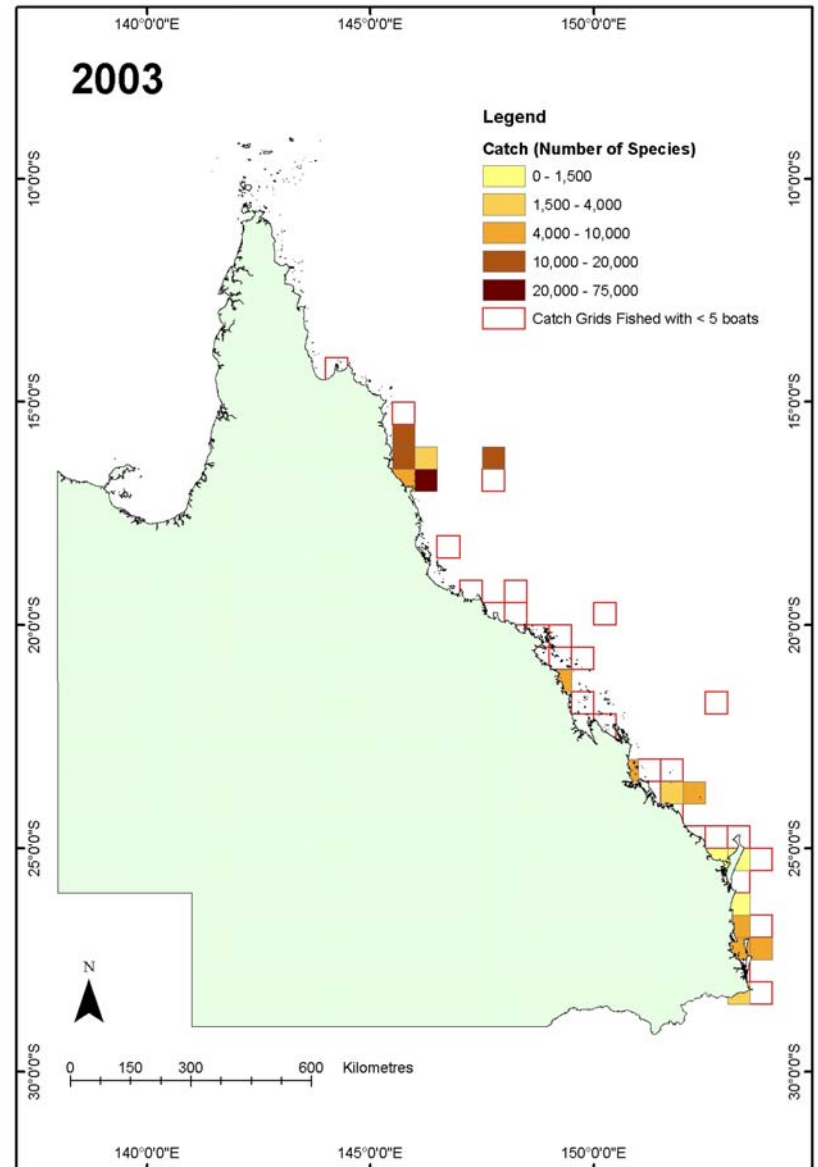
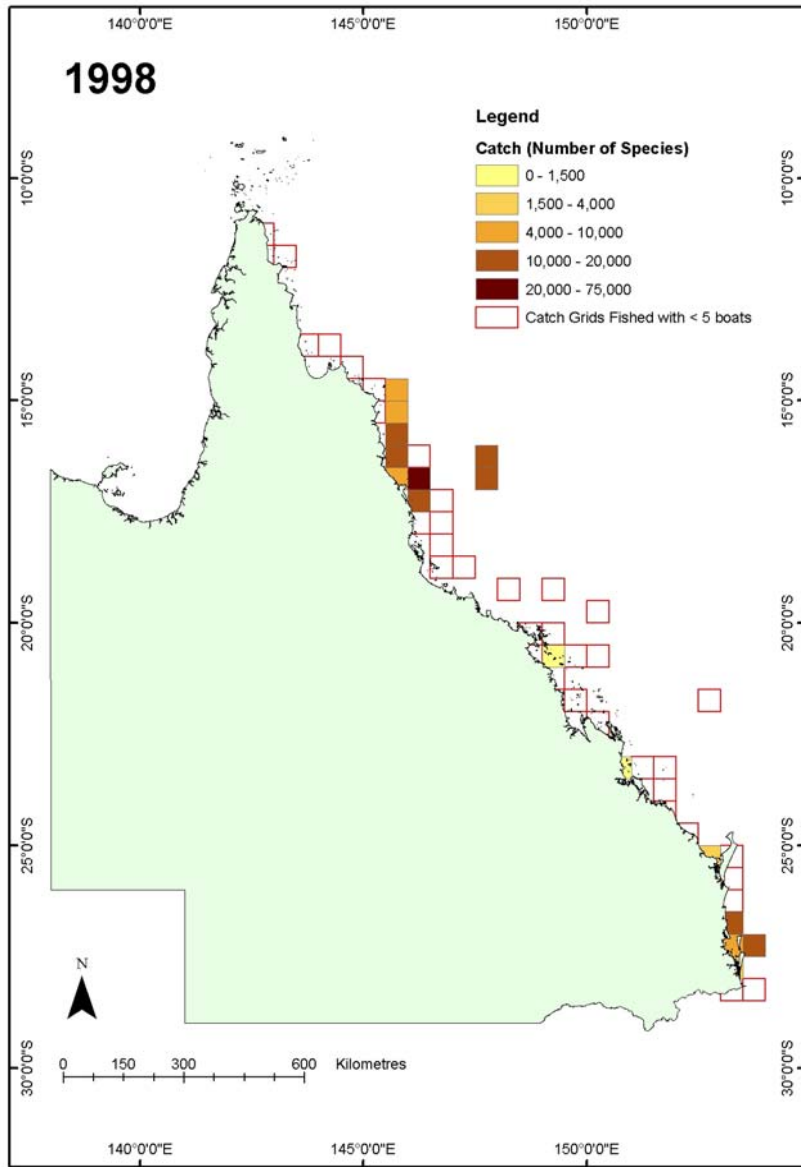


Figure 5. Spatial distribution of the MAFF catch along the Queensland East Coast in 1998 and 2003.

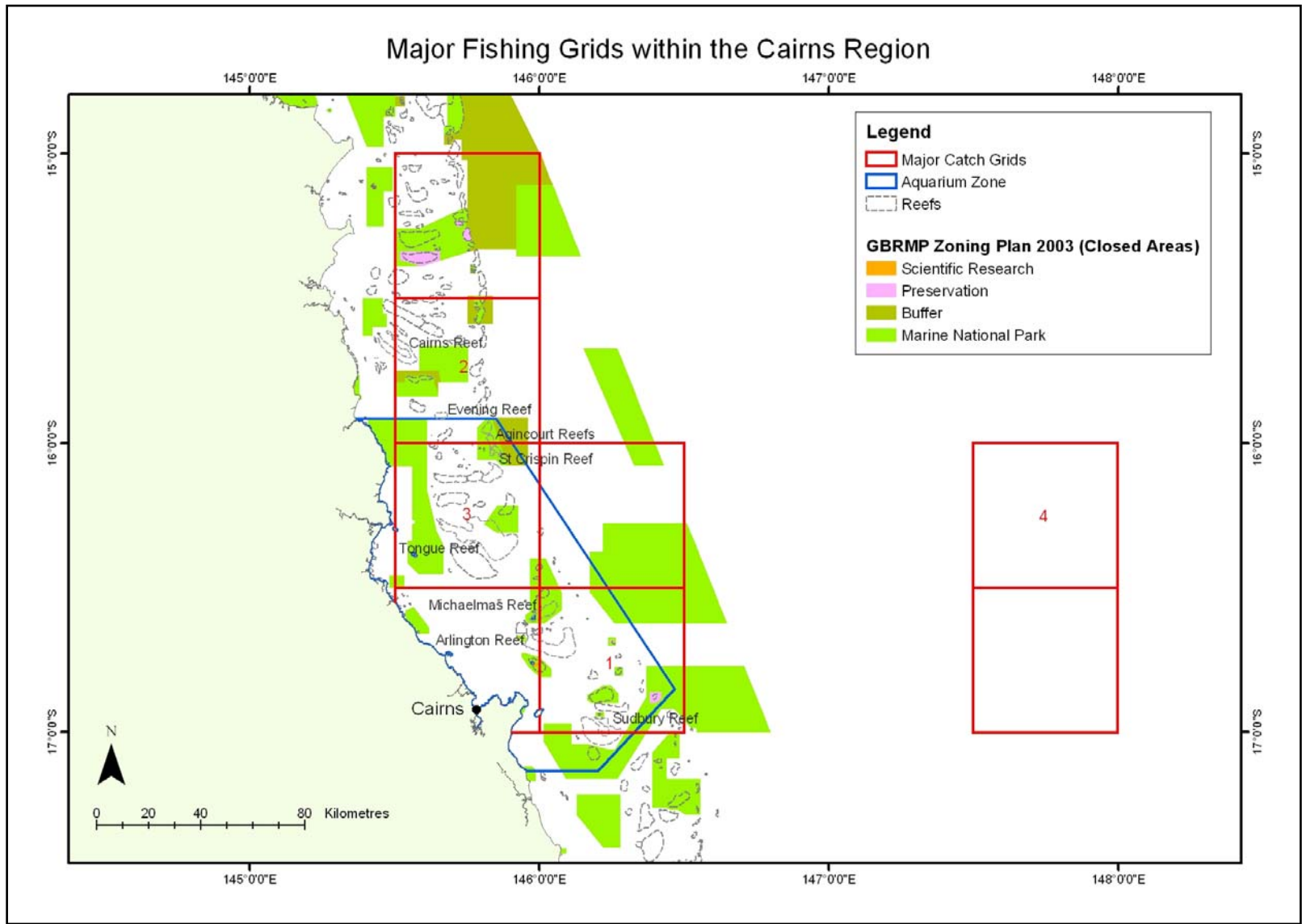


Figure 6. Map of the MAFF fishing area in the Cairns region depicting the: major catch grids based on the CFISH logbook data (bordered in red); the MAFF special management zone (bordered in blue); and the GBRMPA closed areas (light and dark green, pink and orange area).

Catches of the primary family groups

Over 1400 species from over 50 families are incorporated in the international trade in marine aquarium fish (Wood 2001). Despite this diversity however, just six fish families dominate the trade. Damsel fish (Family Pomacentridae) comprise almost half of all specimens collected, with a further 25-30 percent composed of angelfish (Pomacanthidae), surgeonfish (Acanthuridae), wrasses (Labridae), gobies (Gobiidae) and butterflyfish (Chaetodontidae) (Wabnitz et al. 2003).

Figure 7 reveals that the family groups dominating the catch in the Queensland MAFF are the same as those which dominate the international trade, though the relative contribution of each of the major families differs. Figure 8 displays the spatial distribution of the catch of these main family groups for 2003.

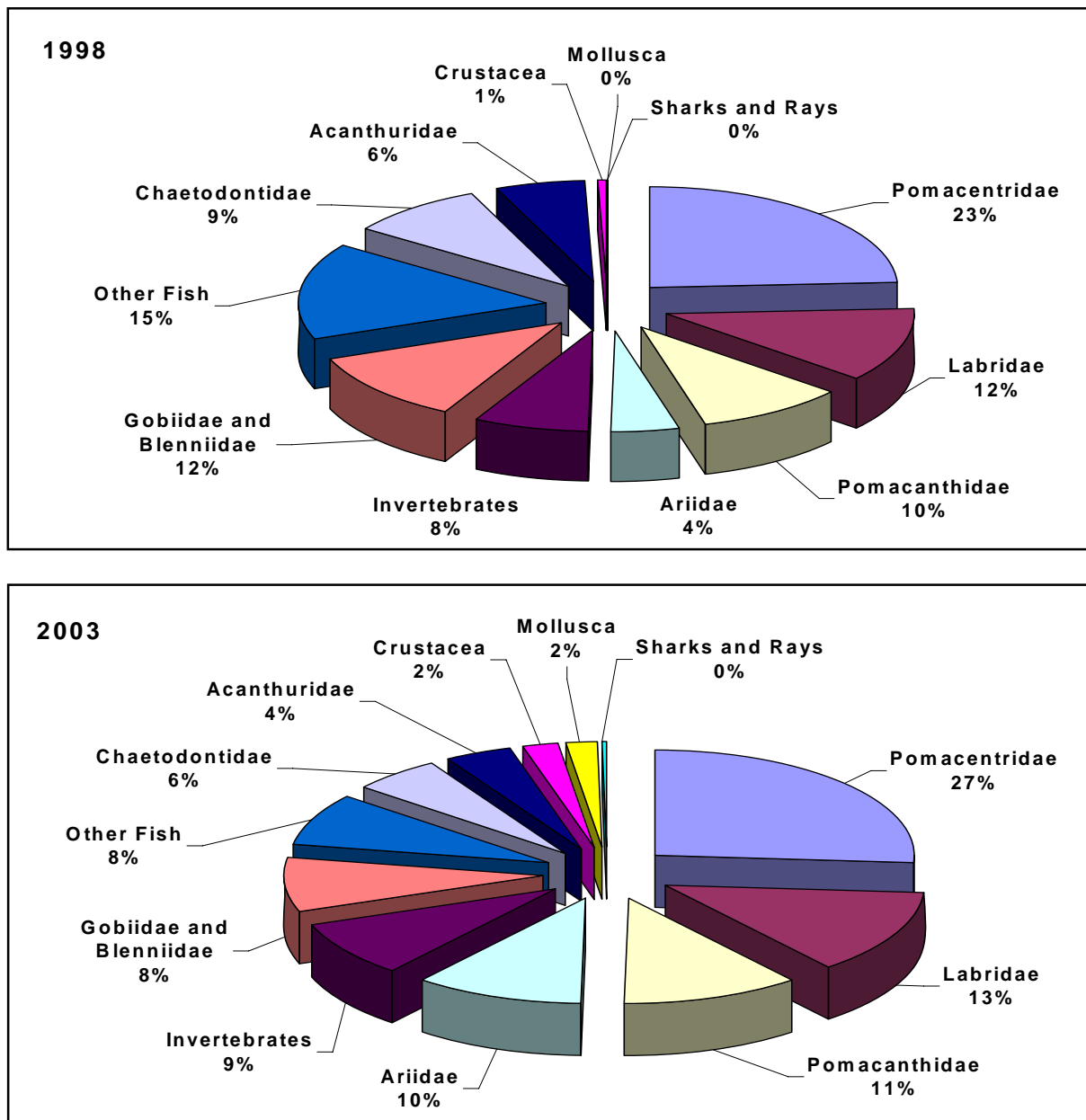


Figure 7. Proportional contribution of the major family groups to the MAFF catch in 1998 and 2003.

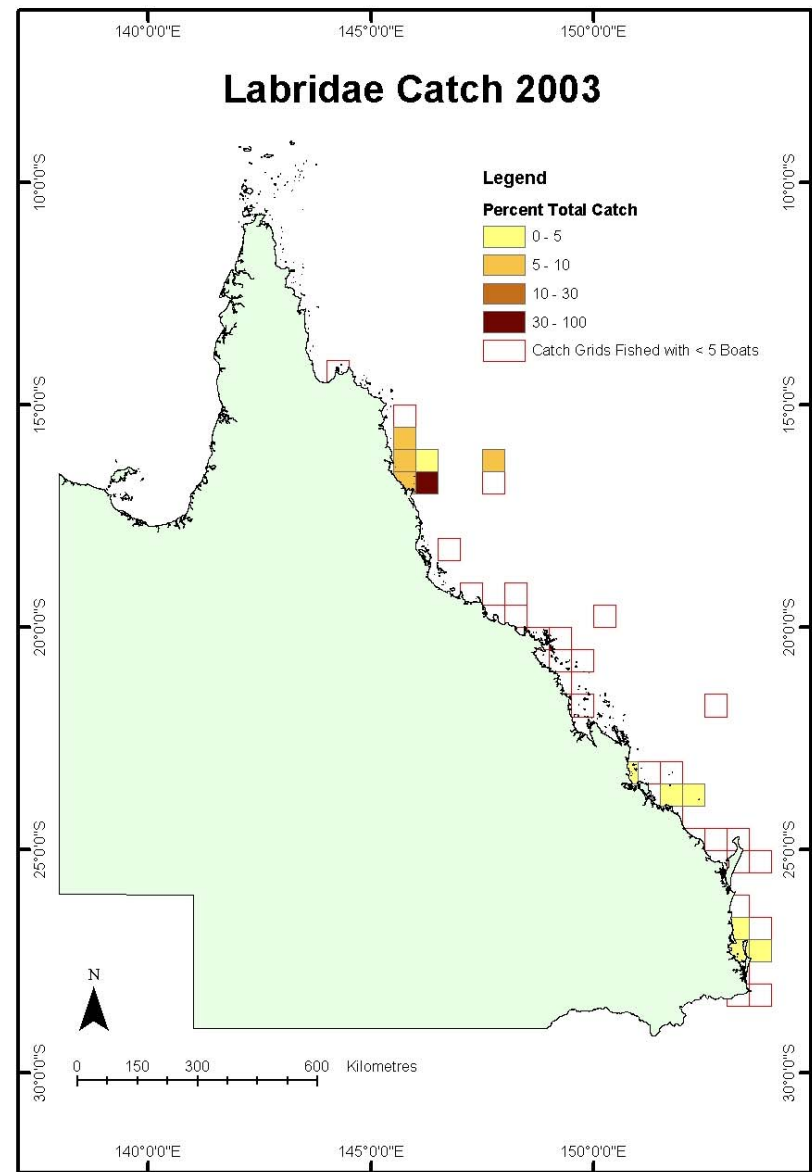
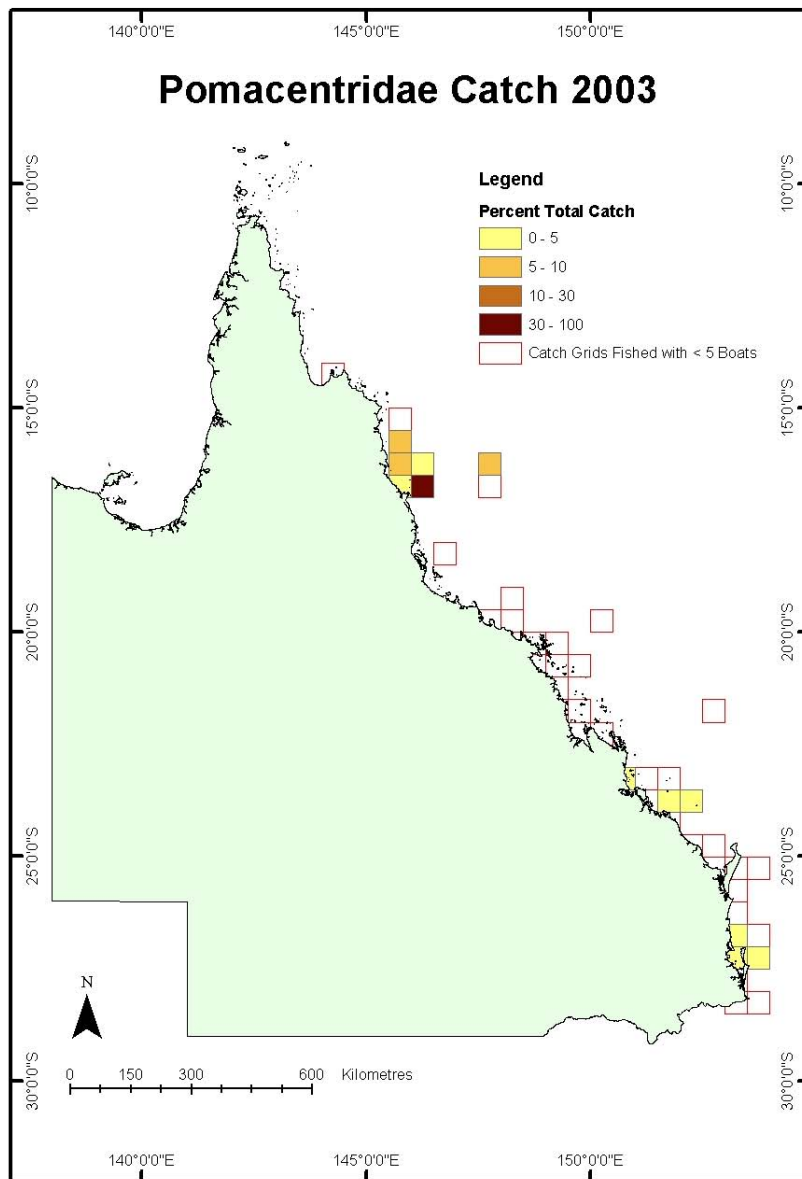


Figure 8. Spatial distribution of the catch of the primary target family groups in the Queensland MAFF.

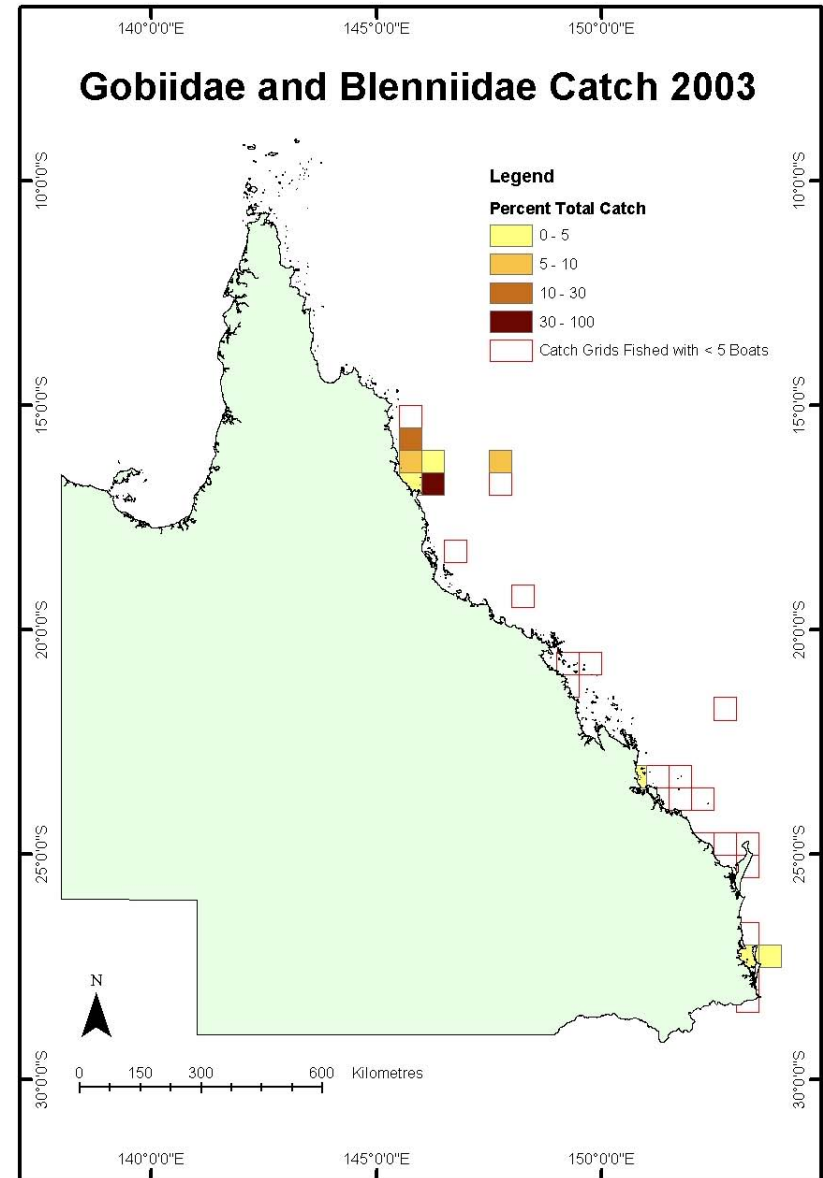
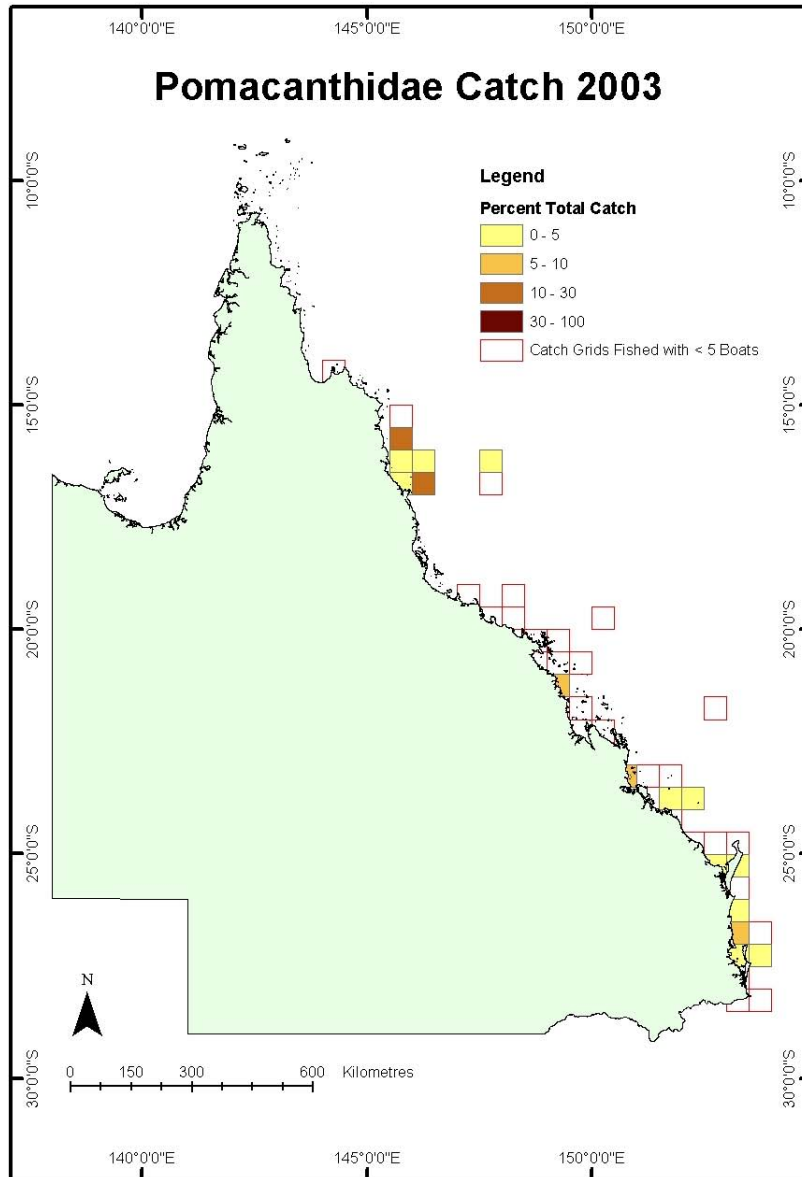


Figure 8 (continued). Spatial distribution of the catch of the primary target family groups in the Queensland MAFF.

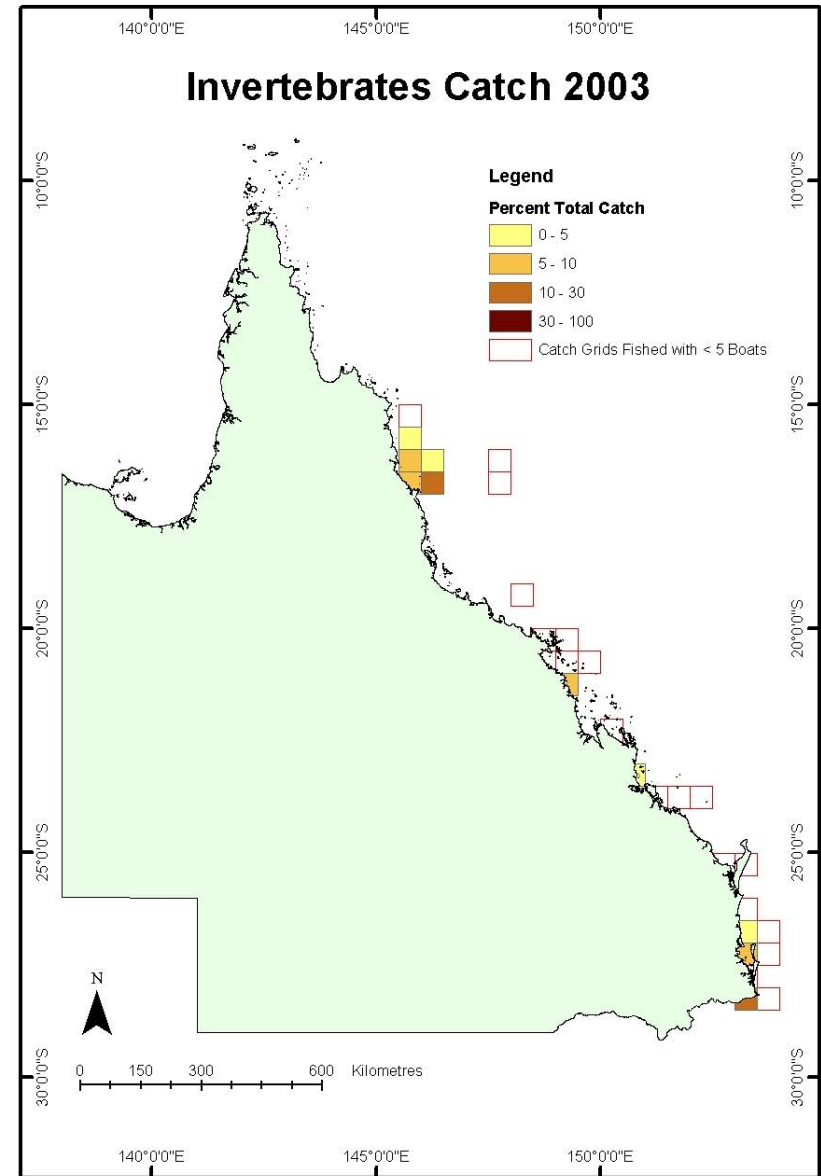
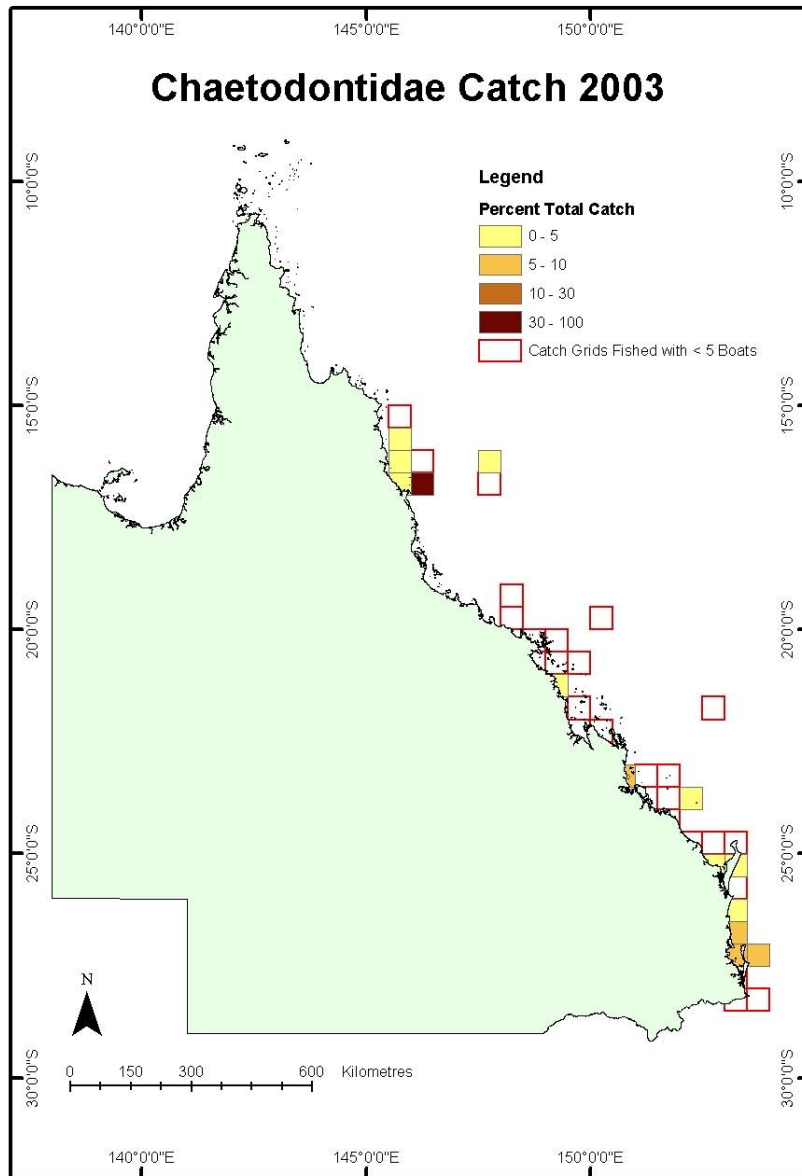


Figure 8 (continued). Spatial distribution of the catch of the primary target family groups in the Queensland MAFF.

Non-commercial Fisheries

There is no information available on the level of take for the recreational harvest of marine aquarium species. Hobby aquarists are known to harvest some marine aquarium species however the scale is believed to be inconsequential relative to the number of fish harvested in the commercial MAFF and relative to assumed natural mortality levels.

The collection of ornamental species is not considered to be a part of traditional or customary fishing practice by indigenous fishers.

1.1.5 There is a sound estimate of the potential productivity of the fished stock/s and the proportion that could be harvested.

The estimated total commercial marine aquarium fish catch in Queensland for 2003 was 197 669 fish. In considering the sustainability of the current harvest it is important to emphasise once again the risk-averse and conservative management arrangements in place in the Queensland MAFF. Operators must adhere to size and bag limits, specifically fishers authorised to take under an 'A2' fishery symbol, and are restricted to hand or hand-held non-mechanical apparatus. The SMAs also restrict the number of fishers accessing those areas, thereby reducing latent effort in the fishery.

At present there is no sound estimate of the potential productivity of the fished stocks. This is due partly to the high diversity of species that can be collected, the geographical spread of the fishery, and its relatively low economic value. However, the general status of reef fish stocks within the GBRMP, which sustains much of the catch, is monitored by a number of research surveys, including a major commitment by the AIMS based in Townsville (QFMA, 1999). AIMS spends several million dollars annually in a long-term project that surveys the status of fish and corals on up to 180 coral reefs. These surveys encompass some reefs from which fish are collected for the aquarium trade and many that are not subject to this type of harvesting. This contrast should allow local depletions to be detected. An analysis of the results from 1992 to 2003 reveals that no local depletions in MAFF species have been detected.

DPI&F considers the number of marine aquarium fish species harvested is likely to represent a small proportion of the available populations given the expanse of the reef and coastal areas available as habitat for these generally widely distributed species and where collectors do not operate.

Management responses

1.1.6 There are reference points (target and/or limit) that trigger management actions including a biological bottom line and/or a catch or effort upper limit beyond which the stock should not be taken.

DPI&F recognises that reference points provide a valuable yardstick against which to assess the sustainability of fish stocks and to indicate appropriate time frames for management intervention. At present no reference points are currently used in the management of the MAFF, however the development of such reference points will be discussed and included in the proposed Management Plan for the MAFF.

Until reference points are established (refer to **Criteria 1.1.2** and **1.1.5**), DPI&F will continue to ensure that Queensland's Marine Aquarium Fish Fishery is sustainable through monitoring of the fishery dependent information.

1.1.7 There are management strategies in place capable of controlling the level of take.

The Department of Primary Industries and Fisheries (DPI&F) manages the MAFF under the *Fisheries Act 1994* (the Act) and subordinate legislation included in the *Fisheries Regulation 1995* (the Regulations). The objectives of the Act were amended in September 2002 to more accurately reflect current interpretations of the ESD principles adopted by Queensland and all Australian governments in the *National Strategy for ESD* (COAG 1992) (See Queensland Government Legislation and Management for the objectives of the Act).

The management of the MAFF uses a variety of management controls to regulate the level of take within the fishery. This section of the assessment report is arranged into three sections; historical, current and proposed management arrangements for the MAFF.

Historical Management Arrangements of the MAFF Fishery

Table 3 is a summary overview of the history of management arrangements for the MAFF. Following Table 3 is a more detailed background to these historical management arrangements.

Table 3. Queensland Marine Aquarium Fish Fishery: History and Management

Year	Management Arrangement	Legislation
1970s	Improved technology enabled fish to be kept alive more successfully in marine tanks and during transport	<i>Fisheries Act 1976</i>
Prior to 1986	Queensland Fisheries Management Authority (QFMA) Management Body was responsible for the Marine Aquarium Fish Fishery Master Fishermen were permitted to take fish for display purposes, under the provisions of an appropriate endorsement	<i>Fishing Industry Organisation Marketing Act 1982</i>
1986	Qld Department of Primary Industries (QDPI) Fisheries Group became responsible for the management and administration of the Marine Aquarium Fish Fishery. Master Fishermen no longer permitted to take fish for display purposes. Commercial participants legally required to hold a 'Fish and Marine Products Permit' that authorised the taking of fish for display purposes. These permits were non-transferable.	<i>Fisheries Act 1976</i>
1986-1992	QDPI in consultation with Industry and Marine Parks set the number of operators annually.	
1990	DPI adopted a 'Replacement Only Policy' to control the number of operators	
1995	QFMA became responsible for the Marine Aquarium Fish Fishery. Commercial aquarium fishers were required to obtain an Authority to collect fish for display purposes only (non transferable)	<i>Fisheries Act 1994 and Fisheries Regulation 1995</i>
1997	QFMA adopted a 'Limited Entry Policy 1997' to restrict the issue of new authorities for the fishery unless	

	exceptional circumstances existed.	
1999	Discussion Paper Released: Marine Aquarium Fish and Coral Collecting Fisheries.	<i>Fisheries Act 1994 and Fisheries Regulation 1995</i>
2000	Department of Primary Industries and Fisheries (DPI&F) took responsibility of this fishery in July 2000. Commercial fishers continued to require an 'Authority to Take Fish for Trade of commerce' endorsed with the fishery symbol 'A' to collect fish for display purposes (non-transferable).	<i>Fisheries Act 1994 and Fisheries Regulation 1995</i>
2002	New Management Arrangements were Gazetted on 6 December 2002 Transferable Authorities Introduction of A1 and A2 fishery symbols to replace the existing A fishery symbol. The A1 and A2 fishery symbols commenced on 1 September 2003 . Introduction of 5 Special Management Areas for the A1 fishery symbol – Cairns, Whitsundays, Keppel, Sunshine Coast and Moreton Bay. A1 Authority Holders can nominate not more than 3 persons as nominees to take, possess and sell Aquarium Fish under their authority.	

Commercial harvest of coral reef fish for the aquarium trade dates back to the 1970's when increased growth in technology (including filtration systems, chemical testing and improved transportation) enabled fish to be kept alive more successfully in marine tanks and during transportation. At this time, the aquarium trade was largely unregulated, and licensed Master Fishermen were able to take and sell marine fish for display purposes. The number of participants, or the harvest of reef fish for the aquarium trade is unknown for this period.

Before 1986, management of the aquarium fish fishery was the responsibility of the QFMA. Master Fishermen were able to take fish for display, under the provisions of an appropriate endorsement. In 1986, responsibility for administration and management of the fishery was assigned to the Queensland Department of Primary Industries (DPI) Fisheries Group. Provisions existed under Section 58 of the *Fisheries Act 1976* to manage the fishery.

In 1986, with changes to the Fisheries legislation, it was no longer legally possible to manage the aquarium fish fishery under the *Fishing Industry Organisation and Marketing Act 1982*. The result was that marine aquarium fish could no longer be taken for sale by fishermen under the authority of a Master Fisherman's Licence. The DPI&F became responsible for the fishery's management in 1986, and it became a legal requirement that all commercial participants in the fishery hold a *Fish and Marine Products Permit* that authorised the taking of fish for display purposes (Couchman and Beumer 1992).

Input controls have regulated the level of effort in the aquarium fishery through limitations on the numbers of permits granted. From 1986 to 1992, the DPI, in consultation with industry and Marine Parks set the number of operators annually. Increases in technology, export opportunities, and popularity of the 'mini-reef' display were considered to be major factors contributing to the increased commercial participation over this period. When the number of permits reached 160 in 1990, the DPI decided that the number of operators would be based on a 'replacement only' policy (Limited Licensing Scheme), with renewal on application of permits to existing operators only for the 3 years (1992 to 1994) to allow monitoring with relatively constant fishing effort (Couchman and Beumer 1992).

Permits issued by the DPI&F were non-transferable and, therefore, did not allow new entrants to enter the fishery. This caused a decrease in the number of permits over the next few years. When the QFMA took over the fishery's management in 1995, 69 participants remained.

In 1995, responsibility for managing the aquarium fish fishery was transferred to QFMA. The new *Fisheries Act 1994* and *Fisheries Regulation 1995* gave the QFMA responsibility for managing all wild stock fisheries, including aquarium fish. Aquarium fish fishers were required to obtain an authority to collect fish for display purposes only. The QFMA developed a 'Limited Entry Policy 1997' and the marine aquarium fish fishery along with other Queensland fisheries were managed on a limited entry basis. In particular the policy reads

“that fishing effort in all commercial fisheries is most likely presently at maximum levels in terms of the resource availability, the community impact of commercial fishing and sharing of access to fisheries resources. Community and resource pressures are such that there is a need to control, and in some cases reduce, the numbers of commercial fishers who have access to fisheries,” and

“until such time as a management plan is determined for a specific fishery under Part 5 of the Act, no further authorities...for that fishery will be issued.....”.

There is, however, a facility available for a new authority to be issued in light of the Limited Entry Policy. Where the applicant can successfully demonstrate that special circumstances exist, the management authority or its delegate may depart from the provisions of the policy in deciding the application. No particular special circumstances are specified. All applications or proposals that require formal decisions are considered by the decision maker and decisions are made on the merits of each individual case, taking into account all relevant factors. It would have to be an exceptionally convincing case for a decision maker to decide to depart from the established policy and issue another license. Only one new Aquarium Authority has been issued under provisions of the Limited Entry Policy in the last 6 years. No other special circumstances permits to gain access to the MAFF have been received since that time.

In 1999 QFMA released the 'Discussion Paper – Queensland Marine Aquarium Fish and Coral Collecting Fisheries' (the 'Discussion Paper') (QFMA 1999) seeking public comment and input on an extensive range of issues facing the fishery (see beginning of this document under Queensland Government Legislation and Management for a complete list of the issues raised for public comment). The release of the Discussion Paper was the first step in developing a formal Management Plan for the fishery.

QFMA collated and analysed the ninety-two responses that were received. There were twelve group responses and eighty individual responses comprised of responses from:

- Organisations/groups/branches;
- Commercial fishers;
- Recreational fishers;
- Conservationists;
- Retailers;
- and other stakeholders.

Most of the respondees were from Queensland, with a few from interstate and overseas.

HarvestMAC also analysed the responses and provided comments and recommendations. See Table 4 for a breakdown of HarvestMAC stakeholder membership.

Table 4. Current HarvestMAC stakeholder membership

Stakeholder Interest
QDPI&F Appointed Chair
Recreational Fisher
Research Scientist
Qld Boating & Fisheries Patrol (QBFP)
Qld Aquarium Supply Divers Association (QASDA) (Marine Aquarium/coral)
Qld Parks and Wildlife Service (QPWS)
Industry representative (Sea cucumbers)
Industry representative (Tropical Rock Lobster)
Great Barrier Reef Marine Park Authority (GBRMPA)
Malacological Society of Australia (Shells)
DEH observer

The DPI&F took responsibility for this fishery in July 2000 when the QFMA disbanded. The DPI&F adopted the Limited Entry Policy 1997 continuing to manage the aquarium fish fishery on a limited entry basis. Fishers were required to hold an Authority to Take Fish for Trade or Commerce, endorsed with the fishery symbol 'A' to collect Marine Aquarium Fish.

Recent amendments to the Queensland *Fisheries Regulation 1995* (the 'Regulation') provide for the transfer of Aquarium Fish Authorities, previously endorsed with the fishery symbol A and the issue of A1 and A2 fishery symbols, based on historic participation in the fishery.

The development of a formal Marine Aquarium Fish Fishery Management Plan remains a priority for DPI&F. At present, the development of specific management plans for the Marine Aquarium Fish Fishery is on hold, pending the implementation of management plans currently 'in-progress' for other fisheries.

Current Management Arrangements

The current management arrangements for the MAFF can be divided into these categories: those that apply to all fishers, those that apply only to the commercial fisheries and those that apply only to the recreational fisheries. Different management arrangements exist for recreational and commercial collectors based on whether the collection of marine aquarium fish is occurring in zoned areas of the Great Barrier Reef Marine Park or not.

All fishers

Harvest of aquarium fish is by hand or hand-held non-mechanical implements only, with the use of fishing lines, cast nets, scoop nets and seine nets. Both recreational and commercial harvesters must adhere to existing fish size and bag limits.

Commercial aquarium fish fishery

Commercial harvesting of fish for aquarium fish purposes is controlled by existing regulatory requirements, which limit access to holders of an *authority to take fish for trade or commerce* endorsed with an 'A1' or 'A2' fishery symbol. The fishery is managed on a limited entry basis with no additional Authorities being granted. Authorities are transferable therefore individuals wanting to enter this fishery can do so by obtaining an existing authority.

The legislative provision for 'A1' and 'A2' fishery symbols came into place in December 2002 however they were not issued and did not replace the 'A' fishery symbol until 1 September 2003. These fishery symbols were granted to existing authority holders based on historic participation in the fishery. The A1 and A2 fishery symbols have been developed in consultation with Industry, the Harvest Fishery Management Advisory Committee (HarvestMAC) (See Table 4), and were

released for public consultation in the Marine Regulatory Impact Statement in September 2002. The fishery symbols address latent effort and localised depletion concerns in the fishery.

There are five SMAs within the fishery area (see Figure 1):

- Moreton Bay - waters within the Moreton Bay Marine Park;
- Sunshine Coast - waters north of Cape Moreton and south of latitude 26°18' south, other than waters within the Moreton Bay Marine Park;
- Keppels - waters west of longitude 151°08' east and between latitude 23°15' south and latitude 23° south;
- Whitsundays - waters within the described as area 1 in the Whitsundays Plan of Management;
- Cairns - waters within the following boundary –
 - from the intersection of latitude 17°08' south with the mainland shore to latitude 17°08' south, longitude 146°12' east
 - to latitude 16°51' south, longitude 146°12' east
 - to latitude 15°55' south, longitude 145°51' east
 - along latitude 15°55' south to the mainland shore
 - along the mainland shore to latitude 17°08' south.

Criteria 1.14 details the impacts on these areas, particularly the Cairns region, with the introduction of the new GBRMP Zoning.

The SMAs can only be accessed by holders of an A1 symbol. Access to these areas is based on historic participation in the region and can comprise one or more areas per A1 authority holder. The remaining area of the fishery is open to both A1 and A2 authority holders.

There are two special permits issued for the MAFF. One is for an one operator to take particular species (restricted by number) using restricted apparatus for supply to certain public aquaria. In addition to the operator being able to take species under an Authority to Take (fishery symbol 'A1' or 'A2'), the operator, under the permit conditions, is authorized to take very limited numbers of groper (*Ephinephelus lanceolatus*), sharks and rays (excluding grey nurse sharks and great white sharks) using specified gear, Potato Cod, small Maori Wrasse, small Black Kingfish, species of holothurians, small Red Emperor and small fish from the Family Carangidae (including Giant Trevally – *Caranx ignobilis*).

The other permit is for the take of blue catfish from the Brisbane River using barbless hooks and line only.

General Conditions for taking fish under authority with a current 'A1' or 'A2' Fishery Symbol

As at 1 September 2003, the general management arrangements that apply to all commercial fishers with an A1 or A2 fishery symbol include:

Not more than 3 persons may take fish at the same time under the authority.

Only the boat identified in the authority and one other boat may be used to take fish in the same location.

Authority holders must not sell fish for human consumption.

Fishing lines, cast nets, scoop nets and seine nets may be used, with limitations relating to their dimensions and mesh size. All apparatus are attended at all times by the diver. Only barbless hooks may be used. During collection SCUBA and hookah may be used.

Fish other than these fish may be taken:

- barramundi;
- beche-de-mer (sea cucumber);

- shell grit;
- star sand; and
- any species of coral, oyster, pearl shell, or trochus.

Beche-de-mer above does not include fish of the following species:

Bohadschia graeffei;
Calachrius crassus;
Cucmaria miniata;
Euapta godeffroyi;
Holothuria hilla;
Holothuria edulis;
Opheodesoma spp;
Pentacta anceps;
Pentacta lutea;
Pseudocolchirus violaceus;
Stichopus noctivagus; and
Synapta maculata.

Note: These are small and colourful species of beche-de-mer that are of little or no value to the commercial beche-de-mer fishery. They can be of high value to aquarium fishers.

The meaning of fish by definition under the Act includes an animal (living or dead) that throughout its life cycle usually lives in water, on foreshores or in or on land underwater. 'Fish' does not include crocodiles or protected animals under the *Nature Conservation Act 1992*. Marine species that are listed as protected under the *Nature Conservation Act 1992* can be found in Appendix 6.

The authority holder may sell fish taken under the authority only if the fish are to be used for:

- display as aquarium fish; or
- brood stock.

Conditions on authorities endorsed for the MAFF specify:

- the permitted area of operation
- the vessel authorised for commercial operations;
- the boat mark; and
- that only two divers/harvesters, plus the authority holder or nominee, may participate in the operation.

Authority holders are required to submit logbook returns within 14 days at the end of every month.

Additional Conditions – 'A1' Fishery Symbol

Authority holders endorsed with an A1 fishery symbol may have access to one or more of five SMAs. Access to the SMAs is based on historic participation in the region. A1 authority holders also have access to the rest of the fishery area along the Queensland coast

A1 authority holders can nominate not more than 3 persons as nominees to take and sell fish stated in the authority. Written notice must be given to the Chief Executive of all nominees. The authority holder or nominee must be present when the fish are taken.

Additional Conditions – 'A2' Fishery Symbol

Authority holders endorsed with an A2 fishery symbol have limited access to the fishery by the implementation of an in possession limit of 10 fish comprising not more than 2 of any given species. Holders of an A2 fishery symbol do not have access to the SMAs.

Recreational fishery

Recreational fishers are limited by all existing bag and size limits for fisheries, as outlined in the Regulations. Recreational fishers are not permitted to sell their catch.

In addition, within the Moreton Bay and other State Marine Parks and the Great Barrier Reef Marine Park, additional limitations exist on recreational harvesters, which may include the requirement for a permit or limitation on the numbers taken over a period of time.

Basis for Current Management Arrangements

Unlike most fisheries in Queensland, which are considered to be fully developed, the aquarium fish fishery has never been managed with the intention of extracting the greatest sustainable yield from the stocks. Partly, this is in recognition of the high value that these resources have for other sectors including passive uses and the lack of specific stock abundance information on species harvested. This is also because harvesters supply specialist niche markets meeting only the low volume demand for a quality high-value product.

Limited licensing of the commercial sector is often used to contain levels of fishing effort. Limited licensing schemes were brought in for the aquarium fish fishery around 1990. QFMA endorsed this approach in 1995 when it assumed responsibility for this fishery.

Dive fisheries are heavily dependent on individual human effort, unlike industrialised (e.g. trawling) or more passive (e.g. crab, line, net) fisheries. Each specimen has to be located, captured and managed. In addition, divers are restrained by physiological limits (decompression sickness) from working long hours under high pressures. Consequently, limitations placed upon the number of divers who may assist an Authority holder impose a further cap on effort. Currently, the impact of the dive fishery for marine aquarium fish is limited substantially by controls on effort.

The species of fish and other organisms that commercial aquarium fishers are authorised to harvest have varied over the years. With the introduction of the *Fisheries Regulation 1995*, the species of fish able to be harvested included fish other than barramundi, beche-de-mer (except non-commercial species), shell grit, star sand, and any species of coral, oyster, pearl shell or trochus. This definition provides for the commercial harvest of echinoderms (starfish, sea urchins); molluscs (shells, octopus, nudibranchs); crustaceans (shrimp, prawns, crayfish); sponges; ascidians and polychaete worms; but excludes all sea cucumber and soft corals including anemones. All current size and bag limits must be adhered to for crabs, and for all finfish species. Additionally, marine fauna listed under the *Nature Conservation Act 1992* are not permitted to be harvested.

Anemone or clownfish live within the protective tentacles of anemones, which are a species of soft coral. In the past aquarium fishers have taken anemones in conjunction with the clownfish to provide the whole anemone fish habitat for marketing purposes. However, under the current regulations this is not permitted.

According to logbook data from the past five years, invertebrates on average comprise 5% of the commercial catch of MAFF species. The impact of harvesting these largely sedentary species is unknown. While many of these species are not harvested now, owing to a lack of knowledge about their biological and physiological requirements, increases in technology and scientific knowledge may provide future demand for these species in the aquarium trade.

While a huge diversity of species is demanded for the aquarium fish trade in Australia and overseas, a number of particularly important species are targeted by commercial and, probably, recreational fishers (See Table 1 and Appendix 2).

Fisheries (Coral Reef Fin Fish) Management Plan 2003

In addition to the above management arrangements, the regulations applying specifically to Coral Reef Fin Fish caught in the MAFF is controlled under the *Fisheries (Coral Reef Fin Fish) Management Plan 2003* (the Plan). The plan includes exemptions for MAFF authority holders where by the holder of a commercial fisher licence who takes or possesses fish under the fishery symbol 'A1' or 'A2' may take or possess a prescribed fish that is less than the minimum size stated in schedule 4, part 2 of the Plan. Considering the biology of the main groups of fish harvested in the MAFF, and the natural mortality rate generally found among juvenile populations, there has been no concern about removing the minimum size limits for the marine aquarium fishers.

Under the Plan the take or possession of barramundi cod, chinamanfish, humphead Maori wrasse, paddletail, potato cod and Queensland grouper is prohibited. Marine aquarium fishers will be required to apply for a permit to collect these species under special circumstances eg. display at public aquaria. Such applications will be considered on their merits and decisions will take into account all relevant factors including the numbers of fish involved and the likely impact on the population.

Rezoning of the Great Barrier Reef Marine Park through the Representative Areas Program

With most of the commercial MAFF catches taken within the boundaries of the GBRMP, the zoning arrangements within the Marine Park have a significant effect on the operation and long-term sustainability of the MAFF. The World Heritage Area (WHA) status of the GBR adds an additional responsibility to manage the fishery with respect to the WHA values for which the Marine Park has been listed.

The rezoning of the GBRMP introduced on July 1st 2004 following the Representative Areas Program (RAP) has significantly enhanced the network of closed areas. Under the new zoning arrangements, approximately 33% of the marine park area is now included in green zones, which are closed to all extractive uses including commercial and recreational fishing. The RAP process identified 70 distinct bioregions within the Marine Park, and aimed to ensure that at least 20% of every bioregion was adequately protected through the network of green zones. As the reef and inner reef habitats and marine aquarium fish communities fished in the MAFF are included in the designated bioregions, they have been protected to at least the minimum 20% level within the Marine Park. As the GBRMPA have noted, the rezoning "better protect[s]...the entire range of habitats, plants and animals in the marine park to maintain the health and resilience of the ecosystem and provide benefits for present and future users" (GBRMPA website: www.gbrmpa.gov.au/corp_site/management/zoning/rap/rap/pdf/FAQs_3Dec2003.pdf).

The new network of closed areas has considerably increased the level of protection afforded to ecological communities within the GBRMP, and will certainly produce flow on benefits to the MAFF. In saying this however, DPI&F recognise that the GBRMP green zones are not a panacea for all the management issues in the fishery. GBRMPA's zoning arrangements are not designated only on the basis of fisheries-related impacts, but rather incorporate all impacts to the Marine Park. In addition, historically the level of fishing effort within the Marine Park has varied temporally and spatially, meaning that the flow-ons to the MAFF may similarly vary.

Fisheries declarations listed under the Queensland Fisheries Act 1994

In association with the current management arrangements, DPI&F has various mechanisms available under the *Fisheries Act 1994* to respond in a timely manner to threats to the sustainability of the fishery. These include power to:

- a) declare a closed season, closed waters or closed species (section 43 of the Act);
- b) declare quota (section 44 of the Act);
- c) make an emergency fisheries declaration (section 46 of the Act) where urgent action is needed to meet a significant threat to fisheries resources or habitat;
- d) refuse to issue or renew an authority (section 59 of the Act) where it is necessary or desirable for the best management or protection of fisheries resources;
- e) impose conditions on issue or renewal of an authority (section 61 of the Act);

- f) amend an authority through a 28-day 'show cause notice' (section 63 of the Act); and
- g) amend an authority by written notice (section 63 of the Act) – where the quota is to be changed.

Compliance responsibilities

The Queensland Boating and Fisheries Patrol (QBFP) is responsible for ensuring compliance with relevant fishery legislation in the MAFF. The fishery is managed through the *Fisheries Regulation 1995*, legislated under the *Fisheries Act 1994*.

QBFP officers are stationed in District Offices along the length of the Queensland coastline, including all major communities adjacent to the GBRMP in which the MAFF primarily operates. Medium-sized vessels operating out of the District Offices conduct patrols of local inshore areas and reefs. In addition, there are larger long-range patrol vessels located in Cairns, Townsville and Gladstone that conduct surveillance trips over offshore areas. QBFP can conduct enforcement operations for fisheries legislation, Marine Park legislation, and transport legislation. The QDEH Marine Parks section has bases in several regional centres and also patrol the GBR region and can conduct enforcement activities in relation to Marine Park legislation.

In addition to the surface patrols, the GBRMPA also uses aerial surveillance flights by COASTWATCH. Breaches in Marine Park legislation observed by the aerial surveillance can be progressed via the GBRMPA. Pettitt and Haynes (1994a, b) reviewed the earlier aerial surveillance information and recommended that a number of changes would need to be made to ensure that the competing demands of a surveillance program and enforcement responsibilities could be met.

QBFP activities focus on both the commercial and recreational sectors and ensure compliance in accordance with the *Fisheries Act 1994 and Fisheries Regulations 1995* more generally. For the MAFF this involves the inspection of: possession limits on permitted species, number; fishing gear and configuration; area restrictions; licences; and logbooks.

Compliance

The Queensland MAFF Fishery is small in terms of size, volume (number of species harvested) and commercial value in relation to other fisheries. Resources to undertake monitoring, assessment and compliance of the MAFF are allocated by DPI&F commensurate with the size of the fishery. A range of enforcement and compliance measures are in place in the MAFF Fishery. One aspect of compliance in the fishery concerns the compulsory return of daily logbook information. For the MAFF, the daily logbook records must be returned to DPI&F within 14 days at the end of every month.

If a fisher does not return the logbook data, the following steps are followed:

- a reminder letter is sent requesting the logbook, and also reminding the fisher of the compulsory logbook requirement;
- approximately one month later a 'show cause' letter is sent. The letter again requests the logbook and also asks the fisher to show cause why the non-compliance should not result in suspension of the fisher's license for that fishery.
- if the logbook is still not forwarded, the fisher's licence for the fishery may be suspended until the logbook is provided.

The Act provides DPI&F with extensive mechanisms that ensure it can respond in a timely manner to any threats to the sustainability of the fishery. These include the power to: declare a closed season, closed waters or closed species (section 43 of the Act);

- declare a quota for a fishery (section 44);
- make an emergency fisheries declaration (section 46) where urgent action is needed to meet a significant threat to fisheries resources or habitat;
- refuse to issue or renew an authority (section 59) where it is necessary or desirable for the best management or protection of fisheries resources;

- impose conditions on issue or renewal of an authority (section 61);
- amend an authority (section 63); and
- suspend or cancel an authority (section 67) where it is necessary or desirable for the best management, use, development or protection of fisheries resources or fish habitats.

The Fisheries Act 1994 ('the Act') defines 'an offence against fisheries legislation prescribed under a regulation or Management Plan to be a serious fisheries offence'. In effect, the Act enables offence types common to many fisheries to be covered by regulation, and significant offences may be addressed within a management plan for that fishery. Section 108 of the Fisheries Regulation 1995 establishes serious fisheries offences as:

- Forfeiture offences for which an inspector may seize fisheries resources in a heap (for example, fish in a processing establishment where, because of the quantity of fish, it is impracticable to count the fish of a particular species or type);
- Offences against fisheries regulation that involve:
 - contravening a closed season or closed-water declaration;
 - buying or selling fish;
 - obstructing, hindering or resisting an inspector; and
 - using or possessing illegal fishing apparatus.

A 'serious' offence can have several consequences. The most obvious is in the penalties applied to offenders. Magistrates have full discretion in setting penalties for fisheries offences up to a maximum level for each offence. If an offence is identified as 'serious', then it is likely that a higher-level fine would be applied.

The Queensland Boating and Fisheries Patrol (QBFP), a division of the DPI&F, undertakes compliance and enforcement activities for all Queensland's fisheries resources. Officers stationed at district offices along the Queensland east coast are involved in enforcement of the provisions of the *Fisheries Act* and the *Fisheries Regulations* described above.

A new Compliance Activity System is currently being developed by DPI&F that will record detailed information on activities performed by the QBFP. The new system will include:

1. Breach Reports Issued (including offences and court outcomes)
2. Unattended Breach Reports
3. Fisheries Infringement Notices (FINS) issued
4. All field activities (from new Field Occurrence Logs)
5. Complaints made via the Fishwatch hotline (Including follow up actions)

As part of this project a number of new code categories have also been developed to allow consistent reporting:

1. Fishery Codes
2. Offence Codes

The location of offences and field activities will also be recoded to 6 nautical mile CFISH sites. This will allow enforcement activities and offences to be represented spatially. Progress to date has been the development of the new system to record Breach Reports, Unattended Breach Reports, and Fisheries Infringement Notices. The new Field Occurrence Logs are currently being trialed.

Present compliance levels are encouraging with recent investigations revealing no major compliance issues within the MAFF.

1.1.8 Fishing is conducted in a manner that does not threaten stocks of by-product species.

(Information contained in Criteria 1.1.1 to 1.1.7 should be applied to by-product species to an appropriate level)

The Australian Government's 'Guidelines for Ecologically Sustainable Management of Fisheries', under which this assessment has been prepared, deals with byproduct and bycatch independently. Accordingly, byproduct will be covered in this criterion 1.1.8, and bycatch will be covered in Principal 2 – Objective 1 – criteria 2.1.1 to 2.1.6. In this assessment, byproduct is defined as all retained non-target catch. Bycatch is defined as all non-retained catch – whether released alive or discarded (i.e. dead). Australia's National Bycatch Policy and a significant body of literature relating to non-target catches support these definitions (e.g. Alverson et al. 1994; Mapstone et al. 1996; Harris and Ward 1999).

Byproduct is generally defined as the component of the landed catch that is not targeted directly but is taken incidentally whilst fishing for the main target species. For fisheries, such as trawl and netting, with high incidental catch rates and even those with lower rates such as line fisheries, the impacts to byproduct species can be an important consideration. However, for Aquarium fisheries, in which the fishing methods and gear used are totally selective, and in which the market has a strong incentive for the aquarium trade to minimise byproduct catches, there is only a very limited, if any, threat to byproduct species.

1.1.9 The management response, considering uncertainties in the assessment and precautionary management actions, has a high chance of achieving the objective.

The current management arrangements in place in the MAFF are conservative and precautionary (Refer to **Criterion 1.1.7**).

The MAFF is managed through controls legislated under the *Fisheries Act 1994* and the *Fisheries Regulations 1995*. The MAFF management regime is further reinforced by the presence of large areas closed to fishing operations under GBRMPA's zoning arrangements for the GBR marine park.

DPI&F recognises that many of the species targeted in the MAFF are susceptible to over-exploitation due to their life history characteristics, specifically those restricted to special habitats, and has therefore managed the fishery accordingly. A strict limited entry policy has been in place in the fishery since the late 1990s to control the expansion of the fishery. Only 49 'A1' and 'A2' endorsements are now authorised to fish in the MAFF with zoning restrictions applying to reduce latent effort in the fishery. Restrictions on the amount and type of fishing gear that may be used are also long established and further ensure that the fishery does not overexploit the capacity of the available fishery resources.

There is a reliable information collection system in place in the fishery from fishery-dependent data. The CFISH program provides a long time-series of reliable fishery-dependent data on the commercial catch and effort in the fishery. This information is sourced from the daily logbook records that all commercial fisher's are required to return to DPI&F as a condition of operation.

The information outlined in **Criteria 1.1.1 to 1.1.8** clearly shows the adequacy of the information, assessment and management aspects pertaining to the target species of the MAFF. DPI&F believes that the management arrangements for the MAFF will ensure that catches of marine aquarium species are restricted to levels that maintain ecologically viable stocks.

Objective 2.

Where the fished stock(s) are below a defined reference point, the fishery will be managed to promote recovery to ecologically viable stock levels within nominated timeframes.

Management responses

1.2.1 A precautionary recovery strategy is in place specifying management actions, or staged management responses, which are linked to reference points. The recovery strategy should apply until the stock recovers, and should aim for recovery within a specific time period appropriate to the biology of the stock.

and

1.2.2 If the stock is estimated as being at or below the biological and / or effort bottom line, management responses such as a zero targeted catch, temporary fishery closure or a 'whole of fishery' effort or quota reduction are implemented.

Queensland has a long-term commitment to ESD principles, most notably through the *Fisheries Act 1994*. The recent *Primary Industries Legislation Amendment Act 2002* (PILA Act) has further refined and focussed DPI&F' ESD obligations to ensure "...the use, conservation and enhancement of the community's fisheries resources and fish habitats..." (The State of Queensland 2002, pg 1).

The MAFF is managed by the DPI&F via a suite of controls legislated under the *Fisheries Act 1994* and the *Fisheries Regulations 1995*. The arrangement provides that the fishery be managed under Queensland law including the statutory requirements to ensure fair access rights and ecologically sustainable use of fisheries resources having regard to optimum community benefit from those resources. DPI&F recognises that reference points provide a valuable yardstick against which to assess the sustainability of fish stocks and to indicate appropriate time frames for management intervention. At present no reference points are currently used in the management of the Queensland MAFF, however the DPI&F has powers to intervene.

Whether management intervention is required depends on the reason for the triggering. For some species, management intervention would depend on the extent of any declines, the estimated role of fishing in that decline, and the characteristics of the specific stock. Interventions available to DPI&F include:

- Increased minimum legal sizes limits, which would allow greater reproductive activity before individuals can be taken. This is only likely to be effective in species that have low discard mortality;
- More conservative possession limits to reduce the scale of the catch;
- Spatial closures to protect spawning and/or nursery grounds;
- Spatial closures to protect fished stocks. It is possible to identify particular areas of high catch for some species (such as aggregation sites), the temporary or permanent closure of which would provide protection to the stock as a whole;
- Temporal closures and fishing moratoria, that allow a stock to re-build;
- Revising the type and amount of gear able to be used, or fishing methods able to be employed, to minimise the impacts to a species; or,
- Prohibiting the take of a species.

As detailed in **Criteria 1.1.1 to 1.1.9**, available evidence suggests that current levels of catch and effort are sustainable. No depletion of marine aquarium fish species has been identified through the monitoring process in place (See **Criterion 1.1.1**).

ASSESSMENT OF THE MARINE AQUARIUM FISH FISHERY AGAINST PRINCIPLE 2.

Fishing operations should be managed to minimise their impact on the structure, productivity, function and biological diversity of the ecosystem.

Objective 1.

The fishery is conducted in a manner that does not threaten bycatch species.

Information requirements

2.1.1 Reliable information, appropriate to the scale of the fishery, is collected on the composition and abundance of bycatch including discards.

The harvest methods and the gear used (see Criterion 1.1.7) in the MAFF allow for operators to individually select target species and limits the catchability of species other than the target species. Furthermore operators must be in attendance of gear at all times whilst it is operational. Currently there is no legal requirement for the fishers to report discarded bycatch species through the Aquarium Fish Trip Logbook (AQ03). However given the very selective nature of this fishery, this is believed to be very low.

Assessments

2.1.2 There is a risk analysis of the bycatch with respect to its vulnerability to fishing.

Management regulations require all non-retained catch to be quickly returned to the water at the point of capture. Due to the harvesting methods employed (by hand or hand held non-mechanical apparatus) fishers are able to select individual fish of the target species and eliminate the majority of bycatch. Whitehead *et al.* (1986) reported that an operator collecting around 25 000 marine aquarium fish estimated mortality to be around 1%. Given the methods used to harvest in this fishery and very low mortality rates, the impact of the MAFF on bycatch species is considered to be very low.

Management responses

2.1.3 Measures are in place to avoid capture and mortality of bycatch species unless it is determined that the level of catch is sustainable (except in relation to endangered, threatened or protected species). Steps must be taken to develop suitable technology if none is available.

Given the low amount and high survivability of bycatch in the MAFF (See **Criteria 2.1.1** and **2.1.2**), there appears no need for bycatch reduction measures at present effort levels.

2.1.4 An indicator group of bycatch species is monitored

And

2.1.5 There are decision rules that trigger additional management measures when there are significant perturbations in the indicator species numbers.

And

2.1.6 The management response, considering uncertainties in the assessment and precautionary management actions, has a high chance of achieving the objective.

As has been outlined in the preceding Criteria (2.1.1 – 2.1.3), at current levels of effort, utilising current fishing gear and methods, and under current management arrangements, DPI&F considers the MAFF does not threaten bycatch species.

No information, formal or anecdotal, exists to suggest that any particular species or suite of species is negatively impacted. Accordingly, no specific indicator species have been identified or are being monitored. If interactions with bycatch species become more prevalent or if any negative impacts are identified to bycatch species, DPI&F will develop and implement specific management responses to reduce the impacts to a sustainable level in a timely manner.

Objective 2.

The fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species and avoids or minimises impacts on threatened ecological communities.

A number of species present in the waters of the MAFF are protected under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act 1999* – for Commonwealth waters) and the Queensland *Nature Conservation Act 1992* (*NCA 1992* – for Queensland waters)(see Appendix 6). There are no threatened ecological communities listed under the *EPBC Act 1999* or its amendments within the area of operation of the MAFF.

The *EPBC Act 1999* contains several provisions for the protection of listed marine species including the development of Recovery Plans (for listed threatened species and ecological communities only); the development of wildlife conservation plans and conservation agreements (for listed marine and migratory species only); and the recognition of Key Threatening Processes and where appropriate reducing their impact through Threat Abatement Plans.

Information requirements

2.2.1 Reliable information is collected on the interaction with endangered, threatened or protected species and threatened ecological communities.

DPI&F generally consider the MAFF to have only limited potential to cause fatality or injuries to endangered, threatened or protected (ETP) species due to the relatively benign fishing methods employed in the fishery. Anecdotal evidence from commercial fishers and researchers suggest that there is a very minimal risk of mortality of, or injuries to, endangered, threatened or protected species within the MAFF.

Under the current logbook program, marine aquarium fish catch must be recorded in the Aquarium Fish Trip Logbook AQ03 (see Appendix 4). The format of the logbook used in the MAFF does not allow interactions with endangered, threatened or protected species to be reported.

Given the minimal chance for interaction with endangered, threatened or protected (ETP) species, DPI&F believes that a 'Species of Conservation Interest logbook' (SOCI) would be of moderate value in the MAFF. However, DPI&F is committed to implementing SOCI logbooks progressively across all fisheries to allow comprehensive reporting of protected species interactions in Queensland fisheries. Fishers are also required under their legal obligations to report interactions with ETP species during fishing operations to the relevant conservation agency. The Queensland Environmental Protection Agency should be advised of any interactions with dugongs, whales and dolphins in state waters. DEH should be advised of any interactions with EPBC Act listed

'threatened', 'migratory' or 'cetacean' species in any location, including in State waters. Interactions with 'listed marine species' need only be reported to DEH when they occur in the Commonwealth Marine Area.

The Queensland Parks and Wildlife Service (QPWS) have compiled a Wildlife Stranding and Mortality Database for several species of conservation interest, including dugongs, cetaceans, pinnipeds and turtles. Monitoring of the species on the database occurs on an annual basis and QPWS publish summary reports periodically (for example, Haines and Limpus 2000a, b, c). DPI&F, with the assistance of ReefMAC consider the database information in addressing issues regarding interactions with ETP species.

Indigenous fishers have traditional and customary rights to take and use many protected wildlife species, with dugong and turtles among the most commonly caught. The National Recreational and Indigenous Fishing Survey (NRIFS) has provided estimates of the catch of ETP species by indigenous fishers in northern Australian waters (Henry and Lyle 2003). It is important to make clear however that indigenous fishers catch ETP species as part of their traditional fishing practices. Accordingly, the indigenous catch of ETP species is an issue related to traditional indigenous fishing generally rather than the MAFF specifically.

Assessments

2.2.2 There is an assessment of the impact of the fishery on endangered, threatened or protected species.

As mentioned previously, the harvest methods and the gear used (see Criterion 1.1.7) in the MAFF allow for operators to individually select target species and limit the catchability of any species other than the target species. Furthermore operators must be in attendance of gear at all times whilst it is operational.

Though the information available to date has not been extensive, all sources suggest there are very limited interactions. Fishery-dependent data and fishery-independent research both report a very low level of interactions with ETP species in the MAFF specifically, and more generally for the harvest methods and the gear employed by the MAFF operators. Anecdotal comments from fishers support that interactions with ETP species are rare events. As a result, there has been no formal assessment of the impact of the MAFF on endangered, threatened and protected (ETP) species.

Given that there have been no reported interactions of endangered, threatened or protected species reported in fisheries dependent, no more detailed assessment has been conducted or is considered warranted.

Highlighting the low impacts emanating from this fishery, a recent assessment by the Australian Marine Conservation Society (AMCS) rated hand collection dive fisheries such as the MAFF as the equal most preferred fishery type in terms of long-term sustainability. The assessment undertook a comparative analysis of the actual and potential environmental impacts arising from Australia's most widely used commercial fishing gears and methods. The potential impacts both to wildlife and on habitats were rated as low (www.amcs.org.au).

Should interactions with the MAFF and species of conservation interest occur or be found to be more prevalent than currently believed, ongoing monitoring of information available from fishery-independent research will detect such changes. The progressive implementation of SOCI logbooks across all Queensland fisheries will also provide comprehensive information on protected species interactions. This information can be used for a review of management arrangements as they relate to the incidental capture and interaction with species of conservation interest.

2.2.3 There is an assessment of the impact of the fishery on threatened ecological communities.

No threatened ecological communities have been identified in the specific area or habitats utilised by collectors in the MAFF. Therefore an assessment has not been undertaken and management measures have not been developed. If there are indications that interaction is increasing, assessment will be undertaken as appropriate.

The rezoning of the GBRMP introduced on July 1st 2004 following the Representative Areas Program (RAP) process has significantly increased the level of protection afforded to the ecological communities within the marine park. GBRMPA has indicated that under the new zoning arrangements approximately 33% of the marine park area is now included in green zones, which are closed to all extractive uses including recreational and commercial fishing. In addition, through the RAP process GBRMPA identified 70 distinct bioregions within the marine park, with one of the primary goals being to ensure that at least 20% of every bioregion was adequately protected through a network of green zones.

A more detailed examination of the impacts to the ecosystem in general is provided under Principle 2 – Objective 3.

Management responses

2.2.4 There are measures in place to avoid capture and/or mortality of endangered, threatened or protected species.

And

2.2.5 There are measures in place to avoid impact on threatened ecological communities.

And

2.2.6 The management response, considering uncertainties in the assessment and precautionary management actions, has a high chance of achieving the objective.

The low actual and potential negative impacts of the MAFF on endangered, threatened or protected species, and on their associated habitats and ecological communities reduces the need for specific management measures. In saying this, DPI&F fully recognises and endorses that regular monitoring is still required to minimise the potential risk of negative impacts.

Inclusion of and consultation with all stakeholders in managing the fishery, via the HarvestMAC process, provides a further avenue for any negative impacts to be raised, discussed and acted upon.

Objective 3.

The fishery is conducted, in a manner that minimises the impact of fishing operations on the ecosystem generally.

Information requirements

2.3.1 Information appropriate for the analysis in 2.3.2 is collated and/or collected covering the fisheries impact on the ecosystem and environment generally.

Information sourced from commercial fishery logbooks and fishery-independent data derived through the AIMS Long Term Monitoring Program and other scientific studies (see Criterion 1.1.1), indicate that the MAFF is a relatively 'clean' fishery, imparting few impacts to the wider marine ecosystem.

However, DPI&F recognises that more rigorous research on the ecosystem generally is required to confirm the informal assessment.

Assessment

2.3.2 Information is collected and a risk analysis, appropriate to the scale of the fishery and its potential impacts, is conducted into the susceptibility of each of the following ecosystem components to the fishery.

No formal assessment or risk analysis has been conducted on impacts of the MAFF to ecological communities, food chains or the physical environment. This is primarily due to consensus among fishers, researchers and managers in Queensland that any general ecosystem impacts are minimal.

The zoning scheme recently introduced into the fishery is designed to eliminate the potential for localised depletion to occur in specific regions of the coast. These areas may include regions where effort is highest, where species-specific impacts occur, or where high conflict with other user groups occurs (QFMA, 1999). Before the 'SMAs' were introduced, Moreton Bay and Cairns were thought to be most likely at maximum sustainable fishing levels. These areas allow only limited access and harvesting by fishers.

The introduction of the new GBRMP Zoning on July 1st 2004 has again reduced the level of access and fishing effort applied to certain areas along the east coast. As Figure 6 shows, a considerable area of the major MAFF fishing grounds off Cairns have been closed to all fishing. In rezoning the marine park, the GBRMPA set aside a minimum of 33% of all bioregion types, meaning that at least 25% of all the habitat types used by MAFF collectors have been closed to collecting and all forms of fishing. Considering the zoning has only recently been implemented, there has been no information collected on the potential for unsustainable localised depletion due to the new zoning. Considering the vast area still available to the fishers, DPI&F does not currently consider there to be any issues associated with over-fishing. DPI&F will however, continue to monitor the fishery through the methods mentioned in Criteria 1.1.1 and apply appropriate management responses if the need arises.

Coupled with the range of DPI&F management arrangements and the considerable practical limitations to harvesting explained in criterion 1.1.2, the likelihood of negative impacts to the target species is minimal.

1. Impacts on ecological communities

As the fishery operates by hand collection, it is highly selective to the target species and has no direct impact on benthic communities or associated or dependent species. Accordingly, the primary potential impacts to the environment arising from this fishery appear to be the removal of the target species from associated food webs and the potential of overfishing in specific areas. Sadovy and Vincent (2002) support this view and have highlighted selective fishing, both in terms of particular species and particular size/colour/sex forms, and overfishing of particular local areas as the predominant threats in live reef fish fisheries such as the MAFF.

The removal of reef fish has unknown effects on the ecosystem of the reef or reef fish populations (Whitehead *et al.* 1986). Lubbock and Polunin (1975) suggest that heavy collecting pressure can result in the depletion of populations of aquarium fish in localised areas and cite anecdotal information from Kenya and Sri Lanka.

Samoilys (1988) found that the abundance of marine aquarium fish species did not differ significantly between a protected site and a site open to aquarium fish collectors on the Kenyan coast. This observation suggests that collecting aquarium fish may not deplete fish stocks. Samoilys (1988) suggests monitoring of species such as Butterflyfishes as indicator species because they are likely to respond to improved coral conditions and extended coral coverage. It has been suggested by marine aquarium fish collectors that the density of anemone fish (*Amphiprion* species) and their host anemones are good indicators of the state of particular reef communities as they are sparse in density and distribution (Sale *et al.* 1986) and therefore may be more prone to overexploitation (Couchman and Beumer, 1992).

Butler (1991) compared the densities of anemone fish and anemone colonies between reefs with different levels of protections from harvesting. The results indicated that there were no significant difference between the densities of both anemone fish and anemone fish colonies between the reefs open and closed to harvesting. This study indicates that in the areas surveyed the collection of anemone fish has not depleted the local populations to levels below those found on unharvested reefs.

Removal of a species of marine aquarium fish may impact on other plants and animals in the community, both directly and indirectly, however these impacts are largely unknown. Most larger fish species living around reefs prey on smaller fish that are the main target species of the aquarium trade. Predators are usually opportunistic and prey species readily interchangeable if their abundance varies. Therefore it is unlikely that a reduction in the number of aquarium fish would have any significant impact on predators.

2. Impacts on food chains

Community structure and productivity flows

There is a huge variety of species taken in the MAFF and there is limited biological knowledge on these species. Few species are in danger of becoming globally extinct as the result of collection. There is the chance for localised depletion of vulnerable species, however because coral reef systems are spatially fragmented and linked through larval dispersal, the potential for marine aquarium fish harvesting to deplete natural stocks is minimised (Kung, 2000). Studies with artificial reefs have shown that once shelter is provided, the post larvae fish settle. This suggests that the availability of habitat is the limiting factor for successful recruitment, rather than the number of larvae of reef fishes (Randall, 1987).

Collection in some areas and collection of fish in accessible depth ranges may deplete numbers in these areas and depth ranges. Available evidence from fish collectors and researchers show the observed effects of collection seem to be negligible (Whitehead *et al.* 1996).

Under the GBRMPA Zoning Plan, aquarium fish harvesting is permitted only in, General use and Habitat protection zones. Harvesting is also permitted in Conservation park zones however restrictions apply..

Through the RAP process GBRMPA identified 70 distinct bioregions within the marine park, with one of the primary goals being to ensure that at least 20% of every bioregion was adequately protected through a network of green zones. As the GBRMPA have noted, the rezoning will “better protect...the entire range of habitats, plants and animals in the marine park to maintain the health and resilience of the ecosystem and provide benefits for present and future users” (GBRMPA website: www.gbrmpa.gov.au/corp_site/management/zoning/rap/rap/pdf/FAQs_3Dec2003.pdf). The Marine National Park zones (green zones) allow for a spatial refuge to help protect spawning areas of species such as those taken in the MAFF.

As mentioned previously in **Criterion 1.1.1**, an analysis of the results from the AIMS LTMP from 1992 to 2003 reveals that no local depletions in MAFF species have been detected.

Figure 7 and Appendix 2 shows that damselfishes comprise the greatest proportion of the commercial catch of species taken in the MAFF. When taking into account the results from the AIMS LTMP, it is evident that the collection of damselfishes has not had any significant negative impact on the stocks of these species. In some cases, the abundance of certain damselfish generally has increased in areas that experience the higher levels of effort from MAFF harvesters. The only region that showed a decline in damselfish over the past five years was in the midshelf reefs of the Swains regions, where crown of thorns starfish (*Acanthaster planci*) are active (Sweatman *et al.* 2001).

The depletion of small plankton feeding coral reef fish may affect the settlement of the larvae of other reef species. Likewise the removal of herbivorous species may lead to increases in algal coverage, which may then impact on the settlement of coral planulae (Lubbock and Polunin, 1975).

3. Impacts on the physical environment

Physical habitat

While it is recognised that divers in collection fisheries are likely to have some contact with the benthos, the level of contact and impact is minimal. The main impact on benthic ecological communities is through anchor damage from the vessels that operate in the fishery. The level of impact arising from the boats must be considered in the context of the considerable level of boating that occurs along the east coast as a result of commercial and recreational fishing, tourism and other commercial shipping generally. In addition, any anchor impact arising from the vessels in the fishery are negligible in comparison to the damage caused by a range naturally occurring phenomena such as extreme weather conditions.

The only other impact that can have an affect on the physical environment is the turning of rocks and the destruction of coral while accessing marine aquarium species. This can lead to gradual habitat degradation and reduced ability for the coral reef ecosystem to support fish life.

Water quality

Both commercial and recreational fishers will release vessel-borne pollution, however the amount discharged must be considered relative to the discharges released by the much larger commercial ships, tourist and recreational-boating fleet. The area in which the MAFF operates includes inter-reef zones generally subject to substantial flows of water from tidal and cross shelf currents. These water flows, in particular the cross shelf flows, supply the reef region with nutrient rich waters from deepwater regions off the continental shelf. This water is considerably more nutrient rich than the nutrient load that would be anticipated from the sewage produced by the recreational and

commercial fishing vessels. To even further minimise the potential risk, vessels on extended trips with more than 6 people are required by Queensland Transport Legislation to return their sullage to an onshore point of disposal. It is assumed that the total discharge of effluent directly to the ocean would be less for the marine aquarium fishery than the much larger tourism industry which operates in far less restricted areas of the GBR region

The only other concern associated with vessel use is any leaking of mechanical fluids and fuels due to poorly maintained vessels. However no such problems have been noted. Given that the success of fishing operations depends on the vessels reliability it is highly unlikely that the operators would allow maintenance to lapse. The *Transport Operations (Marine Pollution) Act 1995* requires all vessels to be maintained and not discharge any materials into the water. The Department of Transport is responsible for checking vessel maintenance and safety through annual survey inspections. Vessels can be inspected both wharveside and at sea for their compliance and sea worthiness.

Due to the types of fishing gear used in the MAFF, it is not considered that the fishery has a significant physical impact on the environment. Should any change in the ecosystem or any of its components be identified, the DPI&F would undertake a review of the fishery and its operations to determine any possible cause and identify any methods of rectification or future avoidance.

Management responses

2.3.3 Management actions are in place to ensure significant damage to ecosystems does not arise from the impacts described in 2.3.1.

and

2.3.4 There are decision rules that trigger further management responses when monitoring detects impacts on selected ecosystem indicators beyond a predetermined level, or where action is indicated by application of the precautionary approach.

and

2.3.5 The management response, considering uncertainties in the assessment and precautionary management actions, has a high chance of achieving the objective.

No evidence has emerged that the operation of the MAFF impacts significantly on the broader marine environment. The fishery zoning within the MAFF and the recent zoning of the GBRMP also ensure that any impacts remain within long-term sustainable levels.

One of the major goals of the fishery zoning in the aquarium fish fishery was to eliminate the potential to mobilize localised depletion along certain areas of the east coast of Queensland. These areas may include regions where localised depletion of stocks may occur, where species-specific impacts occur, or where high conflict with other user groups occurs (QFMA, 1999). Before the 'SMAs' were introduced, Moreton Bay and Cairns were thought to be most likely at maximum sustainable fishing levels. These areas allow only limited access and harvesting by fishers. The reduction in authorities able to access specific areas of the coast reduces the amount of effort and fishing gear deployed and therefore reduces the potential for broader ecosystem impacts.

The introduction of the new GBRMP Zoning on July 1st 2004 has again reduced the level of access and fishing effort applied to certain areas within the range of the GBRMP. As Figure 6 shows, a considerable area of the major MAFF fishing grounds off Cairns have been closed to all fishing. In rezoning the marine park, the GBRMPA set aside approximately 33% of all bioregion types,

meaning that at least 25% of all the habitat types used by MAFF collectors have been closed to collecting and all forms of fishing. Coupled with the range of DPI&F management arrangements and the considerable practical limitations to harvesting explained in criterion 1.1.2, the likelihood of negative impacts to the target species and the environment generally is minimal.

To emphasise the minimal impact to the broader marine ecosystem through the commercial operations of the fishery, below is a summary of the management measures in place in the MAFF. For a detailed description see Section 1, Management Arrangements for the fishery.

Management responses

Hand or hand held non-mechanical apparatus

The commercial aspect of the MAFF is a dive fishery, and usually requires the use of underwater viewing apparatus. Commercial harvesters are able to use self-contained underwater breathing apparatus (SCUBA) or surface-supplied air from hookah apparatus, which provides extended underwater time and increased mobility for fish harvesting. Recreational harvesters cannot legally use SCUBA or hookah apparatus, but may use a mask and snorkel. Harvesting of fish may also occur in shallow intertidal areas or in estuaries where underwater viewing is not required.

All collection must be by hand or hand-held apparatus. Fish are taken using fishing lines, cast nets, scoop nets, seine net, barrier net and a herding device (small rod).

Limited number of operators – effort is capped

Existing management arrangements for MAFF allow for 49 commercial operations to access the aquarium fish fishery. Only 49 commercial operations are currently active. All participants hold an 'authority to take fish for trade or commerce' endorsed for the aquarium fish fishery ('A1' or 'A2' fishery symbol). Currently there are approximately 43 commercial operators authorised with an 'A1' fishery symbol and 6 commercial operators issued with an 'A2' fishery symbol. A2 symbols place greater restrictions on the permitted area of operation than do A1 symbols. *There are however 4 applications still issued with an 'A' fishery symbol that are still undecided and are yet to be amended.*

Area closures

Some areas of the fishery are subject to closures to fishing through general fisheries closures and through the Great Barrier Reef Marine Park Zoning. The area closed to fishing for aquarium fish has increased with the introduction of the new GBRMP zoning implemented on July 1st 2004.

No specific management actions have been implemented and no decision rules linked to indicator species have been developed in relation to impacts to the broader marine ecosystem. All available evidence suggests there is only a minimal impact to the broader marine ecosystem from the MAFF using current gear and at current levels of effort in all sectors of the fishery.

APPENDICES

Appendix 1. List of species taken in the Queensland Marine Aquarium Fish Fishery: common name sorted alphabetically

ANEMONE SHRIMP
ANGEL FISH - UNSPECIFIED
ANGLER FISH
ANTHIAS
ASSESSOR
BASS - STRIPEY
BAT FISH - UNSPECIFIED
BISCUIT STARS
BLACK AND WHITE SNAPPER
BLENNIES
BLUE ASSESSOR (DEVIL)
BLUE LINED TANG
BLUE SPRAT
BOX FISH
BREAM - BUTTER
BREAM - UNSPECIFIED
BRITTLE STAR
BULL ROUT
BULLS EYE
BUTTERFLY FISH
CARDINAL FISH - UNSPECIFIED
CAT SHARK
CATFISH - GOLDEN
CATFISH - UNSPECIFIED
CHELMAN
CLOWN FISH
CLOWN SWEETLIP
COD - CORONATION TROUT
COD - ROCK UNSPECIFIED
COD - UNSPECIFIED
CORAL BANDED SHRIMP
COWRIE SHELL - UNSPEC
CRUSTACEANS
CYPRAEA TIGRIS
DAMSEL FISH
DART - SWALLOW TAILED
DOTTYBACKS
EEL (MARINE)
ESTUARINE STONEFISH
FEATHERWORM
FILE FISH
FISH - UNSPECIFIED
FLUTEMOUTH
FOX FACE
FUSILIER - UNSPECIFIED
FUSILIER - YELLOW TAIL
GOAT FISH
GOBIES
GUDGEON
HARLEQUIN TUSKFISH
HAWK FISH
HOLOCENTRIDAE
HULA FISH
INVERTEBRATES
LEATHER JACKET - UNSPECIFIED
LINED CHROMIS
LOBSTER - UNSPECIFIED
LONG NOSED BUTTERFLY
LUTJANID - UNSPECIFIED
MAGPIE MORWONG
MOLLUSCS - UNSPECIFIED
MONOCLE BREAM
MOORISH IDOL
MORAY EEL
MUD SKIPPER
NUDIBRANCH
OCTOPUS - UNSPECIFIED
OLD WIVES
OTHER - UNSPECIFIED
PAINTECORONATIOD GRINNER
PARROT FISH - UNSPECIFIED
PERSONIFER ANGEL FISH
PIGFISH-UNSPECIFIED
PIGMY FILEFISH
PIKE - UNSPECIFIED
PINEAPPLE FISH
PIPE FISH/SEA HORSES
PROWFISH
PUFFER FISH
RAY - STING UNSPECIFIED
RED MORWONG
REMORA
SCAT
SCORPION FISH - UNSPECIFIED
SCRIBBLED ANGEL FISH
SEA APPLES
SEA STARS
SEA URCHIN
SHARK - EPAULETTE
SHARK - WOBBYGONG
SHARKS AND RAYS
SHRIMP
SILVER SCATS
SLATEY BREAM
SLING-JAW
SNAKE EEL
SOAP FISH
SPINEFOOT
SPONGES
SPOTTED BUTTER FISH
SQUIRREL FISH
STAR FISH

STONE FISH
STRIPED SWEETLIP
STRIPIES
SURGEON FISH
SWEEPER
SWEETLIP - UNSPECIFIED
TANG
THORNBACK COWFISH
TREVALLY - UNSPECIFIED
TRIGGER FISH

TRUMPET FISH
TRUNK FISH
TUBE WORM/POLYCHAETE
TURBO SNAIL
WEEVER
WHIPTAIL
WRASSE - UNSPECIFIED
YELLOW ASSESSOR (DEVIL)
ZEBRA LIONFISH

**Appendix 2. Most commonly caught species in the Queensland Marine Aquarium Fish Fishery:
sorted by proportion of catch for all years (most to least)**

DAMSELFISH	CUTTLEFISH
WRASSES	SQUIRRELFISH
ANGELFISH	LOBSTERS
FORK TAILED CATFISH	BRITTLESTARS
BUTTERFLYFISH	STINGRAYS
GOBIES	OCTOPUS
FISH UNSP	BOX FISH
INVERTS	BREAM
SURGEONFISH	COWRIES
BLENNIES	FEATHERSTARS
DOTTYBACKS	BIG EYES
CRUSTACEANS	TREVALLY
SCATS	MORWONGS
TRIGGERFISH	SOAPFISH
"STARFISH, SEA URCHINS ETC"	SPONGES
MOLLUSCS	TRUMPETFISH
PUFFERFISH	DISCFISHES
ANTHIAS	FLUTEMOUTH
SCORPIONFISH/LIONFISH/STONEFISH	PROWFISH
SEA APPLES	SNAKE EELS
HAWKFISH	GURNARDS
ANEMONE SHRIMPS	GUDEGEONS
ASSESSORS	EEL-TAILED CATFISH
PINEAPPLE FISH	SHOVELNOSE RAYS
SHARKS AND RAYS	PIKE
PIPEFISH/SEAHORSES	WEEVERS
LIZARDFISH/GRINNERS	
NUDIBRANCHS	
SEASTARS	
SHELLS	
MONOCLE/THREADFIN BREAM	
SNAPPERS	
POLYCHAETES	
SPRATS	
GOATFISH	
LEATHERJACKETS	
MOORISH IDOLS	
RABBITFISH/HAPPY MOMENTS	
SEASTARS	
OLD WIVES	
BOX FISH	
WOBBERGONGS/CAT SHARKS	
SWEETLIPS	
ANGLERFISH	
SWEEPERS	
MORAY EELS	
BATFISH	
TURBO SHELLS	
PARROTFISH	
WHIPTAILS	
PIGFISH	
COD	
BUTTER BREAM/MONOS	

Appendix 3. Representative export price list for species taken in the Marine Aquarium Fish Fishery in \$USD

DAMSELS/CHROMIS		sm	med	lge	Jumbo
<i>Chromis nitida</i>	Barrier Reef Chromis	\$2.50	\$3.00	\$3.50	\$3.50
<i>Chromis vanderbilti</i>	Vanderbilts Damsel	\$2.10	\$2.50	\$2.80	\$2.80
<i>Chrysiptera taupou</i>	Fijian Damsel	\$2.80	\$3.00	\$3.50	\$3.50
<i>Chrysiptera starki</i>	Starks Damsel	\$4.50	\$5.00	\$5.00	\$6.00
<i>Chrysiptera talboti</i>	Talbots Damsel	\$2.80	\$3.00	\$3.20	\$3.30
<i>Chrysiptera tricinta</i>	Threeband Damsel	\$3.00	\$3.00	\$3.20	\$3.50
<i>Dascyllus aruanus</i>	Humbugs	\$2.00	\$2.20	\$2.20	\$2.50
<i>Dascyllus reticulatus</i>	Reticulated Damsel	\$2.00	\$2.20	\$2.20	\$2.50
<i>Lepidozygus tapeinosoma</i>	Fusilier Damsel	\$2.80	\$2.80	\$3.00	\$3.00
<i>Neoglyphidodon melas</i>	Bowtie damsels	\$3.00	\$3.00	\$3.00	\$3.20
<i>Neoglyphidodon nigroris</i>	Honey Damsel	\$2.80	\$3.00	\$3.00	\$3.50
<i>Pomacentrus pavo</i>	Blue Chromis	\$3.00	\$3.00	\$3.50	\$3.50
<i>Pomacentrus vaiuli</i>	Princess Damsel	\$2.80	\$2.80	\$3.00	\$3.20
<i>Pomachromis richardsoni</i>	Richardson's Reef-Damsel	\$2.00	\$2.00	\$2.20	\$2.50

ANGELS		sm	med	lge	Jumbo
<i>Centropyge bicolor</i>	Bicolour Angel	\$5.00	\$5.50	\$6.00	\$6.00
<i>Centropyge bispinosus</i>	Coral Beauty	\$7.50	\$7.50	\$7.80	\$8.00
<i>Centropyge flavicauda</i>	White Tail Pygmy Angel	\$6.00	\$6.00	\$6.00	\$6.00
<i>Centropyge heraldi</i> - Black Fin	Heralds Angelfish	\$15.00	\$15.00	\$15.00	\$15.00
<i>Centropyge vrolikii</i>	Pearl Scale Angel	\$6.00	\$6.50	\$6.50	\$6.50
<i>Chaetodontoplus duboulayi</i>	Scribled Angel - Male		\$45.00	\$50.00	\$50.00
<i>Chaetodontoplus duboulayi</i>	Scribled Angel - Female	\$25.00	\$25.00	\$30.00	\$35.00
<i>Chaetodontoplus meredithi</i>	Personifer Angel - male		\$45.00	\$50.00	\$50.00
<i>Chaetodontoplus meredithi</i>	Personifer Angel - female	\$25.00	\$25.00	\$30.00	\$35.00
<i>Genicanthus mealanospilos</i>	Black Spot Angel - male			\$30.00	\$30.00
<i>Genicanthus mealanospilos</i>	Black Spot Angel - female	\$15.00	\$18.00	\$20.00	
<i>Genicanthus watanabei</i>	Watanabes Angelfish			\$35.00	\$35.00
<i>Genicanthus watanabei</i>	Watanabes Angelfish		\$20.00	\$20.00	
<i>Pomacanthus imperator</i>	Emperor Angelfish		\$65.00	\$75.00	\$85.00
<i>Pomacanthus sextriatus</i>	Sixbanded Angelfish	\$25.00	\$35.00	\$45.00	\$55.00
<i>Pomacanthus semicirculatus</i>	Semicircle Angel	\$35.00	\$60.00	\$75.00	\$85.00
<i>Pomacanthus xanthometapon</i>	Blueface Angel		\$75.00	\$80.00	\$95.00
<i>Pygoliptes diacanthus</i>	Regal Angelfish	\$25.00	\$28.00	\$32.50	\$32.50

BUTTERFLIES, BANNERFISH & ALLIES		sm	med	lge	Jumbo
<i>Coradion altivelis</i>	Highfin Coralfish	\$12.00	\$12.00	\$15.00	\$18.00
<i>Coradion chrysostomus</i>	Orangebanded Coralfish	\$12.00	\$12.00	\$15.00	\$18.00
<i>Chaetodon aureofasciatus</i>	Golden Striped Butterfly	\$6.00	\$8.00	\$8.00	\$8.00
<i>Chaetodon auriga</i>	Threadfin Butterfly	\$6.00	\$8.00	\$9.00	\$10.00
<i>Chaetodon bennetti</i>	Bennetts Butterfly	\$6.00	\$8.00	\$10.00	\$12.00
<i>Chaetodon citrinellus</i>	Speckled Butterflyfish	\$4.00	\$4.00	\$5.00	\$5.00
<i>Chaetodon ephippium</i>	Saddled Butterflyfish	\$8.00	\$12.00	\$15.00	\$15.00
<i>Chaetodon guentheri</i>	Gunthers Butterfly	\$8.00	\$8.00	\$10.00	\$10.00

<i>Chaetodon flavirostris</i>	Dusky Butterflyfish	\$12.00	\$12.00	\$15.00	\$15.00
<i>Chaetodon lunula</i>	Raccoon Butterfly		\$12.00	\$15.00	\$18.00
<i>Chaetodon melannotus</i>	Blackback Butterflyfish	\$6.00	\$8.00	\$8.00	\$10.00
<i>Chaetodon mertensii</i>	Mertens Butterfly	\$6.00	\$7.00	\$8.00	\$8.00
<i>Chaetodon meyeri</i>	Meyers Butterfly			\$12.00	\$15.00
<i>Chaetodon ornatissimus</i>	Ornate Butterfly	\$8.00	\$10.00	\$12.00	\$12.00
<i>Chaetodon pelewensis</i>	Dot & Dash Butterfly	\$5.00	\$5.50	\$6.00	\$6.50
<i>Chaetodon plebeius</i>	Blue-spot Butterfly	\$5.00	\$6.00	\$6.00	\$6.00
<i>Chaetodon punctatofasciatus</i>	Spot-banded Butterflyfish	\$5.00	\$6.00	\$6.00	\$6.50
<i>Chaetodon rafflesi</i>	Laticed Butterfly	\$6.00	\$10.00	\$12.00	\$15.00
<i>Chaetodon rainfordi</i>	Rainford's Butterfly	\$10.00	\$10.00	\$10.00	\$10.00
<i>Chaetodon reticulatus</i>	Reticulated Butterfly	\$10.00	\$12.00	\$15.00	\$18.00
<i>Chaetodon semeion</i>	Dotted Butterfly	\$12.00	\$18.00	\$20.00	\$25.00
<i>Chaetodon speculum</i>	Oval-spot Butterflyfish	\$8.00	\$8.00	\$10.00	\$12.00
<i>Chaetodon ulietensis</i>	Double-saddle Butterflyfish	\$6.00	\$8.00	\$10.00	\$12.00
<i>Chaetodon unimaculatus</i>	Teardrop Butterfly	\$6.00	\$8.00	\$10.00	\$10.00
<i>Chaetodon vagabundas</i>	Vagabonds Butterfly	\$6.00	\$6.00	\$8.00	\$10.00
<i>Chelmon muelleri</i>	Muller's Butterfly	\$10.00	\$12.00	\$12.00	\$12.00
<i>Chelmon rostratus</i>	Copperband Butterfly		\$9.50	\$9.50	\$9.50
<i>Chelmon marginalis</i>	Margined Coperband Butterfly	\$18.50	\$18.50	\$22.00	\$22.50
<i>Forcipyger flavissimus</i>	Forceps Fish	\$6.00	\$8.00	\$10.00	\$10.00
<i>Forcipyger longirostris</i>	Longnose Butterfly		\$10.00	\$12.00	\$15.00
<i>Hemitaurichthys polylepis</i>	Pyramid Butterfly	\$6.50	\$8.00	\$8.50	\$10.00
<i>Heniochus monoceros</i>	Masked Bannerfish	\$25.00	\$65.00	\$80.00	\$80.00
<i>Parachaetodon ocellatus</i>	Ocellated Coralfish	\$8.00	\$12.00	\$18.00	\$22.00
<i>Zanclus cornutus</i>	Moorish Idol	\$8.00	\$10.00	\$12.00	\$12.00

WRASSES		sm	med	lge	Jumbo
<i>Anampses neoguinaicus</i>	New Guinea Wrasse - male			\$10.00	\$12.00
<i>Anampses neoguinaicus</i>	New Guinea Wrasse - female	\$6.00	\$8.00	\$10.00	
<i>Bodianus diana</i>	Diana's Hogfish	\$10.00	\$12.00	\$12.00	\$15.00
<i>Bodianus anthioides</i>	Lyre Tail Hogfish	\$18.00	\$20.00	\$22.00	\$25.00
<i>Bodianus axilaris</i>	Axle Spot Hogfish	\$8.00	\$10.00	\$10.00	\$10.00
<i>Bodianus loxozonus</i>	Blackfin Hogfish	\$10.00	\$12.00	\$12.00	\$15.00
<i>Bodianus mesothorax</i>	Splitlevel Hogfish	\$8.00	\$10.00	\$10.00	\$10.00
<i>Cheilinus chlorourus</i>	Floral Maori Wrasse	\$6.00	\$10.00	\$12.00	\$15.00
<i>Cheilinus fasciatus</i>	Red Breasted Maori Wrasse	\$6.00	\$8.00	\$12.00	\$15.00
<i>Cheilinus oxycephalus</i>	Snooty Maori Wrasse	\$6.00	\$8.00	\$10.00	\$12.00
<i>Cheilinus trilobatus</i>	Tripletail Maori Wrasse	\$6.00	\$8.00	\$10.00	\$12.00
<i>Choerodon anchorago</i>	Anchor Tuskfish	\$12.00	\$16.50	\$16.50	\$18.00
<i>Choerodon fasciatus</i>	Harlequin tuskfish	\$26.50	\$26.50	\$26.50	\$26.50
<i>Choerodon jordani</i>	Jordans Tuskfish	\$10.00	\$12.00	\$15.00	\$16.50
<i>Cirrhilabrus laboutei</i>	Magenta-streaked Wrasse	\$10.00	\$12.00	\$15.00	\$18.00
<i>Cirrhilabrus scottorum</i>	Rainbow Fairy Wrasse	\$6.00	\$8.00	\$12.00	\$12.00
<i>Cirrhilabrus lineatus</i>	Purple Lined Fairy Wrasse	\$12.00	\$15.00	\$20.00	\$25.00
<i>Cirrhilabrus tibicense</i>	Tibicen's Wrasse		\$18.00	\$22.50	\$25.00
<i>Cirrhilabrus exquisitus</i>	Exquisite Fairy Wrasse	\$6.00	\$8.00	\$10.00	\$10.00
<i>Cirrhilabrus punctatus</i>	Dotted Fairy Wrasse	\$4.00	\$6.00	\$10.00	\$10.00
<i>Coris aygula</i>	Two Spot Wrasse - juvenile		\$15.00	\$17.50	\$20.00
<i>Coris aygula</i>	Two Spot Wrasse - adult	\$20.00	\$22.00		
<i>Coris batuensis</i>	Batu Coris	\$4.00	\$5.00	\$5.00	\$6.00
<i>Coris dorsomacula</i>	Pale Barred Coris	\$4.00	\$5.00	\$6.00	\$6.00

<i>Coris gaimard</i>	Clown Wrasse - juvenile			\$10.00	\$12.00
<i>Coris gaimard</i>	Clown Wrasse - adult	\$12.00	\$15.00	\$18.00	\$20.00
<i>Epibulus insidiator</i>	Gold Slingjaw - gold	\$8.00	\$12.00	\$15.00	\$16.50
<i>Epibulus insidiator</i>	Gold Slingjaw - other colour	\$8.00	\$12.00	\$15.00	\$16.50
<i>Halichoeres biocellatus</i>	Biocellate Wrasse	\$5.00	\$6.00	\$7.00	\$8.00
<i>Halichoeres marginatus</i>	Margined Wrasse	\$6.00	\$8.00	\$10.00	\$12.00
<i>Halichoeres melanurus</i>	Bluetail Wrasse	\$4.00	\$4.00	\$5.50	\$6.00
<i>Halichoeres prosopion</i>	Twotone Wrasse	\$6.00	\$7.00	\$8.00	\$10.00
<i>Hemigymnus fasciatus</i>	Barred Thicklip	\$6.00	\$8.00	\$10.00	\$12.00
<i>Hemigymnus melapterus</i>	Half & half Wrasse	\$5.00	\$6.00	\$8.00	\$10.00
<i>Hologymnosus doliatus</i>	Pastel Ring Wrasse	\$6.00	\$10.00	\$15.00	\$30.00
<i>Hologymnosus longipes</i>	Sidespot Wrasse	\$6.00	\$10.00	\$15.00	\$18.00
<i>Labrichthys unilineatus</i>	Blue Lined Tubelip Wrasse	\$6.00	\$8.00	\$12.00	\$12.00
<i>Labroides bicolor</i>	Bicolour Cleaner	\$12.00	\$12.00	\$12.00	\$12.00
<i>Labroides dimidiatus</i>	Cleaner Wrasse	\$6.00	\$7.00	\$7.00	\$7.00
<i>Labroides pectoralis</i>	Gold Barrier Reef Cleaner	\$12.00	\$12.00	\$12.00	\$15.00
<i>Labropsis australis</i>	Tubelip Wrasse	\$6.00	\$7.00	\$8.00	\$8.00
<i>Labropsis xanthonota</i>	Yellowback Tubelip - male		\$12.00	\$15.00	\$15.00
<i>Labropsis xanthonota</i>	Yellowback Tubelip - female	\$6.00	\$10.00	\$10.00	
<i>Macropharyngodon choati</i>	Red Leopard	\$8.00	\$8.00	\$10.00	\$12.00
<i>Macropharyngodon kuiteri</i>	Kuiters Wrasse	\$8.00	\$8.00	\$10.00	\$12.00
<i>Macropharyngodon meleagris</i>	Green Leopard - male		\$10.00	\$12.00	\$12.00
<i>Macropharyngodon meleagris</i>	Green Leopard - female	\$4.00	\$6.00	\$7.00	\$8.00
<i>Macropharyngodon negrosensis</i>	Black Leopard	\$6.00	\$8.00	\$9.00	\$10.00
<i>Novaculichthys taeniourus</i>	Raindeer Wrasse	\$12.00	\$15.00	\$15.00	\$18.00
<i>Oxycheilinus digrammus</i>	Cheeklined Maori Wrasse	\$5.00	\$8.00	\$12.00	\$15.00
<i>Pseudocheilinus ocellatus</i>	White Barred Wrasse (Rare)	\$250.00	\$250.00		
<i>Pseudocheilinus evides</i>	Disappearing Wrasse	\$4.00	\$5.00	\$6.00	\$6.00
<i>Pseudocoris yamashiroi</i>	Redspot Wrasse - male		\$12.00	\$15.00	\$15.00
<i>Pseudocoris yamashiroi</i>	Redspot Wrasse - female	\$4.00	\$5.00	\$6.00	\$8.00
<i>Pseudodax moluccanus</i>	Chiseltooth Wrasse	\$10.00	\$12.00	\$15.00	\$18.00
<i>Pteragogus cryptus</i>	Redstriped Cryptic Wrasse	\$8.00	\$10.00	\$10.00	\$12.00
<i>Pteragogus enneacanthus</i>	Redstriped Wrasse	\$8.00	\$10.00	\$12.00	\$15.00
<i>Stethojulis bandanensis</i>	Bluelined Wrasse - male		\$9.00	\$10.00	\$10.00
<i>Stethojulis bandanensis</i>	Bluelined Wrasse - female	\$4.00	\$6.00	\$8.00	
<i>Thalassoma amblycephalum</i>	Blunt Headed Wrasse	\$4.00	\$6.00	\$7.00	\$8.00
<i>Thalassoma hardwicke</i>	Sixbar Wrasse	\$6.00	\$10.00	\$12.00	\$12.00
<i>Thalassoma lunare</i>	Lunare Wrasse (Green)	\$4.00	\$6.00	\$7.00	\$8.00
<i>Thalassoma lutescense</i>	Yellow lunar Wrasse	\$6.00	\$8.00	\$10.00	\$12.00
<i>Thalassoma quinquivittatum</i>	Lightning Wrasse	\$6.00	\$8.00	\$10.00	\$12.00

BLENNYS /GOBIES / TILEFISH & SANDPERCHES		sm	med	lge	Jumbo
<i>Amblygobius rainfordi</i>	Old Glory		\$4.00	\$4.50	\$5.00
<i>Escenius tigris</i>	Tiger Blenny	\$50.00	\$50.00	\$55.00	\$60.00
<i>Escenius australianus</i>	Australian Blenny	\$30.00	\$30.00	\$35.00	\$35.00
<i>Escenius mandibularis</i>	Queensland Blenny	\$30.00	\$30.00	\$35.00	\$35.00
<i>Escenius aequalis/strictus</i>	Great Barrier Reef Blenny	\$30.00	\$30.00	\$35.00	\$35.00
<i>Exyrias bellissimus</i>	Beautiful Goby	\$8.00	\$10.00	\$12.00	\$15.00
<i>Hoplolatilus starcki</i>	Starks Tilefish	\$12.00	\$15.00	\$18.00	\$20.00
<i>Parapercis multiplicata</i>	Redbarred Sandperch	\$5.00	\$6.00	\$8.00	\$10.00
<i>Signigobius biocellatus</i>	Twinspot Goby	\$5.00	\$6.50	\$7.00	\$7.50
<i>Valenciennea helsdingenii</i>	Twostripe Goby	\$8.00	\$10.00	\$12.00	\$15.00

ANEMONE FISH		sm	med	lge	Jumbo
<i>Amphiprion akindynos</i>	Brown Clowns - Singles	\$5.00	\$5.00	\$6.00	\$6.00
<i>Amphiprion akindynos</i>	Brown Clowns - Mated Pairs	\$12.00	\$14.00	\$14.00	\$14.00
<i>Amphiprion chrysopterus</i>	Orange-fin Anemonefish	\$5.00	\$6.00	\$6.00	\$6.00
<i>Amphiprion melanopus</i>	Tomato Clowns	\$5.00	\$5.00	\$6.00	\$6.00
<i>Amphiprion melanopus - Coral Sea</i>	Fire Clowns - Coral Sea	\$12.00	\$12.00	\$13.50	\$15.00
<i>Amphiprion ocellaris - mated pair</i>	Black Clownfish		\$24.50	\$24.50	\$24.50
<i>Amphiprion perideraion</i>	Skunk Clowns - Singles	\$4.00	\$4.00	\$5.00	\$5.00
<i>Amphiprion perideraion</i>	Skunk Clowns - Mated Pairs	\$12.00	\$14.00	\$14.00	\$14.00
<i>Premna biaculeatus</i>	Maroon Clowns - Singles	\$5.00	\$5.00	\$6.00	\$6.00
<i>Premna biaculeatus</i>	Maroon Clowns - Mated Pairs	\$12.00	\$12.00	\$16.00	\$18.00

TANGS, SURGEONS & RABBITFISH		sm	med	lge	Jumbo
<i>Acanthurus dussumieri</i>	Dussumier Surgeon - Juvenile	\$12.00	\$15.00	\$18.00	\$20.00
<i>Naso literatus</i>	Lipstick Tang	\$15.00	\$25.00	\$35.00	\$45.00
<i>Paracanthurus hepatus</i>	Blue Tangs	\$8.50	\$14.00	\$18.50	\$26.00

Boxfish & Puffers		sm	med	lge	Jumbo
<i>Ostracion meleagris</i>	Spotted Boxfish - Male			\$22.00	\$25.00
<i>Ostracion meleagris</i>	Spotted Boxfish - Female	\$12.00	\$15.00	\$18.00	

Triggerfish & Filefish		sm	med	lge	Jumbo
<i>Balistoides conspicillatum</i>	Clown Triggerfish		\$50.00	\$60.00	\$60.00
<i>Odonus niger</i>	Redtooth Triggerfish		\$15.00	\$20.00	\$25.00
<i>Pseudobalistes fuscus</i>	Queen Triggerfish	\$25.00	\$30.00		
<i>Rhinecanthus lunula</i>	Blackspot Triggerfish	\$60.00	\$70.00	\$80.00	\$80.00
<i>Xanthichthys auromarginatus</i>	Blue Gilded Triggerfish - male		\$20.00	\$22.00	\$25.00
<i>Xanthichthys auromarginatus</i>	Blue Gilded Triggerfish - female		\$15.00	\$15.00	

Soldierfish / Squirrelfish		sm	med	lge	Jumbo
<i>Plectrypops lima (*RARE*)</i>	Roughscale Soldierfish	\$20.00	\$25.00	\$30.00	\$35.00
<i>Sargocentron violaceum</i>	Violet Squirrelfish	\$12.00	\$15.00	\$20.00	\$25.00

Anthias / Basslets / Rockcods & Soapfish		sm	med	lge	Jumbo
<i>Luzonichthys waitei</i>	Waite's Splitfin	\$4.00	\$4.00	\$5.00	\$5.00
<i>Pseudanthias bicolor</i>	Bicolour Anthias	\$8.00	\$10.00	\$12.00	\$15.00
<i>Pseudanthias cooperi</i>	Flame Basslet	\$5.00	\$5.00	\$6.00	\$6.00
<i>Pseudanthias dispar</i>	Twotone Anthias	\$4.00	\$4.00	\$5.00	\$5.00
<i>Pseudanthias hutchii</i>	Threadfin Anthias	\$5.00	\$5.00	\$6.00	\$6.00
<i>Pseudanthias hypselossoma</i>	Stocky Anthias	\$4.00	\$5.00	\$5.00	\$6.00
<i>Pseudanthias lori</i>	Lori's Anthias	\$5.00	\$5.00	\$5.00	\$6.00
<i>Pseudanthias pictilis</i>	Painted Anthias - male			\$35.00	\$40.00
<i>Pseudanthias pictilis</i>	Painted Anthias - female	\$15.00	\$20.00	\$25.00	\$25.00
<i>Serranocirrhites latus</i>	Hawk Anthias			\$40.00	\$50.00

Hawkfish		sm	med	lge	Jumbo
<i>Neocirrhites armatus</i>	Flame Hawk	\$12.00	\$12.00	\$15.00	\$18.00
<i>Paracirrhites arcatus</i>	Arc-eye Hawkfish	\$5.00	\$6.00	\$6.00	\$6.00
<i>Paracirrhites forsteri</i>	Blacksided Hawkfish	\$5.00	\$6.00	\$6.00	\$8.00

Dottybacks & Assessors		sm	med	lge	Jumbo
<i>Assessor flavissimus</i>	Yellow Assessor	\$6.00	\$8.00	\$9.50	\$9.50
<i>Assessor macneilli</i>	Blue Assessor	\$6.00	\$8.00	\$9.50	\$9.50
<i>Cypho purpurascens</i>	Oblique-lined Dottyback	\$25.00	\$25.00	\$25.00	\$25.00
<i>Ogilbyina novaehollandiae</i>	Multicoloured Dottyback	\$12.00	\$12.00	\$12.00	\$15.00
<i>Ogilbyina velifera</i>	Saifin Dottyback	\$10.00	\$15.00	\$15.00	\$18.00
<i>Pseudochromis cyanotaenia</i>	Blue-Barred Dottyback	\$15.00	\$15.00	\$15.00	\$15.00

ASSORTED		sm	med	lge	Jumbo
<i>Aeoliscus strigatus</i>	Razor Fish/Shrimp Fish		\$5.00	\$6.00	\$6.00
<i>Caesio teres</i>	Blue & Gold Fusilier	\$4.00	\$6.00	\$8.00	\$12.00
<i>Photoblepharon palpebrates</i>	One-Fin Flashlight Fish	\$65.00	\$85.00	\$85.00	\$100.00
<i>Pterocaesio marri</i>	Marrs Fusiliers	\$4.00	\$5.00	\$6.00	\$8.00
<i>Scalopsis bilineatus</i>	Bridled Monacle Bream	\$5.00	\$6.00	\$8.00	\$10.00
<i>Zanclus cornutus</i>	Moorish Idol	\$10.00	\$10.00	\$12.00	\$14.00

SHARKS		sm	med	lge	Jumbo
<i>Chiloscyllium punctatum</i>	Bamboo Shark	\$18.50	\$22.00		
<i>Eucrossorhinus dasypogon</i>	Northern Tasseled Wobbegong	\$125.00	POA		
<i>Hemiscyllium ocellatum</i>	Epaulette Shark	\$35.00	\$45.00		
<i>Heteradontus galeatus</i>	Crested Port Jackson Shark	\$60.00	\$70.00		
<i>Heteradontus portusjacksoni</i>	Port Jackson Shark	\$55.00	\$70.00		
<i>Orectolobus maculatus</i>	Ornate Wobbegongs	\$55.00	\$75.00	\$150.00	
<i>Orectolobus ornatus</i>	Banded Wobbegong	\$55.00	\$75.00	\$150.00	
<i>Stegostoma fasciatum</i>	Zebra Sharks	\$450.00	POA		

Sea Slugs/Holothurians		sm	med	lge	Jumbo
<i>Holothuria edulis</i>	Burnt Sausage Seaslug		\$4.00	\$5.00	
<i>Pentacta specie</i>	Caterpillar Sea Apple		\$3.50		
<i>Pseudocolourchirus violaceus</i>	Sea Apple		\$8.50	\$8.50	\$8.50

Southern Australian Fish

Damsels & Cardinals		sm	med	lge	Jumbo
<i>Apogon victoriae</i>	Red Striped Cardinal	\$12.00	\$12.00	\$12.00	\$12.00
<i>Chromis klunzingeri</i>	Blackhead Damsel	\$9.00	\$9.00	\$9.00	\$9.00
<i>Parma mccullochi</i>	Mc Culloch's Damsel	\$18.00	\$18.00	\$20.00	

Butterfly's & Allies		sm	med	lge	Jumbo
<i>Chaetodon assaris</i>	Western Butterflyfish	\$24.00	\$24.00	\$24.00	\$29.50
<i>Chelmonops sp.</i>	Western Talma	\$15.00	\$15.00	\$18.00	\$22.00
<i>Enoplotus arnatus</i>	Old Wife	\$15.00	\$17.50	\$25.00	\$25.00
<i>Tilodon sexfasciatum</i>	Moonlighter	\$25.00	\$30.00	\$30.00	\$35.00

Seadragons Pipefish & Seahorses		sm	med	lge	Jumbo
<i>Heraldia nocturnia</i>	Upside down Pipefish	POA			
<i>Hippocampus abdominalis</i>	Pot Bellied Seahorse	POA			
<i>Solegnathus sp.</i>	Spiny Pipefish	POA			
<i>Stigmatopora sp</i>	Wide bodied pipefish	POA			

Wrasse		sm	med	lge	Jumbo
<i>Bodianus frenchii</i>	Western Hogfish	\$28.50	\$30.00	\$30.00	\$35.00
<i>Bodianus perditio</i>	Goldspot Hogfish	\$25.00	\$25.00	\$30.00	
<i>Coris auricularis</i>	Western King Wrasse - Male		\$40.00	\$40.00	\$50.00
<i>Coris auricularis</i>	Western King Wrasse - Female	\$15.00	\$15.00	\$18.00	
<i>Ophthalmolepis lineolatus</i>	Maori Wrasse	\$18.00	\$18.00	\$25.00	
<i>Pseudolabrus biserialis</i>	Red Banded Wrasse	\$16.00	\$16.00	\$20.00	\$25.00

Boxfish / Leatherjackets / Globefish & Puffers		sm	med	lge	Jumbo
<i>Anoplocarpos lenticularis</i>	White Barred Boxfish - Male	\$100.00	\$105.00	\$110.00	\$120.00
<i>Anoplocarpos lenticularis</i>	White Barred Boxfish - Female	\$35.00	\$45.00	\$60.00	\$75.00
<i>Anoplocarpos lenticularis</i>	White Barred Boxfish pr		\$250.00	\$250.00	
<i>Anoplocarpos robustus</i>	Western Smooth Boxfish	\$75.00	\$85.00	\$85.00	\$125.00
<i>Aracana aurita</i>	Shaw's Cowfish - Male		\$140.00	\$140.00	\$140.00
<i>Aracana aurita</i>	Shaw's Cowfish - Female	\$35.00	\$45.00	\$60.00	\$75.00
<i>Aracana ornata</i>	Ornate Boxfish - Male		\$120.00	\$140.00	\$150.00
<i>Aracana ornata</i>	Ornate Boxfish - Female	\$35.00	\$45.00	\$60.00	\$75.00
<i>Brachaluteres jacksonianus</i>	Pygmy Leatherjacket	\$25.00	\$25.00	\$25.00	
<i>Diodon nichthemerus</i>	Globefish	\$30.00	\$30.00	\$30.00	\$35.00
<i>Eubalichthys mosaicus</i>	Mosaic Leatherjacket	\$25.00	\$30.00	\$35.00	
<i>Omegophor cyanopunctata</i>	Bluespotted Pufferfish	\$35.00	\$35.00	\$35.00	\$40.00

Assorted		sm	med	lge	Jumbo
<i>Aetapcus maculatus</i>	Warty Prowfish	POA			
<i>Aploactisoma milesii</i>	Velvetfish	POA			
<i>Aspasmogaster tasmaniensis</i>	Tasmanian Clingfish	\$15.00	\$15.00		
<i>Austrolabrus maculatus</i>	Black Spot	\$12.00	\$12.00	\$12.00	
<i>Calianthus australis</i>	Spledid Perch - Male		\$100.00	\$120.00	\$125.00
<i>Calianthus australis</i>	Spledid Perch - Female	\$35.00	\$40.00	\$45.00	
<i>Centropogon latifrons</i>	Western Fortescue	\$18.00	\$20.00	\$22.50	\$25.00
<i>Cheilodactylus gibbosus</i>	Crested Morwong	\$28.00	\$30.00	\$30.00	\$40.00
<i>Cleidopus gloriamaris</i>	Pineapplefish / Knightfish	\$45.00	\$50.00	\$60.00	\$75.00
<i>Ellerkeldia rubra</i>	Red Seaperch	\$20.00	\$20.00	\$20.00	\$25.00
<i>Epinephalides armatus</i>	Breaksea Cod	\$30.00	\$30.00	\$30.00	
<i>Girella zebra</i>	Zebra fish	\$18.00	\$18.00	\$20.00	\$20.00
<i>Gnathanacanthus goetzei</i>	Red Velvet Fish		\$165.00	\$165.00	\$200.00
<i>Hypoplectrodes nigrorubrum</i>	Blackbanded Seaperch	\$20.00	\$20.00	\$20.00	\$25.00
<i>Microcanthus strigatus</i>	Stripey	\$5.00	\$5.00	\$10.00	\$15.00
<i>Neatypus obliquus</i>	Footballer Sweep	\$30.00	\$30.00	\$30.00	\$30.00
<i>Odax acroptilus</i>	Rainbow Cale	\$12.00	\$12.00	\$15.00	
<i>Parablennius intermedius</i>	False Tasmanian Blenny	\$18.00	\$18.00	\$18.00	\$18.00
<i>Parapercepipes haackei</i>	Wavy Grubfish	\$6.00	\$6.50	\$7.00	\$8.00
<i>Paraplesiops sp</i>	Western Blue Devil	\$70.00	\$85.00	\$95.00	\$95.00
<i>Pegasus sp.</i>	Seamoth	\$60.00	\$60.00	\$60.00	\$65.00
<i>Petroscines breviceps</i>	Shortheaded Sabretooth	\$10.00	\$10.00	\$12.00	\$12.00
<i>Platycephalus fuscus</i>	Dusky Flathead	\$30.00	\$30.00	\$32.50	
<i>Rhycherus filamentosus</i>	Tasseled Anglerfish	POA			
<i>Scorpaena aumptuosa</i>	Western Red Scorpionfish	\$40.00	\$45.00	\$50.00	
<i>Scorpis georgianus</i>	Banded Sweep	\$12.00	\$12.00	\$12.00	\$15.00
<i>Trachichthys australis</i>	Roughy	\$15.00	\$15.00	\$20.00	

<i>Trachinops noarlungae</i>	Yellowheaded Hulafish	\$6.00	\$6.00	\$6.00	\$6.00
<i>Trachinops brauni</i>	Blue Hulafish	\$8.00	\$9.00	\$9.00	\$9.00

Sharks & Rays		sm	med	lge	Jumbo
<i>Squatina australis</i>	Angel Shark		\$65.00	\$75.00	
<i>Orectolobus tentaculatus</i>	Cobbler Catshark	\$55.00	\$75.00	\$100.00	\$125.00
<i>Orectolobus sp</i>	Western Wobbygong	\$55.00	\$75.00	\$100.00	\$125.00
<i>Uroplophus mucosus</i>	Western Stringray	\$45.00	\$55.00	\$65.00	\$75.00
<i>Uroplophus sp</i>	Masked Stringray	\$45.00	\$55.00	\$65.00	\$75.00
<i>Trygonorhina fasciata</i>	Banjo ray	\$55.00	\$55.00	\$75.00	POA
<i>Heteradontus portusjacksoni</i>	Port Jackson Shark	\$50.00	\$60.00	\$75.00	POA
<i>Heteradontus galeatus</i>	Crested Port Jackson	\$60.00	\$65.00	\$75.00	POA

Appendix 4. Marine Aquarium Fish Trip Logbook (AQ03)

Aquarium Fish Trip Logbook – AQ03

Year:		Log No.	Page No.
Month:			

Non-Collection Codes	Authority/ Permit No.	Holder's Name	Marine Park Permit No.	Boat Symbol	Boat name	
	If not collecting for an extended period of time: <i>I did not work between / / and / / Non-Collection code:</i>					
1 = weather 5 = other	Day of month					Each days fishing activity must be filled out for the entire trip. Daily numbers of fish need only be an estimate and the final in Port total should appear below. ↓
3 = gear maintenance						
Non-Collection code (if not collecting)						
Location	Grid →					
	And Site →					
	Reef ID → (if known)					
No. of collectors						
Total collector hours combined						
Harvest Method code → Sc = scuba H = hookah W = wading						
Estimated daily fish catch – number of specimens					No. dead on arrival	
					In Port Total	
Personifer Angelfish						
Scribbled Angelfish						
Angelfish – all other						
Butterfly fish						
Damselfish						
Anemone fish						
Harlequin						
Wrasses – all						
Surgeonfish						
Trigger fish						
Scorpionfish						
Blennies						
Cardinalfish						
Gobies						
Pipefish/seahorses						
Dottybacks						
Sharks/Rays						
Pufferfish						
Crustaceans						
Molluscs						
Other inverts						

COMMENTS:

I declare the above trip report to be a true and accurate record

Signature _____

Date _____

Instructions for Aquarium Fish Trip Logbook – AQ03

- The logbook is a trip logbook, where a page is filled out per trip, and submitted monthly. Where fishers only undertake day fishing trips, one logbook page may be used for multiple days or 'trips'.
- Daily fishing location information must be entered as 30 minute grid references, and 6 minute grid sites for each site per day.
- The daily effort must be recorded as number of collectors, the total collecting hours, and method code (scuba, hookah or wading) at each site for each day.
- **The daily fishing activity is to be filled out at the end of each day. This need only be an estimate, and the final total of fish specimens harvested at the completion of the trip can be entered to verify actual total counts.** Where only trips are one day, the 'In Port Count' column need not be filled out.
- As the total number of fish **collected** needs to be recorded, it is important that this includes the number that may perish on the trip into port. The number of fish specimens dead on arrival to the Port at the completion of the trip must be entered to ensure that the total fish collected include those that were not ultimately sold.

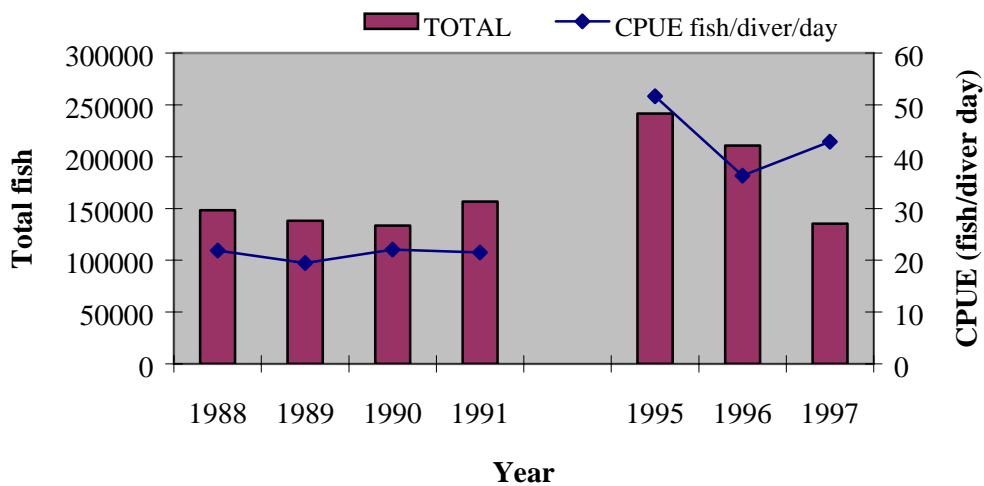
Appendix 5. Catch and Effort trends from 1988 – 1997 (extract from the 1999 QFMA Discussion Paper)

All catch-and-effort-data presented in this paper were collated from fishery participants'. Couchman and Buemer (1992) collated and analysed the available information contained in records for 1988 to 1991. The QFMA maintained all the records for 1995 to 1997. Records for 1992 to 1994 are not collated or analysed. Comparisons between the two datasets have been difficult, because the units of effort measurements, location reporting and other information have differed between sources. Further, the QFMA required that information be completed and submitted quarterly, while the DPI required information only annually. Slight differences in the format of the logsheet and the database storing the information may have differed also, further confounding comparisons between datasets. The information is presented with consideration to the inaccuracies between the datasets but provides the best available information at the time.

Only information on the commercial harvest is presented here, because no information is available on the recreational harvest of aquarium fish.

3.3.2 Aquarium fish fishery data

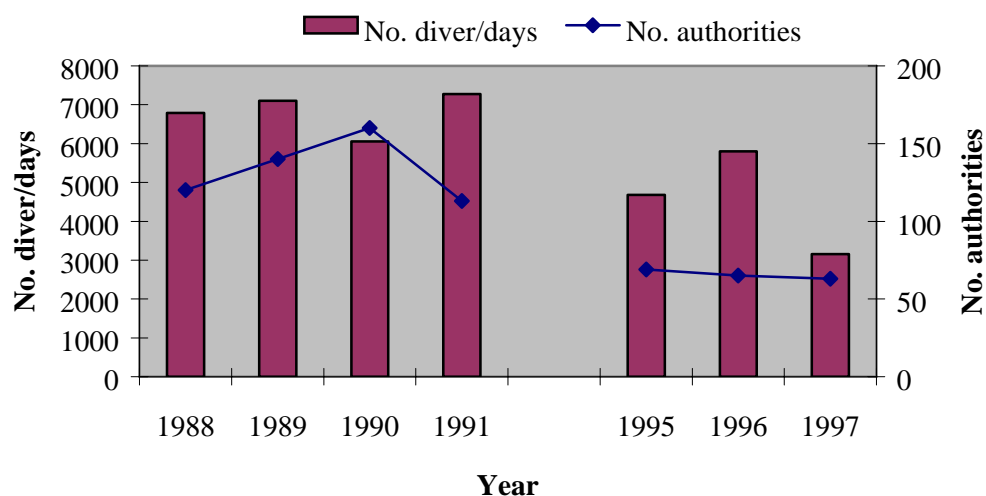
Figure 2. Total number of fish harvested and catch per unit effort (fish/diver/day) for 1988-1997
Source: Couchman and Buemer, 1992 (1988 to 1991) and QFMA records, 1998 (1995 to 1997)



Despite the lack of data for 1991 to 1994, there is an increase in the total number of fish reported as collected in 1995 and 1996 compared with the other years. The decrease in 1997 may be due to a decrease in the number of authority holders who are actively participating in the fishery (see Figure 3).

CPUE has also increased from about 20 fish/diver day to about 45 fish/diver day. The increase in CPUE between the years may be due to differences in effort measurements between the data sets; and accuracy of reporting or data entry and more efficient harvesting through increased diving skills and technology.

Figure 3. Total effort (number of diver days) and total number of authorities for 1988 to 1997.
 Source: Couchman and Beumer, 1992 (1988 – 1991) and QFMA records, 1998 (1995 – 1997).



In recent years annual effort (diver days) has decreased from about 7000 diver days to 5000 diver days. The number of authorities/permits issued for the fishery has also decreased. The calculations of effort may differ between the data sets.

Table 4. Numbers of major aquarium fish groups harvested for 1995-1997
 Source: QFMA records, 1998.

Year	1995	1996	1997
Chaetodonts	18 905	18 219	11 291
Wrasses	28 917	25 736	18 968
Angelfish	34 097	28 224	18 598
Clownfish	17 498	16 619	10 962
Damselfish	59 447	55 922	30 043
Triggerfish	2 107	1 804	1 363
Gobies	24 365	20 538	12 557
Heniochus	1 198	2 397	1 041
Moorish idols	1 897	1 742	1 294
Sharks and rays	874	1 431	649
Other	42 715	25 209	17 964
Crustaceans	3 108	5 267	5 295
TOTAL	241 068	203 108	130 025

During 1997, about 36% less fish were harvested than in 1996. The largest group of fish harvested in all years was the damselfish group. Species in the damselfish family Pomacentridae are smaller specimens than many of the other groups. While clown fish (*Amphiprion spp.*) are also damselfish, their harvest is recorded separately. Damselfish, wrasses and angelfish make up about 50% of all specimens harvested. The number of crustaceans collected increased over the period, which may be due to increased tank technology, knowledge of feed and light requirements and the increase in popularity of 'mini-reef' displays.

Table 5. The number of authority holders who spent the indicated number of authority days in the fishery for 1995 to 1997.

Source: QFMA records, 1998

		1995	1996	1997
Number of authority days				
0 – 10	authority days	28	24	32
11 – 50	authority days	9	7	14
51 – 100	authority days	10	13	6
100+	authority days	22	21	11
TOTAL		69	65	63

Table 5 shows that the number of active authorities decreased between 1995 to 1997. During 1997, 46 authority holders spent less than 50 days in the fishery, while only 17 authority holders spent more than 50 days in the fishery, compared with 1996 when 34 authority holders spent more than 50 days in the fishery. Between 1995 and 1997, about 10 authorities became 'latent', and a further six dropped out of the fishery entirely and allowed their authorities to lapse.

Table 6. Total number of authority days spent in each region for 1995-1997.

Source: QFMA records, 1998.

Year	unknown location	Moreton Bay	South of GBRMP (excluding Moreton Bay)	Mackay/Capricorn Section	Whitsundays/Townsville Section	Cairns Section	Far Northern Section	Total authority days
1995	751	487	722	475	223	1347	9	4014
1996	621	671	855	398	104	2065	29	4743
1997	410	379	598	249	89	906	2	2633

The Cairns area of Queensland is the most important region for aquarium fish collecting. About 38% of all authority days are spent in this region. The next most important is the area between Bundaberg and the NSW border, excluding Moreton Bay. A number of reefs around Hervey Bay and the northern beaches supply certain collectors with fish. Future fishery-dependent monitoring of the aquarium fish fishery will enable fish harvest to be attributed to a region and a specific reef location, enabling CPUE to be calculated regionally to assist in the long-term monitoring of aquarium fish stocks.

Appendix 6. List of protected species

Common name	Species	IUCN Listing	Commonwealth Legislation (EPBC Act)	Queensland Legislation (Nature Conservation Act and Fisheries Act)
Fish and Sharks				
Humphead Maori Wrasse	<i>Cheilinus undulatus</i>	EN		Regulated by species ^{1,4}
Grey Nurse Sharks	<i>Carcharias taurus</i>	VU	CE (east coast population)	EN ³ / Regulated by species ^{2,4}
Great White Shark	<i>Carcharodon carcharias</i>	VU	VU, LOMS	Regulated by species ^{2,4}
Whale shark	<i>Rhinocodon typus</i>	VU	VU, LOMS	
Freshwater sawfish	<i>Pristis microdon</i>	EN	VU	
Green sawfish	<i>Pristis zijsron</i>	EN		
Smalltooth sawfish	<i>Pristis pectinata</i>	EN		
Knifetooth sawfish / narrow sawfish	<i>Anoxypristis cuspidate</i>	EN		
Speartooth shark (<i>Glyphis sp</i>)	<i>Glyphis glyphis</i>	EN	CE	
Murray cod	<i>Maccullochella peelii peelii</i>		VU	Regulated by number and area ⁶
Mary River cod	<i>Maccullochella peelii mariensis</i>		EN	Regulated by species ⁶
Lake Eacham rainbowfish	<i>Melanotaenia eachamensis</i>		EN	Regulated by number ⁶
Oxleyan pygmy perch	<i>Nannoperca oxleyana</i>		EN	VU ³
Red finned blue-eye	<i>Scaturiginichthys vermeilipinnis</i>		EN	EN ³
Honey blue-eye	<i>Pseudomugil mellis</i>		VU	VU ³
Edgbaston goby	<i>Chlamydogobius squamigenus</i>		VU	EN ³
Elizabeth springs goby	<i>Chlamydogobius mircopterus</i>		EN	EN ³
Flinders Ranges gudgeon	<i>Mogurnda clivicola</i>		VU	
Lungfish	<i>Neoceratodus forsteri</i>		VU	Regulated by species ⁶
Turtles				
Green	<i>Chelonia mydas</i>	EN	VU, LMS, LOMS	VU ³
Loggerhead	<i>Caretta caretta</i>	EN	EN, LMS, LOMS	EN ³
Flatback	<i>Natator depressus</i>	DD	VU, LMS, LOMS	VU ³
Hawksbill	<i>Eretmochelys imbricata</i>	CR	VU, LMS, LOMS	VU ³
Olive Ridley or Pacific Ridley	<i>Lepidochelys olivacea</i>	EN	EN, LMS, LOMS	EN ³
Leatherback	<i>Dermochelys coriacea</i>	CR	VU, LMS, LOMS	EN ³
Mary River tortoise	<i>Elusor macrurus</i>	EN	EN	EN ³
Fitzroy tortoise	<i>Rhedytes leukops</i>		VU	VU ³
Gulf snapping tortoise	<i>Elseya lavarackorum</i>		EN	VU ³
Estuarine (saltwater) crocodile	<i>Crocodylus porosus</i>		LMS, LOMS	VU ³
Freshwater crocodile	<i>Crocodylus johnstoni</i>		LMS	
Seasnakes	Family Hydrophiidae		LMS	
Mammals				
Dugong	<i>Dugong dugon</i>	VU	LMS, LOMS	VU ³
Indo-Pacific humpback dolphin	<i>Sousa chinensis</i>	DD	LOMS	Rare ³
Irrawaddy dolphin	<i>Orcaella brevirostris</i>	DD	LOMS	Rare ³
Humpback whale	<i>Megaptera novaeangliae</i>	VU	VU, LOMS	VU ³
Southern Right whale	<i>Eubalaena australis</i>	LR-CD	EN	
Fin whale	<i>Balaenoptera physalus</i>	EN	VU	
Sei whale	<i>Balaenoptera borealis</i>	EN	VU	
Blue whale	<i>Balaenoptera musculus</i>	EN	EN, LOMS	
Bottlenose dolphin	<i>Tursiops truncatus</i>	DD		
Bryde's whale	<i>Balaenoptera edeni</i>	DD		
Cuvier's beaked whale	<i>Ziphius cavirostris</i>	DD		
Dense-beaked whale	<i>Mesoplodon densirostris</i>	DD		
Fraser's dolphin	<i>Lagenodelphis hosei</i>	DD		
Killer whale (orca)	<i>Orcinus orca</i>	LR-CD		
Longman's beaked whale	<i>Mesoplodon pacificus</i>	DD		
Minke whale	<i>Balaenoptera acutorostrata</i>	LR-NT		
Pantropical spotted dolphin	<i>Stenella attenuata</i>	LR-CD	LOMS	
Pygmy killer whale	<i>Feresa attenuata</i>	DD		

Common name	Species	IUCN Listing	Commonwealth Legislation (EPBC Act)	Queensland Legislation (Nature Conservation Act and Fisheries Act)
Risso's dolphin	<i>Grampus griseus</i>	DD		
Rough-toothed dolphin	<i>Steno bredanensis</i>	DD		
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	LR-CD		
Sperm whale	<i>Physeter macrocephalus</i>	VU		
Spinner dolphin	<i>Stenella longirostris</i>	LR-CD	LOMS	
Strap toothed beaked whale	<i>Mesoplodon layardii</i>	DD		
Striped dolphin	<i>Stenella coeruleoalba</i>	LR-CD		
False water rat	<i>Xeromys myoides</i>		VU	VU ³
Marine Birds				
Family Diomedidae				
Wandering Albatross	<i>Diomedea exulans</i>	VU	VU, LMS, LOMS	
Yellow-nosed Albatross	<i>Thalassarche chlororhynchos</i>	LR-NT	LMS, LOMS	
Black-browed Albatross	<i>Thalassarche melanophrys</i>	VU	VU, LMS	
Family Procellariidae (Petrels, Shearwaters)				
Southern Giant Petrel	<i>Macronectes giganteus</i>	VU	EN, LMS, LOMS	
Northern Giant Petrel	<i>Macronectes halli</i>	LR-NT	VU, LMS, LOMS	
Gould's petrel	<i>Pterodroma leucoptera</i>	VU	EN, LMS, LOMS	
Herald petrel	<i>Pterodroma arminjoniana</i>	VU	CE, LMS	EN ³
White necked petrel	<i>Pterodroma cervicalis</i>	VU	LMS	
Providence petrel	<i>Pterodroma solandri</i>	VU	LMS	
Huttons shearwater	<i>Puffinus huttoni</i>	EN	LMS	
Fluttering Shearwater	<i>Puffinus gavia</i>		LMS	
Tahiti Petrel	<i>Psuedobulweria rostrata</i>	LR-NT	LMS	
Family Hydrobatidae (Storm Petrels)				
Family Phaethontidae (Tropicbirds)				
Red-tailed tropicbird	<i>Phaethon rubricauda</i>		LMS	VU ³
White-tailed Tropicbird	<i>Phaethon lepturus</i>		LMS, LOMS	
Family Sulidae (Gannets, boobies)				
Brown Booby	<i>Sula leucogaster</i>		LMS, LOMS	
Family Fregatidae (Frigatebird)				
Greater Frigatebird	<i>Fregata minor</i>		LMS, LOMS	
Least Frigatebird	<i>Fregata ariel</i>		LMS, LOMS	
Family Laridae (Gulls and Terns)				
Little Tern	<i>Sterna albifrons</i>		LMS, LOMS	EN ³
Caspian Tern	<i>Sterna caspia</i>		LMS	
Crested Tern	<i>Sterna bergii</i>	CR	LMS	
Seahorses, Pipefish and Pipehorses				
Duncker's pipehorse	<i>Solegnathus dunckeri</i>	VU	LMS	Regulated by number ⁵
Pallid pipefish	<i>Solegnathus hardwickii</i>	VU	LMS	Regulated by number ⁵
Spiny pipehorse	<i>Solegnathus spinosissimus</i>	VU	LMS	
Robust pipehorse	<i>Solegnathus robustus</i>	VU	LMS	
Gunther's pipehorse	<i>Solegnathus lettiensis</i>	VU	LMS	

IUCN Listings:

- CR CRITICALLY ENDANGERED - A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the criteria (A to E).
- EN ENDANGERED - A taxon is endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined by any of the criteria (A to E).
- VU VULNERABLE. - A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the criteria (A to E).
- LR LOWER RISK - A taxon is Lower Risk when it has been evaluated, does not satisfy the criteria for any of the categories Critically Endangered, Endangered or Vulnerable. Taxa included in the Lower Risk category can be separated into three subcategories.
- DD DATA DEFICIENT - A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution is lacking. Data Deficient is therefore not a category of threat or Lower Risk. Listing of taxa in this category

indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and threatened status. If the range of a taxon is suspected to be relatively circumscribed, or if a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

EPBC Act and Queensland legislation

CE Critically Endangered
E Endangered
V Vulnerable
R Rare
LMS Listed Marine Species
LOMS List Of Migratory Species

- 1 Coral Reef Fin Fish Management Plan
- 2 Queensland *Fisheries Regulation 1995*
- 3 Queensland *Nature Conservation (Wildlife) Regulation 1994*
- 4 Under Section 65 of the *Fisheries Regulation 1995* the take, possession or sale of regulated fish is prohibited. Section 65 does not apply to shark fishing contractors.
- 5 Queensland *Fisheries (East Coast Trawl) Management Plan 1999*
- 6 Queensland *Fisheries (Freshwater) Management Plan 1999*

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