

Pelagic fishes

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Abstract

Fisheries for pelagic species within the Great Barrier Reef World Heritage Area exist over a wide range of habitat areas from coastal headlands, across the continental shelf into oceanic waters. Pelagic species inhabit various levels of the water column and some species may be found adjacent to reef crests.

While a number of smaller species spend their entire life cycle within the Great Barrier Reef World Heritage Area (for example, the smaller pelagics that function as prey for larger pelagics such as Spanish mackerel and juvenile billfish, and reef associated species such as trevallies and double lined mackerels), the dominant species of commercial and recreational importance such as Spanish mackerel, shark, and billfish species migrate in or out of the Great Barrier Reef World Heritage Area on a seasonal or life history basis. As a result of this migratory movement, management of stocks of pelagic fishes can fall to a wide range of State and Commonwealth agencies.

Major issues to affect the long term status of these fisheries include El Nino episodes, fisheries development in adjacent regions to the Great Barrier Reef World Heritage Area, and a lack of consistent catch data for commercial and recreational fishing sectors. Significant fishery interaction issues currently being investigated include by-catch of marlin species taken by the tuna longline fishery that operates on the fringes of the remote waters of the Great Barrier Reef World Heritage Area, while by-catch of cetacean species taken by the shark and barramundi gill net fisheries over the continental shelf could become an issue in the future.

Overview

Pelagic fin fish resources of the Great Barrier Reef World Heritage Area (GBRWHA) include a wide variety of fish families that inhabit various, but usually the upper, levels of the water column. They may range from coastal headlands and nearshore areas, across the continental shelf (sometimes associated with coral reefs) and into oceanic waters.

The term 'small pelagic fishes' usually refers to a diverse group of planktivorous herring or trevally-like species which generally attain a maximum weight of less than 500 g and have attained prominence throughout coral reef areas of the Pacific, at least, as 'baitfish' for industrial tuna pole-and-line fisheries, or as a subsistence food source. There has often been controversial interaction between these fisheries and domestic fisheries. This controversy usually centres around whether or not the industrial fisheries capture juveniles of 'commercially' important species.

Inshore baitfish are small pelagic species normally found close to shore or in close proximity to coral reef crests. While no fisheries currently exist for this group of pelagics within the GBRWHA, potential for industrial fisheries of tuna pole-and-line baitfish species such as anchovies (*Stolephorus*) and sprats (*Spratelloides*) has been shown to exist in substantial localised quantities often close to coral reefs (McPherson unpubl. data 1986, 1992a; Glaister and Diplock 1993).

Open water baitfish are small pelagic species such as garfish (Hemiramphidae, *Hemiramphus* and *Hyporhamphus*), various scads (Carangidae, *Decapterus*, *Selar*, *Atule* and *Selaroides*), pilchards, sardines and herrings (Clupeidae, *Amblygaster*, *Sardinella* and *Herklotsichthytes*). In GBRWHA waters they are either fished commercially as baitfish (especially garfish), or have considerable potential as baitfish for commercial longlinefishing in the Coral Sea (Imai 1972), for recreational marlin or sailfish fishing activities (Williams and Cappo 1990), and perhaps for cat food, mariculture or human consumption (Glaister and Diplock 1993).

Large coastal pelagic species are encountered over continental shelf areas, sometimes associated with coral reefs. They include the narrow-barred Spanish (simply Spanish mackerel) and double-lined mackerels (Scombridae, *Scomberomorus commerson* and *Grammatorcynus* spp. respectively), neritic tunas (Scombridae, *Thunnus tonggol* and *Euthynnus affinis*), trevallies (Carangidae, primarily *Caranx*, *Carangoides* and *Scomberoides*), barracudas (Sphyrnidae) and semi-pelagic reef fish (Lutjanidae, *Caesio* and *Pterocaesio*). Commercial and recreational fishing for all but the semi-pelagic Lutjanidae species is usually line based on trolling methods which depends on the highly mobile and carnivorous behaviour of the species. Fishing technology is available to utilise drift gill net commercial fishing activities for most of these species. These gear are currently utilised to take a number of shark species of the Family Carcharhinidae which inhabit continental shelf waters, and the more inshore *Scomberomorus* species (grey 'Spanish' mackerel *S. semifasciatus*, Australian spotted 'Spanish' mackerel *S. munroi* and school 'Spanish' mackerel *S. queenslandicus*).

Oceanic pelagic species of tuna (Scombridae), billfish (Istiophoridae), wahoo (Scombridae, *Acanthocybium solandri*) and dolphinfish (Coryphaenidae, *Coryphaena hippurus*) usually occur in oceanic or continental slope waters with juveniles of some tuna (yellowfin *Thunnus albacares*) and marlin (black marlin *Makaira indica*) species occurring for a short period in continental shelf waters. Other oceanic billfish such as sailfish (*Istiophorus platypterus*) may be found as either juveniles or adults in both oceanic and continental shelf waters.

Existing zoning

In the General Use 'A' and 'B' Zones within the Great Barrier Reef Marine Park offshore from the outer Barrier Reef, pelagic fishing operations are limited to line gear of no more than six hooks. Commercial pelagic activities are therefore restricted to trolling, pole-and-line, handline, and very short horizontal or vertical longlines. Commercial netting activities for larger pelagics is permitted for specific large mesh nets of specified length depending on whether the gear is deployed offshore or inshore. Some limited length and smaller mesh nets are permitted in surround net fisheries for bait species such as garfish.

Great Barrier Reef Marine Park Authority (GBRMPA) Marine Park Buffer Zones exist around a number of reefs which restrict pelagic fishing operations for large pelagics within set distances of the reef crests. 'Seasonal' closures of waters adjacent to specific reefs are available if required, to afford seasonal protection to spawning stocks. Both of these closure types were primarily developed to protect demersal reef fish stocks. McPherson (1987) demonstrated that open water small pelagic species were more important in the diet of Spanish mackerel than reef associated semi-pelagic lutjanids that are usually restricted to within the Buffer Zones.

The gamefishing sector has expressed concern at the closure of Hilder Reef near Lizard Island through GBRMPA rezoning. The area was a prime location for baitfish capture intended for use in the heavy tackle marlin fishery.

When high incidences of ciguatera fish poisonings have been reported from pelagic fish (primarily Spanish mackerel), the Queensland Fisheries Management Authority (QFMA) has restricted fishing operations within these areas.

Management

Management of many of the larger coastal pelagic species is often complicated by the migratory behaviour of adults, or variable habitat requirements throughout the life cycle of some species, which means individual fish may spend only a part of their life history within the GBRWHA.

Management of stocks of large pelagics in the GBRWHA is the responsibility of a range of State and Commonwealth agencies. The Offshore Constitutional Settlement (Anon. 1987) established that tuna and some tuna-like species (and billfish species) fall under the responsibility of the Commonwealth, now the Australian Fisheries Management Authority (AFMA) through its East Coast Tuna Management Advisory Committee (ECTUNAMAC). Tuna fishing by longline of more than six hooks occurs outside of the GBRWHA. In waters to the north of latitude 19°S there is a restricted zone where effort is restricted to 13 domestic longline vessels each limited to sets of 500 hooks, and Japanese effort restricted to handline gear. Management of tuna stocks within the restricted zone and GBRWHA has primarily been cautious, awaiting research information on the stock structure of yellowfin and bigeye (*Thunnus obesus*).

While management of billfish stocks is generally an issue for consideration by the Commonwealth, which adjacent to the GBRWHA in the Australian Fishing Zone involves the commercial non-retention of black and blue marlin and sailfish, through a voluntary ban (since 1 March 1996), there are no specific regulations relating to the troll gamefishery for billfish species. The recreational sector has a voluntary code of practice of non-retention of black marlin, except first marlin in some cases or potential record weight fish. The majority of marlin taken are released, some are tagged.

The tuna-like species such as the continental shelf *S. commerson* are considered to be a component of the Reef Line Fishery and as such fall within the responsibility of the QFMA and its Reef Management Advisory Committee (REEFMAC) as are the more reef associated pelagics such as carangid species and double-lined mackerels (*Grammatorcynus* spp.). Wahoo appear to be landed in higher quantities by longline gear outside the GBRWHA although responsibility for management of the species is with REEFMAC.

Shaklee (1990) and McPherson (1992b) have demonstrated that two stocks of *S. commerson* occur in Queensland waters, a northern Australian stock and an east coast stock. The latter east coast stock is present in waters south of Torres Strait within the GBRWHA, and seasonally into waters of southern Queensland and into northern New South Wales waters.

For east coast stock fish within GBRWHA a minimum legal size holds for *S. commerson*, while a bag limit exists for the recreational sector. A ban on 'target' gill netting of the species east of Cape York was established to prevent any gill netting on major identified spawning areas for this species off Cairns and Townsville. This ban was partly established following problems with Taiwanese gill net vessels operating illegally in the Torres Strait Protected Zone (TSPZ) waters in 1983. Taiwanese vessels operating in the vicinity of the only defined spawning location of the northern Australian stock in Torres Strait waters apparently affected troll catch rates within the TSPZ, and generated clear evidence of fish 'dropout' from the gill nets (McPherson 1986). Interpretation of 'target' gill netting is left to the discretion of Queensland

Boating and Fisheries Patrol (QB&FP) officers. 'Target' netting is permitted for the northern Australian stock.

Other large pelagics of the continental shelf such as 'edible' shark species and other *Scomberomorus* species (notably *S. semifasciatus*, *S. munroi* and *S. queenslandicus*) are managed by the QFMA's Tropical and Subtropical FINFISHMAC's as the species' are taken for commercial purposes primarily by gill nets. Specific gill net and surround net length and mesh size regulations exist for these fisheries. Minimum legal size provisions hold for these *Scomberomorus* species, with a bag limit for the recreational fishery.

Apart from regulations pertaining to small mesh surround nets deployed for garfish species, there are currently no specific management practices for small pelagics within the GBRWHA that have baitfish or fishmeal potential other than QFMA gear restrictions that presently do not permit purse seine or liftnet type gear. Although initially rejected by QFMA, a commercial operator has achieved a license through the courts to conduct purse seine operations for small pelagic species in waters immediately adjacent to the southern GBRWHA boundary. The possible effect of this operation on larger pelagic species is not known.

Issues

Effect of 'El Nino' episodes on pelagic fisheries

A relationship appears to exist between recruitment of young-of-year spanish mackerel to the offshore troll fishery and high rainfall during the preceding summer months (McPherson, unpubl. data). During the mid to late 1970s Queensland spanish mackerel landings averaged 1018 tonnes until a decline to around 700 tonnes after 1977 (McPherson 1989). Official figures are unavailable from 1980 to 1985. Landings have remained low from then, up to more recent landing figures for Queensland waters of 710 tonnes in 1993 (QFMA Logbook Data for east coast and Gulf; AFMA Logbook Data for Torres Strait).

As two stocks have been demonstrated to occur in Australian waters, the commercial landings by stock are given in Fig. 1. Landings of the east coast stock occur primarily within the GBRWHA where catches have substantially declined over recent years from 675 to 407 tonnes. Approximately 60 to 70% of total east coast landings are reported from the Cairns to Townsville region, notably during the October to November spawning period for the species (McPherson 1994).

Landings data for east coast stock in 1995 exhibit a continued downward trend in catch and catch per unit effort (QFMA CFISH Database). A preliminary examination of the available biological data collected by the Queensland Department of Primary Industries (QDPI) since the mid-1970s suggests that the fishery is fully exploited and stocks are in decline with a relative spawning stock biomass levels at seriously low levels.

Over recent years the Australian east coast has been influenced by a sustained negative index of the Southern Oscillation Index caused by 'El Nino' episodes in the eastern Pacific. Whether recent declines in catches can be attributed to the effects of 'El Nino' events is not clear.

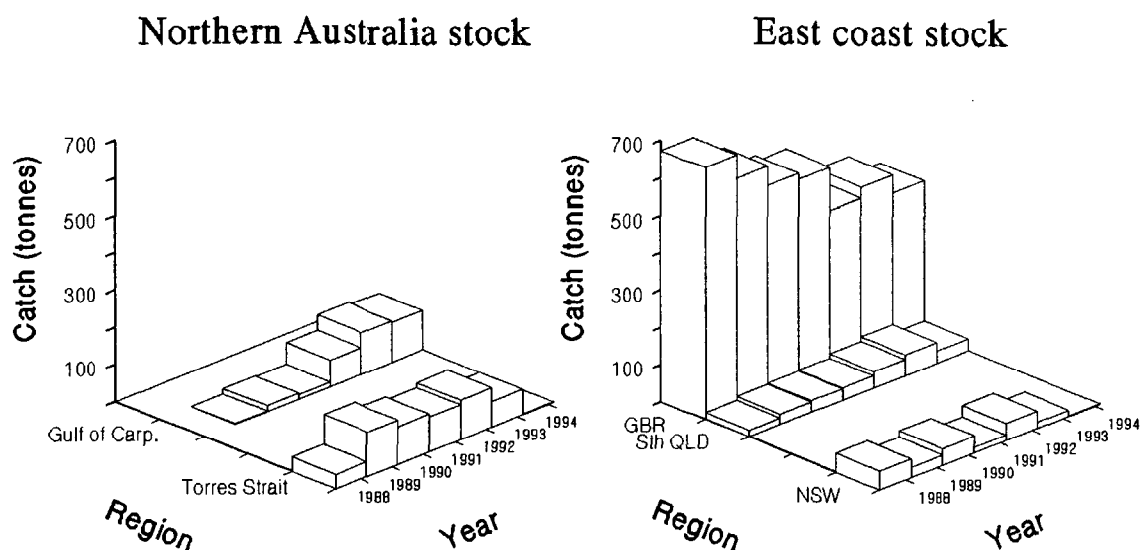


Figure 1. Landings of *Scomberomus commerson* from the northern Australian and east coast stocks

Cetacean by-catch in gill nets

Catches of offshore and nearshore set gill nets often include marine mammals. These catches are undesirable as they could have the potential to deplete a mammal population and may cost commercial operators substantial downtime and gear replacement. The management plans for marine animals under the Queensland Department of Environment Nature Conservation Plan requires that cetaceans and turtles be released if taken incidentally by any fishing gear.

There has been a variety of approaches to reduce mammal by-catch in gill nets involving net redesign, closures, and passive and active alarms. The International Whaling Commission (International Whaling Commission 1991, published 1994) reviewed early research to 1990 into these approaches (Lien, pers. comm.). A general consensus was that those early developmental active acoustic alarms did not provide conclusive solutions to the problems of cetacean entrapment in gill nets. Alarms were also considered to be costly, difficult to maintain and hard to deploy which would render them unattractive to deployment by commercial gill net operators (Dawson 1991).

Since the collation of acoustic alarm data up to 1990 for the International Whaling Commission review, Professor Jon Lien (Memorial University, Newfoundland) who chaired and drafted the report on 'Causes and Solutions' of gill net entrapment, has developed an acoustic alarm to reduce collisions between humpback whales (*Megaptera novaeangliae*) and floating cod traps off Newfoundland resulting in a progressive reduction from 150 per year at the worst to 21 in 1995, although fishing levels were reduced from previous years. Nonetheless the reductions in entrapments coincided with an increase in the north Atlantic population of humpbacks from approximately 600 to 1000 in 1970 to 4-5000 at present (Lien, pers. comm.).

The Queensland Shark Control Program of QDPI established the same alarms on half of the shark nets off the Gold Coast during 1993. The low incidence of collision between humpbacks and Queensland Shark Control Program nets prior to the installation of the alarms made comparison between alarmed and non-alarmed nets extremely difficult. The only humpback entrapped during the 1993 season was in a non-alarmed net.

Present conclusions are that the installation of alarms on all nets has reduced the accidental collisions of whales. These observations have coincided with an increase of approximately 11.7% per year in the numbers of northward migrating adult whales, and southward moving adult and calf whales over the past three years (Paterson et al. 1993). There has been an increase in the incidence of entrapments of whales in non-alarmed fishing gear throughout south-east Queensland, especially during 1996.

Highly successful pilot studies on the use of acoustic alarms to reduce harbour porpoise (*Phocoena phocoena*) by-catch in gill nets off Maine in 1992 and 1993 (Lien et al. 1995) resulted in the United States National Marine Fisheries Service recommending that more exploration of the use of acoustic alarms for harbour porpoise was warranted. These experiments have been concluded with the clear result that acoustic alarms significantly reduced harbour porpoise by-catch (Kraus et al. in press). Further studies concluded by the Protected Species Branch of the National Marine Fisheries Service in the Gulf of Maine (Potter unpubl. report) and northern Washington State (Gearin et al. unpubl. report) also provided significant reduction in harbour porpoise by-catch.

The Queensland Shark Control Program will continue to develop low frequency acoustic alarms suitable for humpback whales, and continue to liaise with providers of higher frequency alarms and fisheries organisations currently trialing these devices suitable for smaller cetacean species with the ultimate objective of deployment of alarms on shark control, and commercial fishery, gill nets in Queensland waters. While alarms provide a potential for reducing entrapment, the low probability of entrapment in any gill net would make clear demonstration of their effectiveness a long term objective.

The draft report of the Acoustic Deterrents Workshop sponsored by the National Marine Fisheries Service (March 1996) accepted that by-catch in some fisheries would always be low and sample sizes required to demonstrate alarm effectiveness would not be feasible. For these instances a series of component projects were suggested where the results of small studies of several similar fisheries could be combined to make an overall inference about significance.

The by-catch in all forms of gill nets within the GBRWHA will be an issue for the future. Some United States of America States have legislated for compulsory involvement of acoustic alarms on gill nets, while Canada is considering such an approach (Jon Lien, pers. comm.). The United States Marine Mammal Commission draft report on active acoustic alarms urged restraint on the unrestrained use of acoustic devices to reduce cetacean by-catch, particularly in the absence of monitoring of cetacean responses. However the report is positive about the potential of active acoustic devices to reduce cetacean by-catch.

Marlin by-catch on tuna longlines

Yellowfin and bigeye tuna are primarily targeted by domestic longliners within the Coral Sea of the Australian Fishing Zone. The potential by-catch of billfish species important to the recreational gamefishery (particularly black marlin) by the longline fishery is of considerable importance to the well established Australian east coast gamefishery. Little information exists to evaluate the interaction between the fisheries. There is currently a Commonwealth Scientific and Industrial Research Organisation/QDPI study funded by ECTUNAMAC to investigate the interaction effects, with an ultimate objective to define a window of longline operation that would minimise the level of interaction between the fisheries.

This issue has been identified by all stakeholders, including those with areas of management responsibility well beyond the boundaries of the GBRWHA, as being highly emotional but of uncertain biological risk.

Baitfisheries

Determining the potential, or advisability, of baitfisheries for small coastal pelagic species within the GBRWHA will always be a major issue. Glaister and Diplock (1993) identified two major issues of concern to pelagic fisheries baitfish requirements:

- rights of access to bait stocks for commercial tuna operations; and
- concerns of the recreational sector of the potential impact of commercial operations on baitfish stocks, particularly those identified by Williams and Cappo (1990). Issues identified included dispersal of aggregations, and the significance of the aggregations to juvenile marlin.

While no data are available on landings, there has been an apparent decline in the catch, or availability, of 'scad' (*Grammatorcynus bilineatus*) by the gamefishing sector. The species is attractive as a marlin bait for its moderate size (namely 3-5 kg) and long 'life' as a towed marlin bait. The species is taken around bommies on the western side of outer barrier ribbon reefs north of Cairns (McPherson 1984). To reduce pressure on scad stocks an alternate bait source for marlin fishing could well come from small yellowfin, bigeye or skipjack (*Katsuwonus pelamis*) taken by longline gear. Glaister and Diplock (1993) noted a requirement for 15-20 (maximum of 50) marlin baits per day.

Although an application to conduct purse seine operations for small pelagic species immediately south of the GBRWHA was rejected by the QFMA, subsequent legal action has resulted the QFMA not being in a position to prevent the development of this fishery. The long term effect of this fishery on larger pelagic species that migrate to and from the GBRWHA through the area of operation of this new fishery is not known.

Shark fisheries

Landings of shark on the east coast varied from 320 to 450 tonnes between 1988 and 1993. Between 60 and 95% of these landings were reported from within the GBRWHA (Fig. 2).

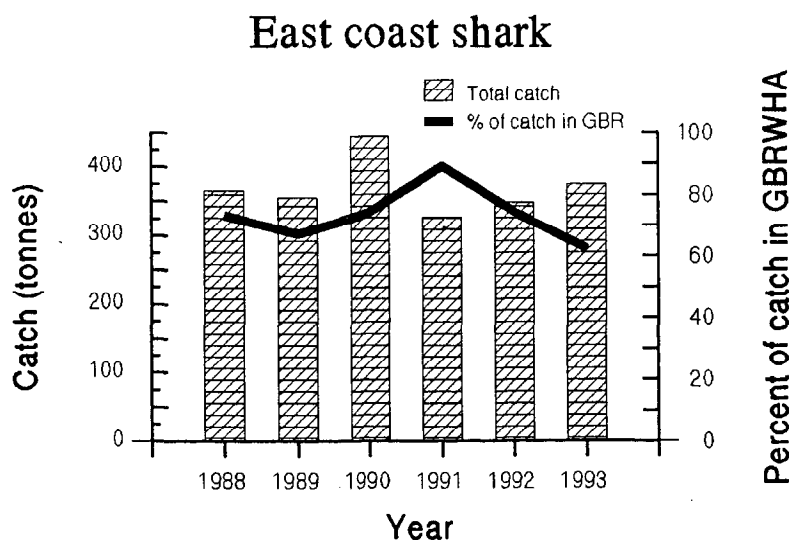


Figure 2. East coast shark landings

Despite the size of the shark fishery, little has been documented about the species composition within the fishery (McPherson 1985a, 1985b), and the mercury levels of the landed product (Queensland Health Department Report 1993).

Research and monitoring

While a number of issues have been flagged as potential areas of concern or resource conflict there are a number of areas that require long term attention. These include:

- Monitoring of the relative catch and effort of the commercial and recreational fishing sectors for spanish mackerel, and the age composition and relative reproductive contribution of spanish mackerel during the spawning season off Cairns to Townsville.
- Monitoring of catch and effort rates of the heavy tackle marlin, and light tackle billfish and spanish mackerel gamefisheries, and the scad baitfishery.
- Assessing the stock structure of various billfish species in relation to other Pacific localities.

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