

9. Management of Striped Marlin

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9.1 Introduction

All billfish, including striped marlin, are highly migratory species listed on Annex I of the United Nations *Convention on the Law of the Sea*. As the description, ‘highly migratory species’ suggests, billfish can move widely within the ocean in which they live including between the jurisdictions of multiple nations and across the high seas, although not all individual fish necessarily make large migrations on a regular basis.

Due to their highly migratory nature, truly effective long-term management of striped marlin will require international cooperation. However, on more local scales, billfish are the pre-eminent gamefish targeted by recreational anglers and conflict between recreational and commercial fishers over access to stocks has been, and will continue to be, a major driver of demands on management. Furthermore, there is increasing evidence that despite their description as highly migratory species, many species of tuna and billfish, including striped marlin, show some regional fidelity within the species range and hence sub-regional or even localised management may be appropriate to avoid localised depletion.

To assist consideration of the needs and options for effective management, this chapter will:

- examine the information requirements for effective management;
- review the billfish management experiences in Australia, New Zealand, United States of America and other countries;
- review the international agreements relevant to billfish including regional fisheries management organizations; and
- discuss the most effective tools to manage billfish and in particular striped marlin.

9.2 Information and Data Needs

King (1989) estimated that 90% of the global commercial catch of billfish has been taken by fishers targeting other species. The fact that billfish, including striped marlin, are predominantly considered to be ‘just a bycatch’ (or more correctly byproduct), has dramatically reduced the quantity and quality of catch data available compared to the information available for commercial tuna species. The multispecies nature of commercial fisheries taking billfish provides further problems for the meaningful analysis of effort data (Squire and Muhlia-Melo, 1993) because data is often lacking to assist the standardisation of catch per unit of effort with respect to billfish. In addition to the gaps in commercial data, there has been very little meaningful catch and effort data collected from recreational fisheries taking billfish (with some exceptions) and this is a significant impediment to developing and assessing management actions especially those seeking to address conflict between user groups.

As a result of the absence of evidence, specific management consideration of billfish either hasn’t occurred or management arrangements have been developed to address political pressure resulting from sectoral conflict. Empirical review of the effectiveness of management has rarely occurred.

To improve the performance of fishery management with respect to marlins, it is vital that information and data needs are recognised and appropriate mechanisms to collect data and information are established. Data and information needs include biological information (e.g. distribution, abundance, stock structure, movement and growth), fishery (e.g. actual catch, effort, size and sex of fish in catch) and socio-economic information (e.g. participation rates and motivations for fishing). For reasons that will be discussed later in this chapter, it is vital that data on marlins is independently verified so as to provide reasonable confidence in the advice generated from it.

While there are considerable gaps in the data and information regarding billfish including striped marlin, an immediate priority for research is improving estimates of post-release mortality of billfish (including striped marlin) and describing the factors that alter mortality rates in both the recreational and commercial sectors. This information is vital to both stock assessment and consideration of alternate management arrangements including those seeking to address sectoral conflict.

As discussed elsewhere in this report, the biology of striped marlin is different to that of other billfish. Similarly the motivational drivers of fishers to catch striped marlin are also different to those for other marlins (e.g. striped marlin sometimes fetch prices equivalent to bigeye tuna in sashimi markets whereas black marlin and blue marlin generally fetch much lower prices). Hence, it is important that both data collection and management is designed with due recognition to the differences between marlin species.

9.3 Review of Domestic Management of Marlins

The following section provides a review of domestic management actions relating to all marlins including striped marlin and white marlin (*Tetrapturus albidus*), a close relative of the striped marlin found in the Atlantic Ocean. In some places, regulations referring to swordfish have been included, however for a more detailed review of swordfish management the reader is referred to Ward and Elscot (2000).

9.3.1 Australia

In contrast to many countries, Australia has a relatively long history of action that has been directly targeted at management of fishery interactions with marlins. Much of the review of Australian management of marlin below has been drawn from Findlay *et al.* (2003).

Jurisdictions

Following the signing of Offshore Constitutional Settlements (OCS) Agreements, the Commonwealth of Australia manages all significant commercial effort taking marlin (including all commercial fisheries allowed to retain and sell marlin) with the exception of some hand-line and troll fishing in an area off the State of New South Wales (NSW). Management of recreational fisheries occurs primarily at the State level although, at present, the Commonwealth also has responsibility for charter fishing for marlin in Commonwealth waters and on the high seas (i.e. waters outside 3nm from land).

Management Action

Under both Commonwealth and State law, there have been a number of significant management actions applied to Australian fisheries that interact with marlin. These include:

- limited entry;
- non-retention policies;
- non-targeting policies;

- closed areas;
- gear restrictions; and
- limits/bans on take, landing and/or sale.

The impact of these decisions on both the interactions with marlin and the conflict between the sectors will be discussed in turn.

Limited Entry

Both foreign and domestic commercial fleets have been subject to limited entry arrangements that control the maximum number of vessels that could operate in the AFZ and various areas within it. In the case of the Japanese fleet, the limit was originally set at 350 vessels in 1979 and this limit decreased over time to 50 in 1991. In addition, limits on the number of days the foreign fleet could fish in the AFZ were introduced in 1991 (3150 days) and day limits remained in force (at decreasing levels) up to the cessation of bilateral access agreements in 1997.

Limited entry arrangements were not introduced specifically to manage marlin interactions by either the domestic or foreign fleets in most areas of the fishery but they did establish maximum bounds on capacity in the fisheries and hence, in theory, limited entry arrangements did limit the maximum potential interaction levels. The maximum limits on the number of Japanese vessels allowed to fish in the AFZ were not reached in the 1980s but by the early 1990s the limits had been reached. Limited entry arrangements appear to have had little effect on domestic fleet numbers as considerable number of latent permits have persisted throughout the history of the fishery with only a maximum of around 160 out of a possible 220 longline vessels ever having operated.

While limited entry does ultimately provide a constraint on the total number of vessels that may operate (and hence a major component of possible total effort), the limits on either the domestic or foreign commercial fleet were not based on specific sustainability considerations or sectoral allocation considerations for any species including marlins. Furthermore, the broad scale nature of limited entry arrangements has done little to manage sectoral conflict with respect to marlins. This may be due to the difference in scale between limited entry arrangements and areas of sectoral conflict. Sectoral conflict with respect to marlins is generally a very localized or broad scale philosophical problem and limited entry applied on a broad scale without explicit consideration of marlin interactions appears to have had little effect on the conflict.

In contrast to the arrangement discussed above, limited entry arrangements were applied specifically to manage marlin interactions in Area E of the AFZ. Area E encompasses a significant portion of the spawning ground for black marlin (*Makaira indica*) in the Coral Sea and domestic vessel numbers in Area E have been limited to 13 since 1994 as part of a suite of measures designed to manage the interactions of the domestic commercial fleet with black marlin in this area. In this case, limited entry when combined with other measures (discussed below) has significantly reduced sectoral conflict but it is unclear how much of this effect can be attributed to limited entry alone.

In 2000, NSW introduced a limited entry arrangement for charter boats targeting tuna and billfish. The management objective of this limit is unclear but these arrangements do impose a maximum limit on charter boat capacity directed at catching marlins in areas under NSW jurisdiction. However, it is unlikely that such a limit will represent a meaningful constraint in the foreseeable future as there is likely to remain considerable latent effort under the current limit.

Non-Retention Policies

In November 1986, the Japanese longline fleet agreed to adopt a policy of releasing all black marlin and blue marlin (*Makaira mazara*) taken in the AFZ that were alive at the time of retrieval of the line. In the same year they also agreed to release all live striped marlin (*Tetrapturus audax*) taken in the AFZ in an area between 12 and 50nm off shore from northern NSW.

Observer data collected on Japanese longline vessels estimates that 74% of black marlin, 71% of blue marlin and 60% of striped marlin were dead or moribund at the time of line retrieval. Therefore, a policy to release black and blue marlin that were alive at time of retrieval has the potential to reduce mortality rates by as much as 20-30% (dependent on post-release survival). However, Japanese longline vessels did not report discarded catch in logbooks and hence it is difficult to determine the real impact (if any) of this non-retention policy. Catch and catch rate data (Figures 9.1A & 9.1B) do not show any meaningful reduction in retention of marlins following introduction of the non-retention policy. In fact the data show a marked increase in catch and catch rate after introduction of the policy.

While observers on Japanese longliners operating in the eastern AFZ did collect data on discards, the low level of observer coverage of Japanese longliners (other than those fishing for southern bluefin tuna) precludes meaningful analysis. Furthermore, it is very uncertain whether or not vessels without observers abided by the policy. Given the observations from the data and the real and perceived risk that such policies will not result in a change of behaviour by vessels, the effectiveness of a policy (or regulation) not to retain fish that are alive at the time of retrieval is questioned.

Management reports show that the domestic commercial fishery had established a voluntary non-retention policy for black and blue marlin in December 1986 and data from the limited amount of fishing effort in the domestic longline fishery suggest that this policy possibly resulted in a decrease in catch rates (Figure 9.2A) but not total catch of black or blue marlin due to concomitant increases in effort (Figures 9.2B & 9.2C).

Non-targeting Policies

In December 1992, the Japanese Government agreed that Japanese fishing vessels in the AFZ would not “deliberately target” marlins. Similar to the non-retention policy introduced around the same time, this policy appears to have had no impact on reducing take of marlins by Japanese vessels (Figure 9.1B).

STRIPED MARLIN: BIOLOGY AND FISHERIES

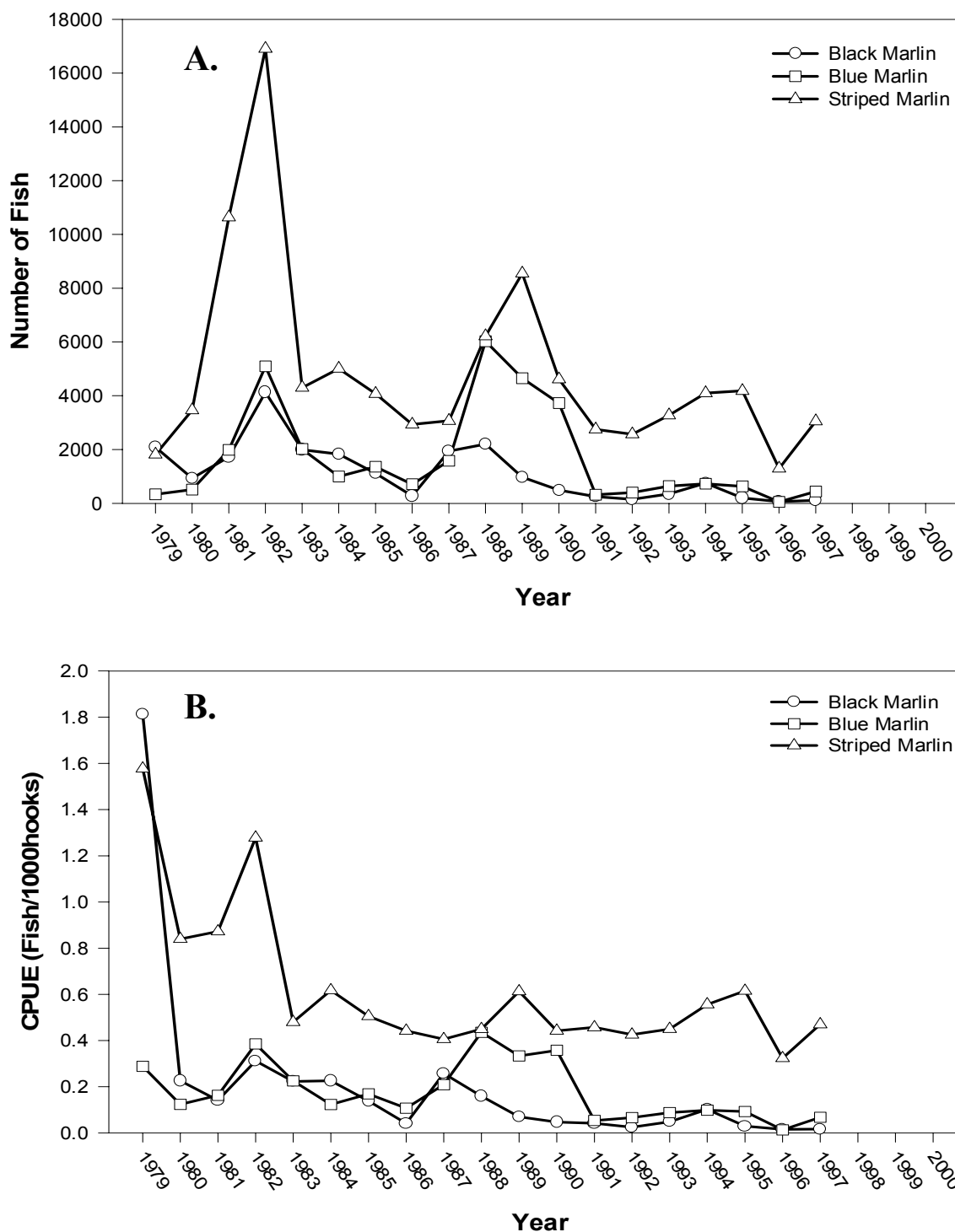


Figure 9.1 - A) Annual catch of marlins by Japanese longliners in the eastern AFZ. (Source: AFMA). B) Annual catch-per-unit-of-effort (CPUE) of marlins from Japanese longliners in the eastern AFZ. (Source: AFMA).

STRIPED MARLIN: BIOLOGY AND FISHERIES

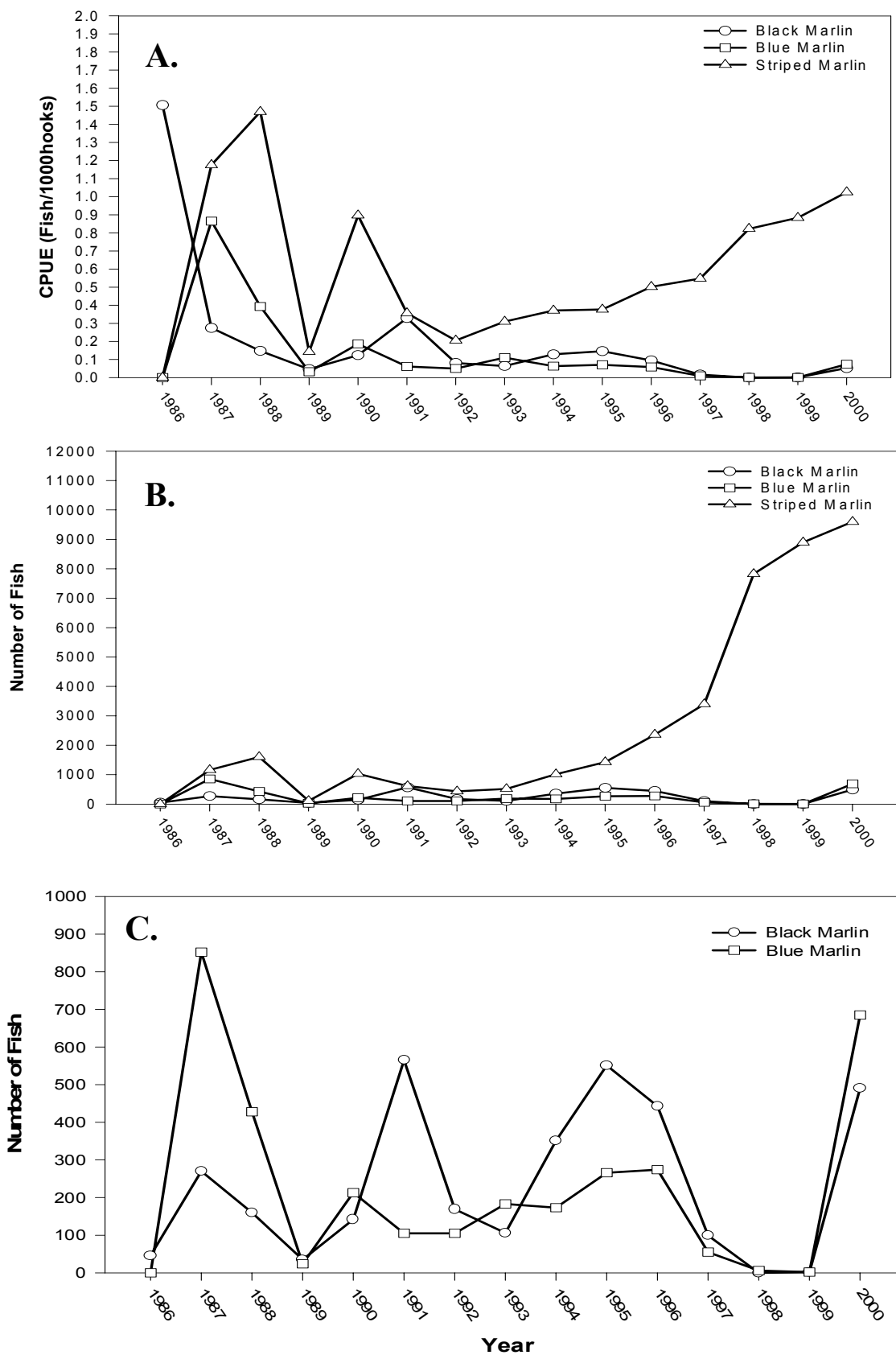


Figure 9.2 - A) Annual catch-per-unit-of-effort (CPUE) of retained and non-retained marlins from Australian longliners in the eastern AFZ (Source: AFMA, 2003). B) Annual catch of marlins by Australian longliners in the eastern AFZ (Source: AFMA, 2003); C) Annual catch of black and blue marlin by Australian longliners in the eastern AFZ (Source: AFMA, 2003)

In 1995, the Commonwealth and the State of Queensland signed a Memorandum of Understanding in which the Commonwealth agreed not to issue fishing concessions specifically for the targeting of billfish. Despite this agreement, Commonwealth endorsements continue to allow targeting of striped marlin and broadbill swordfish (*Xiphias gladius*).

Closed Areas

Closed areas were included in the very first bilateral AFZ access agreement with the Japanese Government reached in 1979 and all subsequent bilateral access agreements. These areas were closed with the express purposes of both specifically reducing interactions with marlins and reducing conflict with the recreational fleet through spatial separation. Under the access agreements the extent of the closed areas increased over time but in November of 1980 and 1990, two key closures to longlining in the Coral Sea were introduced specifically to reduce the interactions with black and blue marlin.

The 1990 closure involved an area of the AFZ, known as the Townsville Trench, in which 58% of the black marlin taken by Japanese longliners in the eastern AFZ up to that time had been caught. Hence, closure of this area was expected to deliver a meaningful reduction in the catch of this species. As can be seen in Figure 1, the actual impact of the 1990 closure was dramatic. In effect the closure resulted in a greater than 85% average decrease in the annual catch and catch rate of black marlin. It also resulted in a decrease of more than 80% in average total catch and 70% in the average catch rate of blue marlin but had no clear impact on catch or catch rates of striped marlin. However, while these results appear to show that the closure was highly successful, it is unclear if the obvious sensitivity of the Australian public (as reflected in the Government negotiating position) had an effect on the data recorded by Japanese longliners with respect to catch of black and blue marlin.

Despite apparent reductions in catch of black marlin by Japanese longliners, Campbell *et al.* (2000) reported that data collected on strike rates aboard recreational (charter) vessels fishing for black marlin on the Cairns grounds did not show any significant increase that could be attributed to the closures. In general, correlations between longline effort (Japanese and domestic collectively) and recreation strike rates for black marlin did not show a strong interaction relationship but the relationship was highest for longline effort in inshore areas where recreational vessels operate.

However, Campbell *et al.* (2000) also noted that during the early 1990s there was some replacement of Japanese effort with domestic longline effort in the areas closed to the Japanese longline and hence the overall impact of the closure on the recreational fishery is impossible to distinguish. The increase in domestic longline effort in the areas closed to Japanese longliners did coincide with declines in recreational strike rates however data limitations and inter-annual variability make any conclusions on a causal relationship difficult to sustain with any confidence.

In addition to the specified closures and other management arrangements established within the bilateral access agreements with respect to marlins, delays in the finalisation of access agreement negotiations had an interesting impact on the interactions of the Japanese fleets with marlins inside the AFZ. Bilateral access agreements for Japanese vessels to fish within the AFZ expired each year on 31 October. From 1989 until the cessation of the agreements in 1997, delays in finalising negotiations for the next year's agreement lead to all Japanese vessels being excluded from the AFZ for much of November and December. Logbook records show that 69% of black marlin (by number) taken by Japanese longliners in the AFZ were taken in the fourth quarter of each year (i.e. October-November). The proportion of the fourth quarter available for Japanese vessels to fish inside the AFZ never exceeded 70% in the period 1989-1997 and in the last three years of the bilateral access arrangements no Japanese vessels operated inside the AFZ during the last quarter of each year. Hence, the exclusion of

Japanese vessels due to failure to reach agreement on the forthcoming years access agreement probably had a large impact on the number of black marlin taken. Furthermore, the fact that nearly 70% of all black marlin were taken in a single quarter demonstrates why temporal and spatial considerations are important when developing management arrangements.

Gear Restrictions

In 1994, the Australian Fisheries Management Authority introduced a limit of 500 hooks per set for domestic longliners operating in Area E. This measure was introduced to reduce longline soak time. The duration of a longline set is correlated with morbidity of hooked black marlin (Campbell *et al.* 1997a,b). At-sea independent observations recorded that 44% of black marlin were dead or moribund at time of retrieval when longline soak time exceeded 16 hours longline while soak times of less than three hours resulted in only 10% of black marlin being dead or moribund at time of retrieval. The actual impact of this regulation is difficult to determine in the absence of verified logbook data from the domestic fishery.

As an aside, even when soak times were equivalent, mortality rates on Japanese and domestic longliners are remarkably different. For the same soak times, domestic mortality rates are approximately half those observed on Japanese longline vessels. This suggests that the gear configuration (e.g. braided rope as used by the Japanese fleet, versus the monofilament gear used in the domestic fleet and hook shape and style), line retrieval or some other fishing technique difference other than soak time has a significant impact on mortality rate at the time of retrieval.

Limits/Bans on Take, Landing and/or Sale

In 1989, NSW amended sections of the *Fisheries and Oyster Farms Act 1935* to prohibit the landing of billfish. These amendments were later incorporated into the *NSW Fisheries Management Act 1994*. This prohibition does not apply to striped marlin taken by Commonwealth endorsed fishers or recreational fishers (including charter). It is difficult to determine the effect of this prohibition as data on catch (including discards) and effort is not available from the NSW-managed sector of the commercial fishery for tuna and billfish.

In 1997, the Commonwealth *Fisheries Management Act 1991* (the 'Act') was amended to impose a ban on the commercial take of black and blue marlin within the AFZ. The Act defines 'take' to mean "catch, capture, take or harvest". However, there is legal uncertainty about the operational definition of take with regard to fishing and, at present, the effect of this amendment is to prohibit the retention and sale of black and blue marlin by Commonwealth-managed commercial fishers.

The amendment of the Act to ban the take of black and blue marlin by Commonwealth commercial fishers followed a heated political debate between recreational and commercial fishers that received considerable media attention. This ban currently does not apply to recreational fishers. Interestingly, Section 4(5) of the Act states, "For the purposes of this Act, a charter boat and the person in charge of the boat are taken to be engaged in commercial fishing." Hence, the ban on commercial take of black and blue marlin would presumably apply equally to both commercial and charter fishers. However the ban is only enforced for commercial fishers and this exemption may be afforded by Section 4(1) of the Act defining a charter boat as "a boat that is being used exclusively for recreational fishing....".

As noted above, there is some uncertainty about the operational definition of 'take' under the Act and the potential responses from management to various activities. In particular, this uncertainty has led to considerable concern amongst commercial fishers that they may be prosecuted if they recorded the capture of black and blue marlin on their logbooks even if the fish were subsequently released/discarded. Indeed this concern resulted in no black marlin being recorded in logbooks completed by Commonwealth commercial fishers in 1999 (Figure

4). Obviously, in the absence of an observer program or other means to collect catch data, such reactions to regulation can have dramatic consequences on the data available to scientist to provide advice to managers.

In 1991, the State Government in Western Australian (WA) introduced a regulation that banned the landing and sale of all marlins by commercial fishers (both State- and Commonwealth-managed) in response to pressure from recreational anglers. Despite these regulations being introduced in 1991, and restated in Section 18 of the Fish Resources Management Regulations 1995, they were not applied to striped marlin landings by Commonwealth commercial fishers until 1999. Because Commonwealth regulations allow the take of striped marlin the enforcement by WA of the ban on landing of striped marlin by Commonwealth-managed fishers has resulted in threats of legal challenge by both individual fishers and the Commonwealth Government but to date no such challenges have eventuated and the prohibition on landing remains in-force. The WA ban on landing does not apply to recreational fishers including charter fishers. Recreational fishers have called on the NSW State Government to introduce similar regulations to prohibit the landing of striped marlin by Commonwealth-managed fishers.

In recent years, both NSW and WA have introduced bag limits to regulate the take of marlin by recreational and charter fishers. In NSW there is a combined species limit on billfish of two per angler in possession. In WA the combined species limit for marlins is one per angler in possession (previously four). Anecdotal information suggests that these bags limits do not appear to have had any significant impact on the landing of billfish by recreational anglers and given the low retention rates of recreational anglers such limits are only likely to affect a very small number of fishers.

Ancillary Actions/Events

In addition to the management arrangements listed above, there are a number of ancillary actions/events worthy of discussion in the context of a review of management of marlins in Australia.

Organised gamefishing competitions in Australia have encouraged tag and release and the use of heavier rather than lighter breaking strain lines (in an effort to improve post-release survival) through point-score systems that favour release over retention (e.g. minimum sizes for point-scoring). These systems are described in considerable detail in Anon. (2000). Incentives to use heavier tackle may have resulted in increased catch per day through reduced fighting times but little data is available on which to assess such an impact.

For many years, local “gentleman’s” agreements have existed between recreational and domestic commercial fishers. Under these agreements the commercial fleet typically agrees to avoid certain inshore fishing areas at certain times of the years (e.g. during recreational fishing tournaments). These agreements have varied in their effectiveness in minimising sectoral conflict. For example, the agreements are generally effective when the commercial fishers live in the local area but the agreements often breakdown when vessels based in other ports enter the area in question.

With respect to sectoral cooperation, in recent years there has been an interesting development in recreational/charter and commercial relations in Area E. Following many years of acrimony, domestic commercial vessels and charter vessels often cooperate to find concentrations of their respective target species. At this stage the impact of such cooperation on the broader question of sectoral conflict over marlins is unclear.

9.3.2 New Zealand

The Ministry of Fisheries manages all recreational and commercial fishing in New Zealand including all fishing activities in relation to striped marlin. New Zealand commercial fishers are prohibited from landing all marlins including striped marlin and are encouraged to tag and release all live marlin including striped marlin. Longline vessels are also prohibited from targeting swordfish. Despite the prohibition of targeting, there has been a rapid increase in swordfish catch in the late 1990s and early 2000s utilising techniques associated with swordfish targeting (e.g. squid baits, light sticks, shallow sets at night).

In the recreational sector, there is a bag limit of one marlin per day per person. Gamefishers are encouraged to practice catch and release of fish caught and charter vessels are required to release all billfish caught in the Auckland Fisheries Management Area. Live billfish taken by charter vessels are to be tagged and release and information on all billfish caught must be provided to the Ministry for Fisheries.

9.3.3 United States of America

Billfish management in the US occurs on multiple levels and a range of tools have been implemented in both the Atlantic- and Pacific-based US fisheries.

Jurisdiction – West Coast

Until 1976, fishery regulations for fisheries taking striped marlin on the US west coast were under the jurisdiction of the individual States. In 1976, the US Federal Government claimed management jurisdiction over all billfish within the United States Fishery Conservation Zone (USFCZ) (3- 200 nautical miles off the coast) under the *Fishery Conservation and Management Act* (1976). This Act provided for Regional Fishery Management Councils to develop and conduct management programs for marine fisheries and their resources within the USFCZ.

In considering domestic management action in the Pacific Ocean (and Atlantic), the US has recognized that unilateral action will be of little benefit in the long-term unless all nations cooperate to manage and conserve highly migratory species. Additionally because these species are highly migratory, any local management by countries within their EEZs will predominantly be based on economic, social and cultural considerations rather than sustainability. However, this will not necessarily be the case if the species in question has a key “hotspot” (e.g. breeding ground, key feeding area) within the countries EEZ (Orbach, 1990).

The management plan dealing with billfish was adopted in the late 1970s for the US west coast. Unlike other plans this plan was not developed further in the 1980s following advice from the Pacific Fishery Management Council’s (PFMC’s) that it could not provide a meaningful estimate of maximum sustainable yield (MSY) or other meaningful biological advice on billfish resources within the EEZ for inclusion in a revised plan. The conclusion was reached that “billfish ...are highly migratory species and their fisheries cannot be effectively managed on a biological basis inside the area of the USFCZ. Biological management of these stocks is an international problem” (Squire and Muhlia-Melo, 1993).

On the west coast, US fishery regulations differ between the State and Federal levels. For example, in California, State regulations assume that actions are illegal if not authorized by law, whereas Federal regulations assume actions to be innocent unless prohibited by law. However, in the case of billfish fisheries management, State regulations only apply within 3nm of the coastline.

Jurisdiction – East Coast

The Fishery Management Plan for Atlantic Billfishes, including white marlin, was developed under the authority of the Magnuson Fishery Conservation Act by the five eastern seaboard Fishery Management Councils and applies to all Atlantic billfish species as occur in the 200nm EEZ of the USA.

Bag Limits

Californian regulations restrict fishermen to 1 striped marlin per fisher per day, yet the CPUE for this region between 1969-89 off California has only been around 0.1 striped marlin per angler day. Such regulations thus relate more to fishing goals than to resource management.

In the Atlantic, there are no bag limits and catch and release is strongly promoted. Voluntary catch and release is believed to be greater than 90% of caught fish (NMFS, 1997).

Time/Area Closures

The waters off the States of Washington and California are closed to pelagic longlining within 100nm. Oregon allows pelagic longliners to harvest swordfish and blue shark outside of 25nm if the longliner has a permit (but waters inside 25nm are closed), although no landings have been made under this scheme so far.

In California, Congressman Duncan Hunter has introduced a bill in 2003 (prepared following pressure from the US angler group the Recreational Fishing Alliance (RFA)) to ban pelagic longlining in the US west coast EEZ. The bill counters a current proposal from pelagic gill net fishers to replace their drift nets with longlines with the intent of "reducing bycatch". At present, pelagic longlining is not allowed within 200 miles of the coast, but longliners can dock at Californian ports. While this bill will not represent a major change in striped marlin management in California, it will have greater significance in Oregon where longlining is allowed.

In addition to direct measures, regulations imposed on fishing of other species may impact on marlin stocks. For example, banning of Hawaiian longliners targeting swordfish north of the equator in response to seabird and turtle concerns, might significantly reduce striped marlin catches by this fleet, but the confining of fishing to the north of 5°N in April and May also might increase competitive interactions between longliners and small recreational fishing boats. Furthermore, displaced Hawaiian vessels may increase fishing pressure in areas such as American Samoa, where fishing effort levels recently increased significantly.

In 1986, foreign longlining was banned within 150nm of the islands within the EEZ around Hawaiian fishery due to concerns that bans on take of black and blue marlin were an inappropriate tool to ensure the protection of the sport and game fishery around these islands.

In the Atlantic there have been a time/area closures implemented to reduce the incidental take of marlin and juvenile swordfish.

Non-retention

The *Fishery Conservation and Management Act* allowed for the Secretary of Commerce to establish conditions on access when applications to fish in the USFCZ were received from foreign nations. In 1978, non-retention zone for billfish caught by foreign vessels within 100nm was established, while the total allowable level for foreign fishing catch of striped marlin in the USFCZ was determined to be zero. In 1981 the PFMC evaluation of striped marlin resources off the west coast found no reason to limit striped marlin take by US citizens in the USFCZ. By 1993, the non-retention conditions on foreign vessel catch of striped marlin was the only regulation believed necessary in this region (Squire and Muhlia-Melo, 1993).

In the Atlantic, US commercial vessels are not permitted to retain any marlins and all marlin must be returned to the sea dead or alive. Live marlin and undersize swordfish must be released in a manner that will maximise probability of survival.

Limited entry

Limited entry is in place in the Atlantic although it is unclear if the number of vessels was set with explicit consideration on the impact on marlins. Recreational fishers in the Atlantic do not currently need to have a permit to take billfish, however charter boats that target HMS must have a permit. NMFS is considering introducing permits for recreational fishers targeting HMS (White Marlin Status Review Team, 2002). As a result of pressure from the recreational sector, the USA is currently considering a limited entry program for the west coast.

Ban on Sale/Landing

The management plan in the Atlantic bans the sale or import of blue and white marlin from the North Atlantic, sailfish from west Atlantic and spearfish from entire Atlantic although some allowances have been made for the traditional Puerto Rican handline fishery. NMFS is responsible for billfish data collection via logbooks and observers on commercial vessels. Recreational fishing tournaments are also required to report catch and effort information. Only billfish caught on recreational rod and reel may be retained. There are minimum size limits for recreational catches of billfish.

Under State law, striped and blue marlin may not be imported, exported or sold commercially in the State of California (black marlin may be imported under certain conditions).

Swordfish quotas

Following ICCAT recommendations, National Marine Fisheries Service (NMFS) implemented quota reduction for Atlantic Swordfish between 1997 and 1999. No quotas have been set for marlin or swordfish in the Pacific.

Size Limits

The recreational fishery in the Atlantic Ocean is managed by size limits. There has been a suggestion that minimum size limits for recreational catches of white marlin based on sexual dimorphism between males and females might be valuable, however it is unlikely that this would be of use for striped marlin off the west coast, which show little sexual dimorphism (Wilson et al., 1990).

Live Bait Bans

To reduce the bycatch of marlin, live bait may not be used in the Gulf of Mexico, and vessels in this area are not allowed to keep live baitfish on board.

Gear restrictions

In the Atlantic, recreational fishers may only use rod and reel to catch Atlantic billfish.

Management Performance

Despite having imposed a wide range of management measures in relation to marlins, there is little information available upon which to undertake assessments of the performance of measures. Despite overfishing in the Atlantic and stock status uncertainty in the Pacific, marlin management activity in the US has been principally driven by sectoral conflict. It appears that management action has generally favoured recreational fishers over domestic commercial operators and domestic commercial operators over foreign commercial operators.

Political pressure rather than empirical evidence seems to have been the driving force behind management however, a Fishery Management Council review in 1987 stated that the greatest overall benefit to the nation would result from reserving billfish for the recreational fishery, as this fishery yields far greater benefits and has the intent and capacity to make use of all billfish

in the EEZ, but that this fishery depends on a high availability of fish. The Council established objectives to “minimize billfish mortality and eliminate waste of the resource to the greatest extent possible” and to “maintain the highest level of availability of billfish to the US recreational fishery, maximising the social and economic benefits to the nation”, as a reflection of this assessment.

Interestingly, NMFS has had formal data reporting requirements in recreational fishing tournaments for many years. This is the only example of formal data collection requirement in a recreational sector (outside requirements for charter vessels that apply in several countries) in the world.

9.3.4 Mexico

The Secretary of Fisheries, Mexico DF (SEPESCA), implements all fishery regulations relevant to the management of billfish resources, including striped marlin. The states within Mexico have no jurisdiction over pelagic resources (Squire and Muhlia-Melo, 1993).

Both Japanese and domestic longline vessels have fished off Mexico taking billfish both as a target catch and as a bycatch. Before 1967 Mexico had established a 9nm coastal zone in which no longlining was permitted, and this was extended to 12nm in 1969, though some Japanese longline operations were allowed in the 9-12nm zone. Prior to 1976, there were only limited regulations relating specifically to the catch of billfish. After that time, efforts were made to manage the interacting sports and commercial fisheries and in that year a ‘species list’ was established, which listed all billfish as a sport fish only, however, the law was subsequently modified (Squire and Muhlia-Melo, 1993).

In the 1983, pressure from sportfishers resulted formation of a sportfishery preserve or zone extending to 50nm offshore, in which commercial targeting of billfish was prohibited. In August 1987 this preserve area was extended even further off the coast and new protection areas based on billfish ‘vulnerability’ and reproductive areas were established which excluded commercial fishing off the south west coast of Baja California, the entrance to the Gulf of California, and the Tehuantepec Bight. In addition, operational rules were imposed on the commercial fleet to further reduce billfish interactions and mortality.

From 1990, commercial fishing for marlin and sailfish was prohibited, with all licenses cancelled for vessels exclusively targeting billfish. However, shark and tuna longline permits persisted with these vessels taking an incidental catch of billfish. Commercial fishing for swordfish was allowed, as recreational fishers did not traditionally target this species. At present striped marlin can still be sold commercially in Mexico (Squire and Muhlia-Melo, 1993).

Over many years, various tourism-based fishing resorts have applied their own catch limits and other conditions on fishing but these were voluntary. More recently, a Sports Fishery Development Plan was published and regulations were imposed including bag limits of one billfish per angler per day and limits on fishing gear. The sport fishery only operates in about the first 50nm of the coast, and it is suspected that a sizeable level of illegal foreign commercial fishing for billfish is occurring in the remainder of the Mexican exclusive economic zone. As a result it is difficult to estimate the impact of this fishery on striped marlin stocks. In response to this intrusion on its EEZ and the lack of a Pacific-wide international management body for billfish, Mexico has claimed the right to manage billfish unilaterally in its own EEZ despite the highly migratory nature of these species (Sosa-Nishizaki, 1998).

Most management regulations in the EPO result from sportfishing pressure creating restrictions on commercial fisheries. However, with the exception of the exclusion of longlining from high catch rate core areas off Baja, California (discussed below), few of the regulations imposed to date in the region are expected to have any significant impact on the striped marlin resource of the region (Squire and Muhlia-Melo, 1993) due to the overwhelming magnitude of the bycatch of billfish in distant-water longline fleets operating in the region.

The Baja area, a core area for striped marlin in Pacific, has a high CPUE for both recreational and commercial sectors. The recreational fishery for striped marlin in the Baja core area accounts for the capture of 5000 to 12000 striped marlin per year and this sector is very important economically to Mexico. The average CPUE for this core area for recreational catches was around 0.51 fish per angler day (Squire and Muhlia-Melo, 1993). The overlapping longline fishery targeted striped marlin in the summer and autumn in an area extending south from Magdalena Bay and Cabo San Lucas to the Revilla Gigedo Islands (Squire and Muhlia-Melo, 1993). Commercial catch of striped marlin in the Baja core area contributed 23% of the total commercial striped marlin catch in the Eastern Pacific and tagging studies suggested high emigration and immigration rates through the core area (Squire and Au 1990). Following the closure of the core area to commercial longlining CPUE for striped marlin increased in both the recreational sectors and, for the area outside the closed zone, in the longline sector.

9.3.5 Japan

Japan, through the Fisheries Agency, limits entry to its' high-seas fleet but these limits are not set with specific regard for the sustainability of striped marlin or other billfish stocks. It is unclear what, if any, arrangements are in place in Japanese coastal fisheries with regard to managing the harvest of striped marlin. Striped marlin are a commercially valuable species in Japan's and their national catch of striped marlin in 2000 represented 3.346 million yen in value to their economy (Gross Fisheries Output 2000 Report). Recreational fishing is not permitted in Japan, apart from a few registered tournaments (*pers comm.* Dr Ziro Suzuki, National Research Institute of Far Seas Fisheries). The level of compliance with this ban is unclear.

9.3.6 South Africa

Pelagic fisheries management in South Africa is the responsibility of the Marine and Coastal Management Branch of the Department of Environmental Affairs and Tourism. Until January 2003, distant-water longline fleets from Japan, Korea and Taiwan fished in the South African EEZ for tuna and billfish under bilateral access arrangements including limited entry. Since the mid-1990s South Africa has sought to develop a domestic commercial longline fishery for tuna and billfish to replace the foreign fleet and in January 2003 it ceased all foreign bilateral access for pelagic longlining.

There was a recreational fishery for swordfish established in the early 1990s. Catch rates in this fishery plummeted following the commencement of domestic commercial longlining for swordfish in 1997. An area of the swordfish fishery has been closed to longlining, but the recreational fishery has not improved. There is a recreational bag limit of 5 swordfish. It does not appear that South Africa has any marlin-specific management arrangements currently in place.

9.2.8 Chile

Chile has a scheme known as *mar presencial* where Chile has an enhanced "presence" beyond its EEZ, where it monitors the activities of other nations. This is thought to be legally problematic by other nations, but could potential help prevent fishing for striped marlin that is against international agreements. A 120 nm exclusion zone for commercial longliners has also

been instituted to protect artisanal fishers. Dead discards of swordfish are not counted in the national quota, and as a result the total allowable catch is often exceeded (Ward and Elscot, 2000). Other than conditions relating to swordfish it does not appear that Chile has any other billfish-specific management arrangements in place.

9.4 International Agreements and Regional Fisheries Management Organisations

9.4.1 United Nations Convention on the Law of the Sea

The Convention of the Law of the Sea (UNCLOS) is an agreement between nations of the United Nations on the legal status of the high seas and was ready for signing in 1982. By 1987, the Convention had been signed by 155 out of 176 member states, including those nations which take the majority of fishery catch, but had been ratified by only 35 of these.

UNCLOS establishes a number of requirements upon fishing nations around the world. Articles 56, 61, 62 and 64 of Part V pertain to problems of managing fish species in general. Article 56 assigns coastal states sovereign rights over resource management in the EEZ, and Articles 61 and 62 describe how to exercise these sovereign rights.

Article 64 applies specifically to highly migratory species listed in Annex I, including all billfish and tuna, and states that coastal states and states using distant water fleets shall cooperate directly or through international management authorities to ensure conservation and appropriate resource utilisation, both within and beyond their EEZs. If no such management body exists for a region, the various states will cooperate to establish one.

UNCLOS requires international disagreements over management of fisheries to be fixed by multilateral cooperation. Enforcement of arrangements is left to each State and authority over a vessel's compliance lies with its owner State. In many cases this has been ineffective in controlling the activities of vessels. An alternative arrangement might be for control by port State in addition to flag State, as already used in pollution laws. This would require ports of entry to inspect vessels for compliance with international fishing regulations. Where violations are detected, the vessel will be reported to its State or detained. A Memorandum of Understanding (MOU) could also be developed to promote inspection of vessels by the port State.

However, while 157 countries have signed/acceded to UNCLOS and of these 145 countries have ratified the agreement (as of 13 November 2003), major players in highly migratory fisheries have either not signed or not ratified the agreement. Hence, despite entering into legal force on 16 November, 1994, UNCLOS has not had the full operational force it needs to be successful in achieving meaningful changes in international fisheries management.

9.4.2 United Nations Fish Stocks Agreement

In 1995, the United Nations adopted the *Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks*. The objective of this Agreement is to ensure the long-term conservation and sustainable use of highly migratory and straddling fish stocks through effective implementation of the relevant provisions of the Convention.

This entire agreement is intended to direct international management of highly migratory and straddling fish stocks and should serve as a minimum standard for cooperative international management. By 13 November 2003, 59 countries had signed/acceded to the agreement and,

of these, 36 have ratified. Never-the-less the agreement entered into force on 11 December 2001.

9.4.3 International Convention on the Conservation of Atlantic Tunas

ICCAT is a regional fisheries management organization responsible for the management of tuna and tuna-like species in the Atlantic Ocean and adjacent seas. It was established in 1969. There are currently 25 members. Its recommendations are binding six months after notification, unless legal action is taken (Ref 7). Members are required to share catch and effort data including data on the catch of marlins. At its' annual scientific and Commission meetings, ICCAT reviews the status of white and blue marlin stocks, considers the effectiveness of data collection and existing management measures and reviews the recommendations for future management. Both white marlin and blue marlin are overfished in the Atlantic Ocean.

Following adoption of a number of non-binding measures for billfish, in 1997, ICCAT instituted its first binding recommendation on billfish. This recommendation required members to reduce their landings of white and blue marlin by 25% by 1999. While some members met this target, overall this target was not achieved and in 1998, a new deadline of 2000 was set. By 2000, the target had been met for the Atlantic catch overall, although some non-members did not cooperate.

At the ICCAT meeting in 2002, further recommendations on billfish were adopted. These included a recommendation to reduce of landings blue marlin and white marlin by a further 50% and 67% respectively from the 1999 catch level. ICCAT also recommended that live marlin caught by longliners and purse seiners were to be released in a way that maximized their chance of survival.

In recognition of the importance of data in assessing stock status and the effectiveness of management arrangements, at the 2000 meeting, recommendations were made to increase observer coverage, improve recording of marlin catch and discards, and to promote the adoption of minimum size limits in the recreational sector of 251cm lower jaw fork length.

In addition, ICCAT members are required to promote the use of monofilament leaders to improve the post-release survival for billfish, and to improve catch statistics and information about post-release mortality of fish released live from commercial and recreational fisheries.

In addition to these direct measures, ICCAT has also placed a seasonal ban on the use of fish aggregating devices (FADs) in the Gulf of Guinea and this may have reduced the impact of purse seiners on white marlin in this area.

9.4.4 Indian Ocean Tuna Commission

The Indian Ocean Tuna Commission (IOTC) is an intergovernmental organization formed under the *Agreement for the Establishment of the Indian Ocean Tuna Commission*. This agreement was adopted by the Food and Agriculture Organisation (FAO) Council on 25 November 1993, and entered into force on 27 March 1996. The IOTC is responsible for the management of tuna and tuna-like species in the Indian Ocean. Catch, effort and size data from fisheries must be provided to the IOTC including that relating to marlins (Ref 5). The IOTC has made no management decisions with regard to marlins.

The IOTC has established a Working Party on Billfish. This group met for the first time in 2000. At that meeting the Working Party concluded that there was insufficient information available on which to base recommendations on specific management action for any billfish. At its' second meeting in 2001 the group suggested that the status of swordfish stocks in the

Indian Ocean should be closely monitored and further increases in catch and effort on this species are unlikely to be sustainable. No management recommendations were made regarding marlins or other species. The third meeting of the Working Party was held in October 2003 and again this meeting focussed on swordfish rather than marlins although several papers on marlins were presented.

9.4.5 Inter-American Tropical Tuna Commission

The Inter American Tropical Tuna Commission (IATTC) was established in May 1949 and currently has 13 members. The IATTC is responsible for the conservation and management of fisheries for tunas and other species taken by tuna-fishing vessels in the eastern Pacific Ocean. The Commission collects and compiles catch and effort data on commercial fisheries in the eastern Pacific Ocean including data relating to billfish (Greenough and Rothschild, 1989).

At its meeting in 2003, the Commission consolidated resolutions on bycatch made in 2000, 2001 and 2002 including resolutions on billfish. The IATTC requires purse seine vessels to promptly release all billfishes. The same resolution requires IATTC staff to:

- develop techniques and /or equipment to facilitate the release of billfish;
- seek funds to carry out experiments to determine the survival rates of released billfish; and
- define periods in which billfish were most likely to be caught.

9.4.6 Western and Central Pacific Ocean

At present there are four entities relevant to consideration of international management of marlins in the Western and Central Pacific Ocean. These are:

- the Secretariat of the Pacific Community (SPC);
- the Standing Committee on Tuna and Billfish (SCTB);
- the South Pacific Forum Fisheries Committee and Agency (FFC & FFA); and
- The Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean (WCPFC).

SPC

The Secretariat of Pacific Community (SPC) is an international regional development organisation for the Pacific region and was formed by an Agreement signed in Canberra in 1947. The SPC acts as an advisory and consultative body to governments in the Western and Central Pacific Ocean regarding economic and social development. The SPC adopted a Tuna and Billfish Assessment Program in 1981, which conducted research into the stocks of tuna and billfish in the region. SPC currently has the Oceanic Fisheries Program (OFP) who compiles regional fisheries data and undertakes stock assessment and preparation of other scientific advice. The OFP has undertaken dedicated research into billfish fisheries in the region which has focussed on establishing data collection systems to ensure data is collected on which to base management advice. The OFP also acts as a Secretariat to the Standing Committee on Tuna and Billfish.

SCTB

The Standing Committee on Tuna and Billfish (SCTB) is an open forum for pelagic fisheries scientists and others with an interest in the tuna and billfish resources of the Western and Central Pacific to present and discuss scientific information. First established in the mid-1980s, SCTB now plays a key role in the development of scientific advice on tuna and billfish to various regional management bodies including the South Pacific Forum Fisheries Committee and the Preparatory Conference for the Establishment of the Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific.

In recognition of the importance of billfish in the region, SCTB has established the Billfish and Bycatch Research Group (BBRG).

At its most recent meeting in July 2003, the BBRG reached the following conclusions in relation to billfish:

- a strong focus should continue to be maintained on monitoring regional billfish catches, both in commercial pelagic fisheries and from recreational fisheries;
- the importance of observer programs in obtaining accurate estimates of bycatch is noted and efforts should be made to improve observer coverage in WCPO pelagic fisheries in order to obtain more reliable statistics on bycatch, and to permit risk analysis on bycatch species;
- it was recommended that additional research be conducted on stock structure and stock boundaries of species of interest to the BBRG; and
- The BBRG, recommends that data collection programs be modified to better report bycatch.

FFC & FFA

The Forum Fisheries Agency (FFA) was established in 1979 to promote regional cooperation and coordination in respect of fisheries issues and seek to secure maximum benefits from the living marine resources of the region, in particular the highly migratory species.

Under the 1979 Convention, the Forum Fisheries Agency consists of the Forum Fisheries Committee (FFC) which is the governing body, and a Secretariat. The Agency presently has sixteen members, each of which is represented on the FFC.

The FFA has not made any management recommendations specifically in relation to billfish in the region.

WCPFC

After four years of complex negotiations between the coastal States of the Western and Central Pacific and States fishing in that region, the *Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean* was opened for signature at Honolulu on 5 September 2000. This Convention is one of the first regional fisheries agreements to be adopted since the adoption of the UNFSA.

The objective of the Convention is to ensure, through effective management, the long-term conservation and sustainable use of highly migratory fish stocks in the western and central Pacific Ocean. For this purpose, the Convention establishes a Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central

Pacific Ocean. The Contracting Parties to the Convention are, *ipso facto*, members of the Commission.

The Convention applies to all species of highly migratory fish stocks (defined as all fish stocks of the species listed in Annex I of UNCLOS occurring in the Convention Area and such other species of fish as the Commission may determine) within the Convention Area, except sauries.

The Convention Area is defined in Article 3 of the Convention and comprises all waters of the Pacific Ocean bounded to the south and to the east by a line drawn from the south coast of Australia due south along the 141° meridian of east longitude to its intersection with the 55° parallel of south latitude; thence due east along the 55° parallel of south latitude to its intersection with the 150° meridian of east longitude; thence due south along the 150° meridian of east longitude to its intersection with the 60° parallel of south latitude; thence due east along the 60° parallel of south latitude to its intersection with the 130° meridian of west longitude; thence due north along the 130° meridian of west longitude to its intersection with the 4° parallel of south latitude; thence due west along the 4° parallel of south latitude to its intersection with the 150° meridian of west longitude; thence due north along the 150° meridian of west longitude.

As at 1 November 2002, the Convention had been signed by 19 States: Australia, Canada, Cook Islands, Federated States of Micronesia, Fiji Islands, Indonesia, Marshall Islands, New Zealand, Nauru, Niue, Palau, Papua New Guinea, Philippines, Samoa, Solomon Islands, Tonga, Tuvalu, United States of America and Vanuatu. Four States, namely Fiji Islands, Marshall Islands, Papua New Guinea and Samoa, had ratified the Convention.

In accordance with Article 36, the Convention will enter into force 30 days after the deposit of instruments of ratification, acceptance, approval or accession by three States situated north of the 20° parallel of north latitude and seven States situated south of the 20° parallel of north latitude. However, if, within three years of its adoption (i.e. by September 2003), the Convention has not been ratified by three States situated north of the 20° parallel of north latitude, it will nevertheless enter into force six months after the deposit of the thirteenth instrument of ratification, acceptance, approval or accession.

The Convention also contains special arrangements for participation by fishing entities and by territories situated within the Convention Area and on 5 September 2000, Chinese Taipei signed the Arrangement for the Participation of Fishing Entities.

Simultaneously with the adoption of the Convention, the participants in the Multilateral High-Level Conference also adopted a resolution establishing a Preparatory Conference for the Establishment of the Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean. The task of the Preparatory Conference, which will continue until the Convention enters into force, is to lay the groundwork for the establishment of the Commission and to ensure that no vacuum exists in the period between adoption of the Convention and its entry into force. Specifically the Preparatory Conference is to establish the organizational and financial framework for the new Commission and its subsidiary bodies, as well as facilitate the future work of the Commission. It is to begin the process of collecting and analysing data on the status of the fish stocks and, if necessary, recommend conservation and management measures.

The Preparatory Conference has not made any management recommendations in relation to billfish at any of its' five meetings to date.

9.5 Discussion

Until the mid to late 1990s no international management arrangements had been established for marlins. Catch and size limits introduced since that time within ICCAT appear to be working in terms of controlling official catch but in the absence of sufficient data verification it is impossible to be sure what the real impact of the catch limits has been. The impact, if any, of the IATTC Resolution requiring purse seiners to immediately release billfish is also unclear due to uncertainty about post-release survival and the relatively low interaction rates by purse seiners relative to longliners. Regional fisheries management organizations in the Western and Central Pacific Ocean and Indian have not yet introduced any specific management arrangements for marlins.

To date, domestic management, both in Australia and elsewhere, has principally been driven by sectoral conflict resulting from differing values being placed on the marlin resources by different sectors. In most cases, little empirical information has been used in the development of management arrangements or in any assessments of the effectiveness of various management actions and significant weight has been placed on perceived deleterious impacts.

As evidence of the perceptual rather than empirical basis underpinning most domestic management decision-making with respect to marlins to date, it is notable that, in many cases, nations have been willing to explicitly manage foreign commercial vessels to minimise the take of marlin but have been far more reticent when it comes to imposing the same conditions on their domestic commercial fleets. Similarly, in a number of areas, recreational pressure on managers has resulted in time-area closures to pelagic commercial fishing or total commercial landing bans for marlins. Often these restrictions have been put in place without clear evidence of overfishing and/or negative interaction between sectors. Such an approach is in marked contrast with the typical process for dealing with commercial-only fisheries. The main constraint on evidence-based management decision-making and review has been a lack of suitable data.

While noting the limitations of the available data, the apparent effectiveness of various management actions has varied considerably both in terms of addressing overfishing concerns and managing sectoral conflict. Voluntary non-targeting and/or non-retention agreements from commercial fishers have been relatively common but seem to have achieved little by way of meaningful management outcomes and have, in most cases, been followed by more stringent regulatory action. Given the financial incentives for the capture and retention of marlins it is not surprising that voluntary arrangements have not worked. Management tools that have formally addressed the incentive/ability for commercial targeting of marlins (e.g. non-retention laws, live bait bans) appear to have been unsuccessful in some cases in reducing conflict due persistent perceptions of significant but hidden mortality in the absence of verified data.

Closed areas seem to have had the most marked impact on interaction rates and sectoral conflict. As noted by Squire and Au (1990) for the Baja California area of the eastern Pacific, Goodyear (1999) for the eastern US EEZ and Findlay *et al.* 2003 for the eastern Australian EEZ, relatively small time-area strata are often the source of relatively large proportions of marlin catch. Hence, time area closures should be carefully considered as a means to deliver cost-effective management outcomes with respect to marlins. Furthermore, one of the key tools in reducing sectoral conflict seems to be physically separating the fishing activities to improve the perceptions (if not necessarily the reality) of recreational fishers about the quality of the experience.

Formal regulatory bans on landing do eliminate the incentive for targeting but do not stop the mortality of marlins during commercial fishing. Depending on interaction and mortality rates,

bans on landing may have no real effect and, indeed, be wasteful in the eyes of many as dead fish must be returned to the sea. Hence, if non-retention is to be used as management arrangement, careful consideration will need to be given to post-release survival if management objectives are to be achieved.

In the case of recreational fisheries for marlin it is increasingly the case that the landing of marlin is not the predominant outcome but rather tag and/or release except possibly for record sized fish. Hence, the performance of such fisheries can be measured more effectively by strike rates and access to record size fish than it can by landed weight of fish at the wharf. As such the biomass capable of producing maximum sustainable yield is less relevant to these fishers than the biomass capable of generating the highest strike rates and encounter rates with record sized fish. Using a suite of management tools it may not be necessary to pick one fishery over another as there are many management options available.

Similarly, management arrangements in sport fisheries that predominantly do not retain their catch need careful consideration. For example, classical recreational bag limits or sectoral shares of a retained quota are very unlikely to provide a meaningful basis for management of such fisheries. Similarly, allocation of a share of retained quota to a non-retention fishery would only create the almost perverse situation in which such a stakeholder is best served by seeking to make the overall total allowable catch (i.e. total retained catch) for all sectors equal to zero regardless of biomass. Hence, it is clear that this approach will do little to reduce sectoral conflict.

In addition to addressing sectoral conflict and reducing the risk of overfishing, management is increasingly being called upon to address accusations of recreational angling cruelty. This adds a new dimension to the debate that will also need careful consideration. Tools such as regulating against the use of light tackle are clearly an option to address such concerns.

Regardless of the objectives of management, it is apparent from this review that performance measures have not been established and management agencies have not been collecting the necessary data. In the absence of such an approach, future management decisions cannot be taken from an empirical base and management performance will continue to suffer as a consequence.

