Report on the Bycatch and byproduct risk assessment for the East Coast Spanish Mackerel Fishery

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The Department of Primary Industries and Fisheries (DPI&F) seeks to maximise the economic potential of Queensland's primary industries on a sustainable basis.

This publication provides information on a bycatch and byproduct risk assessment undertaken for the East Coast Spanish Mackerel Fishery.

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Executive Summary

This report documents the outcomes of an ecological risk assessment undertaken on bycatch and byproduct associated with the East Coast Spanish Mackerel Fishery (ECSMF).

The ECSMF has always been considered a highly selective fishery, based on a relatively benign fishing method. The risk assessment was designed to formalise, quantitatively wherever possible, the risks to non-target species associated with the fishery.

The risk assessment was valuable in that it exposed a number of invalid views about the fishery, but also helped confirm some of the long-standing assumptions. Participants rejected the notion that large Spanish mackerel are not retained. It was acknowledged that the Sydney Fish Markets will not accept whole Spanish mackerel over 10kg in response to concerns about ciguatera poisoning. However, fishers noted it was standard practice to fillet larger fish instead of selling them whole. Consequently, almost all large Spanish mackerel are retained. Fishers suggested that research into whether ciguatera in Spanish mackerel is a legitimate concern for the species should be a priority given its influence on the marketability of individual fish.

The risk assessment process confirmed that the catch of undersize Spanish mackerel is rare and that both commercial and recreational fishers are routinely able to selectively target certain size classes of fish. Data provided from the DPI&F Long Term Monitoring Program (LTMP) supported this position.

In regard to retained non-target species, fishers' experience, as well as data from logbooks and buyers, indicated that byproduct was rarely equivalent to more than 5% of the total catch of Spanish mackerel.

Interestingly, participants at the workshop expressed concern about the increased targeting of shark mackerel by operators as a result of it being a non-quota managed species. In response, it was suggested that the logbook be expanded to capture the catch of lesser mackerels and other pelagic species in order to monitor any changes in targeting behaviour. It was agreed that this form of monitoring of byproduct would be sufficient to assess any changes over time.

The risk assessment results indicated that the ECSMF poses a low risk to the majority of the bycatch or byproduct species identified. Sharks caught incidentally, but not retained, were the only species identified as moderate risk, in recognition that they are vulnerable to overexploitation because of their life history traits. These results mirror outcomes of similar risk assessments undertaken by WA and NT fisheries agencies.

It is anticipated that the results of the risk assessment will be validated through periodic observer trips.

Introduction

The East Coast Spanish Mackerel Fishery (ECSMF) is an important recreational and commercial fishery targeting *Scomberomorus commerson.* It has been suggested that the fishery is one of the cleanest in terms of the composition and quantity of bycatch taken.

This risk assessment is designed to provide a more formal assessment of the impacts of the fishery on bycatch[1] and byproduct[2] species associated with the fishery.

The ECSMF was approved for three years as a Wildlife Trade Operation (WTO) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) in December 2004.

The Australian Government Department of the Environment and Heritage (DEH) made a number of recommendations that form conditions of the WTO approval. The recommendations were designed to address any risks or uncertainties that were identified during assessment of the fishery.

A number of these recommendations relate to bycatch and/or byproduct:

> *As part of the biennial review of the ECSMF, DPI&F to develop fishery specific objectives linked to performance indicators and performance measures for target, bycatch, protected species and impacts on the ecosystem. (Deadline: 31/3/2006)*
>
> *DPI&F, as part of the development of performance indicators and performance measures for the fishery, to include a mechanism to identify and respond to changes in the composition and quantity of bycatch in the ECSMF. (Deadline: 31/3/2006)*
>
> *That DPI&F, at its biennial review of the ECSMF, consider means of reducing the capture of undersized and large Spanish mackerel including more effective size selective gear.(Deadline: 31/3/2006)*

All three recommendations are required to be implemented by early 2006. DPI&F considered that a more formal assessment of the species potentially at risk from the fishery was necessary to better inform discussions about size selectivity, bycatch monitoring and performance measurement.

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[1] For the purposes of this risk assessment, bycatch is defined as species that are discarded from the catch or retained for scientific purposes, and that part of the "catch" that is not landed but is killed as a result of interaction with fishing gear. This includes discards of commercially valuable species, in particular, undersize target species.
[2] For the purposes of this risk assessment byproduct is defined as species that are retained because they are commercially valuable but are not the main target species.

This risk assessment is based on a workshop held on 16 November 2005 with key stakeholders. These stakeholders included:

- Fishery managers
- DPI&F assessment and monitoring staff
- DPI&F Long Term Monitoring Program staff
- Experienced commercial Spanish mackerel fishers (north and south)
- Recreational fishers known to target Spanish mackerel (north and south)
- Spanish mackerel researchers from JCU / CRC Reef.

The list of participants can be found in Appendix 1.

The objectives of the workshop were to:

- Determine the level of risk to the ecological sustainability of bycatch and byproduct associated with the ECSMF.
- Assess the need for monitoring of bycatch or byproduct and what form this may take.
- Discuss potential ways in which the DEH recommendation relating to more size selective gear may be met.
- Develop objectives, performance indicators and performance measures related to bycatch and byproduct.

Because of the limited time available to complete the risk assessment in the workshop, the development of performance measures was not discussed at the workshop. However, the performance measures set out in this document have been developed by DPI&F and provided to participants and the Reef Management Advisory Committee's (MAC) Scientific Advisory Group (SAG) for comments. DPI&F will determine the most appropriate framework to implement the performance measurement system.

Process

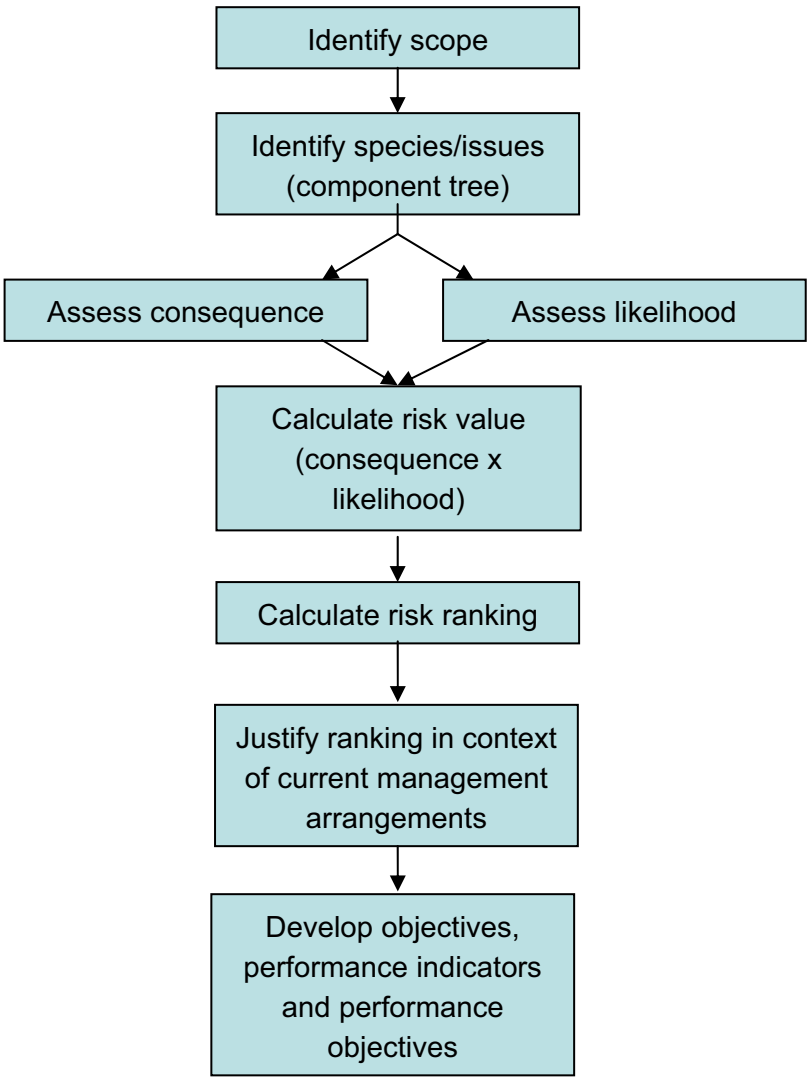


Figure 1

Figure 1 provides an overview of the process that was followed in the workshop, highlighting the importance of justifying risks, and the linkage with development of performance measures. The risk analysis tool used in this process is based upon the AS/NZ Standard, but adapted for use within the fisheries context (Fletcher *et al,* 2002). It works by assigning a level of consequence (from negligible to catastrophic) and the likelihood of this consequence occurring (from remote to likely) for each issue/species. The overall level of risk assigned to each species is based on the group's assessment of the perceived consequence multiplied by the perceived likelihood. Further information on the process can be found in Fletcher *et al*, 2002.

Scope

There was significant discussion at the beginning and throughout the workshop in regard to the scope of the assessment. This section provides a synthesis of these discussions. It highlights some of the inherent characteristics of the Spanish mackerel fishery and other line

fisheries that were identified to ensure a clear scope for the assessment. The discussion was extremely valuable as it ensured all participants were aware of the context when assessing risk.

Regional differences

The ECSMF exhibits distinct regional differences. The majority of the catch in the northern section (i.e., north of Gladstone) has historically been taken by the commercial sector, while the catch in the south is dominated by the recreational sector. In addition, Spanish mackerel in the north are often associated with coral reefs, while in the south they are often found in open water or associated more often with rocky reefs. Initial discussions about bycatch and byproduct indicated that because of the different habitat characteristics between the north and the south, bycatch and byproduct species would also differ. It was determined that, depending on the species of interest, it may be appropriate to assess the level of risk to species separately for each region.

Gear and bait differences

The gear used to target Spanish mackerel is known to vary regionally, both between and within sectors.

In north Queensland commercial fishers tend to troll with 200ft of wire on a 12-14 inch reel, sometimes on a paravane/downrigger. Depending on the behaviour of the fish, operators may change to lighter gear, using 50lb monofilament line on rod and reel. This is often done to encourage fish to the surface if trolling is unsuccessful. Bait ranges from gar to pilchards. Operators in the north tend to use lures (e.g., spoons) more than their southern counterparts.

Commercial operators in the north who fish predominantly for coral reef finfish often float a single pilchard on gang hooks in order to potentially catch a Spanish mackerel while they are also bottom fishing for demersal coral reef fish.

Commercial operators in the south tend to use lighter gear, trolling with 50lb monofilament line on rod and reel. Bait also differs from the north, with southern fishers often collecting live bait of slimy mackerel, yellowtail scad and bonito.

Recreational fishers use a variety of gears, but predominantly use around 30lb monofilament or braided line on rod and reel. The type of bait used varies significantly, from lures to live and dead baits.

It was acknowledged that gear and bait differences apparent between regions may influence the risk values.

Overlap in line fisheries

The workshop recognised that significant overlap exists between a number of Queensland line fisheries, including the ECSMF, the Coral Reef Finfish Fishery, the Rocky Reef Fishery and the Deepwater Finfish Fishery. Given that the type of gear permitted is similar in the fisheries and the areas of operation also overlap, participants expected that it may be

difficult to distinguish which fishery bycatch or byproduct species were taken in. In addition, many operators are endorsed to operate in a number of these fisheries, further confounding whether the catch is taken as a target species in one fishery or byproduct in another.

Overall assessment of scope

Based on the points raised above, it was identified that the scope of the assessment should:

- Be limited to the Spanish mackerel fishery on the east coast only;
- Only consider the impacts of line fishing, which is the only permitted method for targeting Spanish mackerel (i.e., exclude Spanish mackerel caught incidentally by net);
- Where appropriate, separate issues into regions (north; south) or sectors (commercial; recreational);
- Not include bait collection, which was considered a separate fishery and would not be assessed as part of the Spanish mackerel fishery;
- Not consider that floating a pilchard while actively fishing for coral reef finfish is "targeting" Spanish mackerel. It was felt that this activity may be more accurately described as an incidental capture of Spanish mackerel while fishing in the Coral Reef Finfish Fishery. It was also established that the aim of the workshop was to assess bycatch and byproduct taken when actively targeting Spanish mackerel, rather than confound the issue by considering overlapping fisheries.

Issue identification (component trees)

Issue identification is an important step in any risk assessment process. The purpose of developing component trees is to assist the process of issue identification by moving through each of the ecological components of ESD in a comprehensive and structured manner, maximising consistency and minimising the chances of missing issues. Participants added issues not covered in the generic component trees and deleted issues that weren't considered relevant to the fishery.

A number of issues and species were discussed at this stage and subsequently not added to the component tree.

No-take species prescribed under the *Fisheries (Coral Reef Finfish) Management Plan 2003* were not included in the component trees. It was established that the no-take fish species (barramundi cod, potato cod, Queensland groper, paddletail, red bass and hump-headed Maori wrasse) are associated with the reef proper, rather than the reef edge where Spanish mackerel fishing tends to occur and catch of these species wasn't known to occur.

Discarding fish in order to high-grade was not considered a relevant issue. In some quota managed fisheries high-grading can be a significant issue. However, Spanish mackerel commercial fishers are highly effective at targeting the preferred size classes that fetch the best prices. These preferred size classes aren't generally larger fish (i.e., >10kg). Recreational fishers have recently been further constrained by a reduced in-possession limit from ten to three fish. However, the participants indicated that high-grading does not occur in the recreational sector. The large size of the fish targeted and captured means most

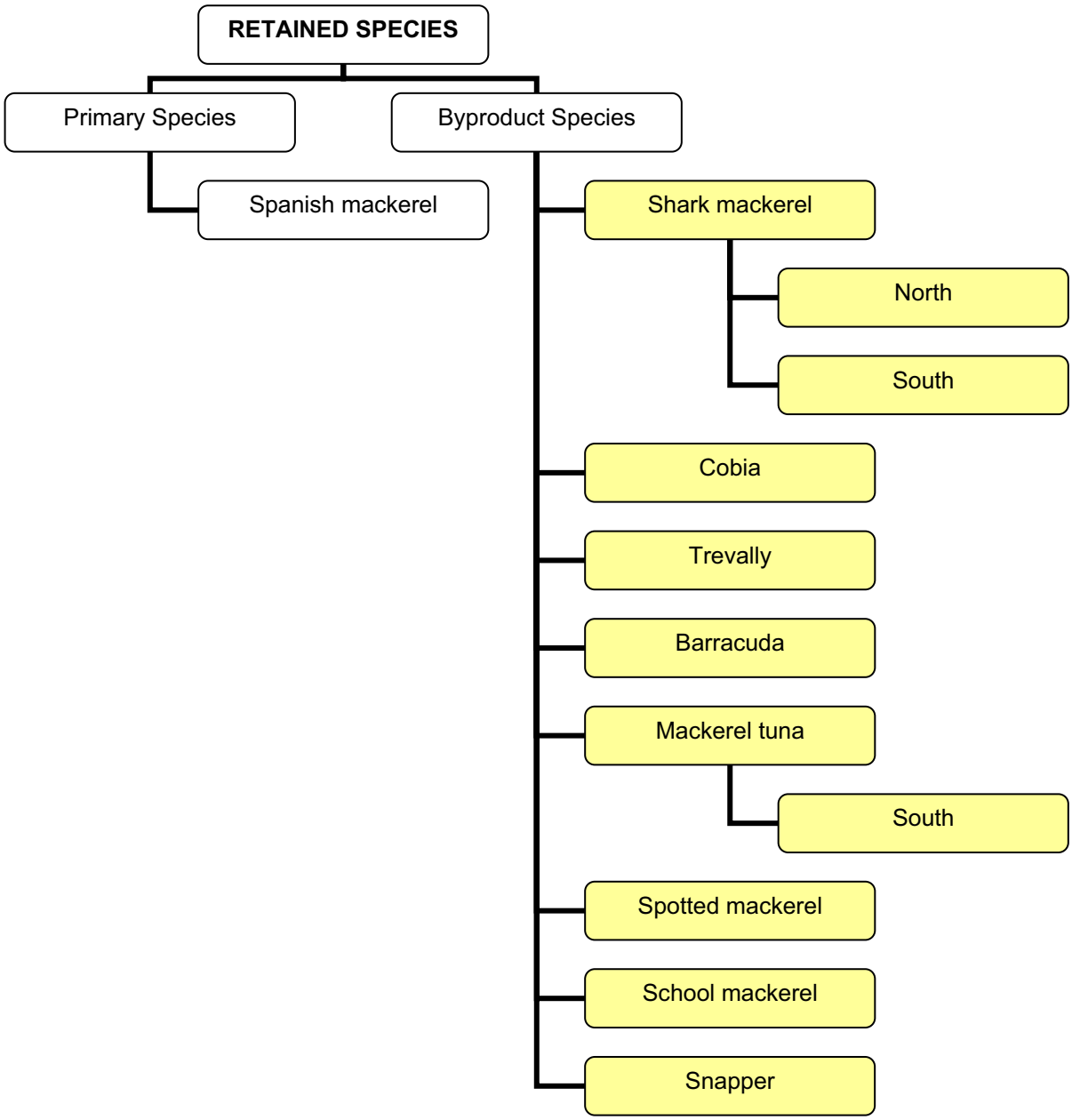
anglers are satisfied with their catch and the amount of seafood obtained for personal consumption.

The discard of large Spanish mackerel wasn't considered a relevant issue and was subsequently not included in the non-retained species component tree. In the past it has been suggested that commercial fishers discard fish over 10kg because of concerns about ciguatera poisoning. Commercial fishers at the workshop indicated that the association of the species with ciguatera toxins has not been formally established and that it doesn't generally influence their fishing behaviour. The Sydney Fish Markets will not sell whole Spanish mackerel over 10kg. Queensland commercial fishers, therefore, tend to fillet the larger individual fish and sell the product. This is supported by data collected through the DPI&F Long Term Monitoring Program (Appendix 6), which shows the size class distribution of the commercial catch. It demonstrates that fish over the 10kg mark are retained. The size distribution of retained commercial catch follows a smooth curve, rather than a severe drop off at the 10kg size, which would be expected if larger fish were discarded.

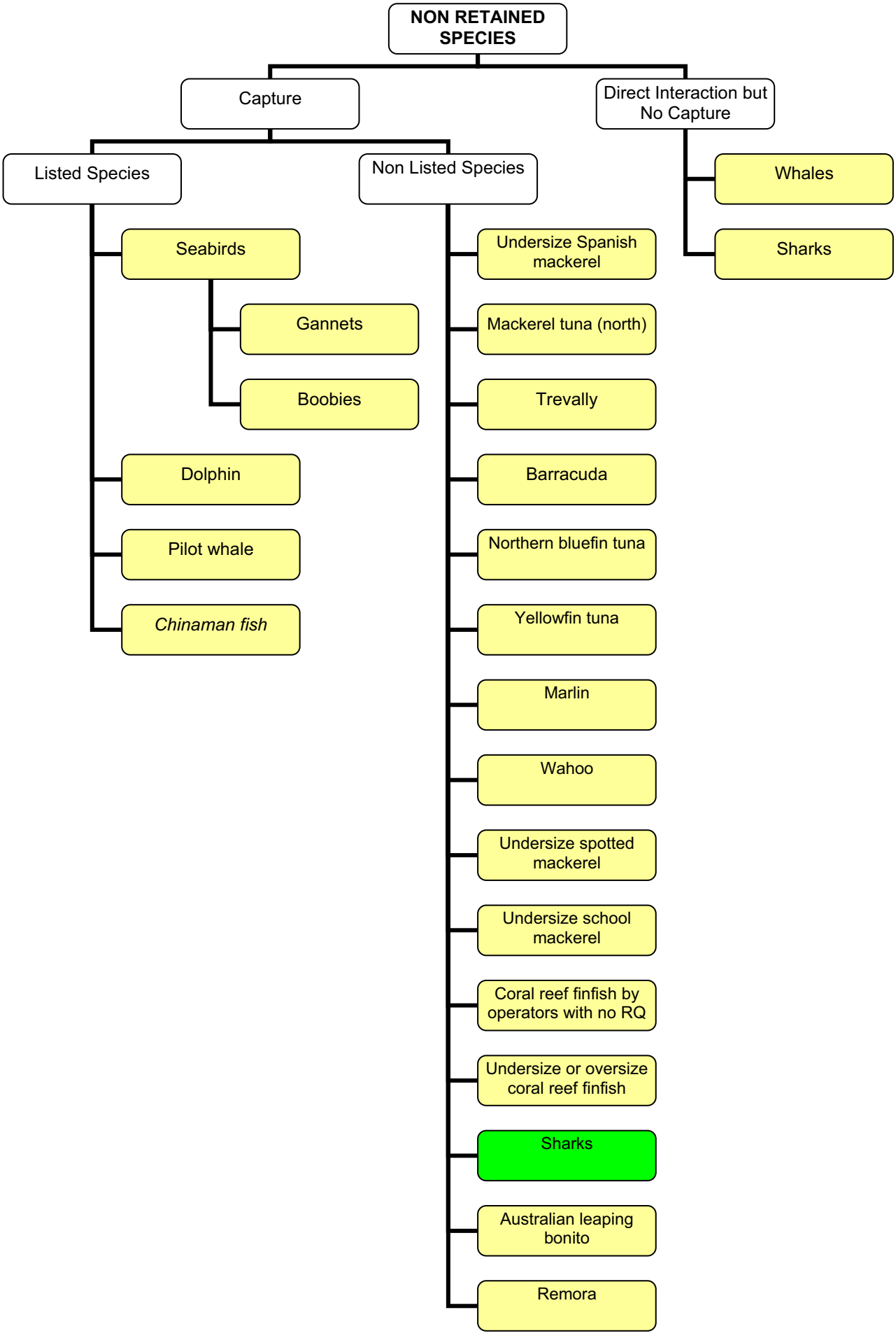
Commercial fishers indicated that there was a priority need to review previous research on whether or not Spanish mackerel carry ciguatera toxins and whether it relates only to certain areas (such as Platypus Bay).

The catch of undersize snapper (*Pagrus auratus*) was not included in the non-retained component tree as participants felt the catch of snapper was restricted to larger individuals coming up from depth to attack the trolled bait. No participants had encountered undersize snapper while targeting Spanish mackerel.

The component trees include a summary of the risks rankings that were assigned to each component, through different colour codes. Justifications for the risk rankings follow after a description of the risk assessment process.



Blue boxes indicate negligible risk
Yellow boxes indicate low risk
Green boxes indicate moderate risk
Orange boxes indicate high risk
Red boxes indicate extreme risk


NON RETAINED SPECIES
Capture
Direct Interaction but No Capture
Listed Species
Non Listed Species
Whales
Sharks
Seabirds
Gannets
Boobies
Dolphin
Pilot whale
Chinaman fish
Undersize Spanish mackerel
Mackerel tuna (north)
Trevally
Barracuda
Northern bluefin tuna
Yellowfin tuna
Marlin
Wahoo
Undersize spotted mackerel
Undersize school mackerel
Coral reef finfish by operators with no RQ
Undersize or oversize coral reef finfish
Sharks
Australian leaping bonito
Remora

Risk assessment

The overall level of risk assigned to each species is based on the group's assessment of the perceived consequence multiplied by the perceived likelihood. A realistic estimate was made by the group, based upon the combined judgment of the participants, who have significant expertise or experience in the fishery.

When considering the level of consequence or likelihood, participants made an assessment in context of what existing control measures and management arrangements are already in place. When assessing consequence, participants noted the consequence on a population or region, not an individual fish. The consequence and likelihood tables can be found in Appendix 2. The tables have been amended slightly from Fletcher *et al*, 2002, to better suit the ECSMF and focus more closely on byproduct and bycatch issues.

A risk ranking was given, based on the risk value (see Table 5 and 6 in Appendix 2). The risk ranking dictated the amount of justification required and also the extent of management likely to be needed to address the risk.

Justification of the risk values and ratings are provided below. A summary table can also be found in Appendix 3.

Background information and data that was used to make an assessment has been included in Appendix 4 – 6.

Retained species

Shark mackerel (Grammatorcynus bicarinatus) – north

Risk ranking: Low
Risk value: 4

Shark or salmon mackerel currently forms the main byproduct species in the northern part of the fishery. The species is incidentally captured when fishers troll too close to the reef. Grant (1997) states that shark mackerel are commonly seen on the Great Barrier Reef schooling close to coral rims where rivulets that drain the lagoons into deeper waters entice bait fish to gather.

They are caught incidentally while actively targeting Spanish mackerel, but are also occasionally targeted in their own right.

Because no quota is deducted for retaining shark mackerel it has become a more popular species to retain and helps supplement income from quota species alone. For those operators that did not receive an SM fishery symbol in 2004, it may become an increasingly important target species. Participants also noted that shark mackerel are now starting to be targeted by active Spanish mackerel fishers at the end of the season. Notwithstanding these comments, participants reiterated that shark mackerel are only currently caught on a low percentage of Spanish mackerel fishing days. CFISH data (Appendix 4) indicates that approximately 13 tonne of shark mackerel were caught on the same day as Spanish

mackerel in 2004. This equates to around 30% of the total Queensland catch of shark mackerel in 2004.

It was noted that a significant market for the species has not yet been established, but it was thought that it was highly likely to occur.

A buyer and commercial fisher based in Townsville has provided byproduct weight statistics relating to the retained catches (in weight) of several Townsville-based Spanish mackerel fishers (Appendix 7). The catch is also described as a percentage of the total catch taken when targeting Spanish mackerel. These data help to demonstrate the likelihood values that were assigned, where logbook data on byproduct is difficult to obtain. His data indicate that the amount of shark mackerel retained by commercial fishers is consistently less than 20kg and as a proportion of the total catch when targeting Spanish mackerel is between 0 and 4.2%.

Proposed Management Actions:

With anticipated increases in the catch of shark mackerel, the participants agreed it was important that commercial fishers should be recording catches of other mackerel species in the logbook. Workshop participants agreed that a separate "pelagic" logbook should be developed in order to gain more accurate information and be able to detect shifts in targeting and marketability of different species. *Note: This proposed management action applies to all retained pelagic species in this document (i.e., other mackerel species, cobia, mackerel tuna, barracuda, trevally).*

Shark mackerel (Grammatorcynus bicarinatus) – south

Risk ranking: Low
Risk value: 2.4

Shark mackerel are generally not caught south of Sandy Cape. Most of the southern catch is restricted to the Capricorn-Bunker Group. However, targeting behaviour in the area reflects the same trends evident in the north of the fishery and there is an increasing likelihood of shark mackerel being retained more often with a shift in marketability.

Commercial fishers estimated that the current catch in the central Queensland region may be equivalent to 0.5% of the Spanish mackerel catch, indicating a similar catch rate to the north.

The species was assessed separately for the north and the south because of its limited distribution and the associated difference in risk values.

Cobia (black kingfish) (Rachycentron canadus)

Risk ranking: Low
Risk value: 2.4

Cobia are taken incidentally in small quantities in the Spanish mackerel fishery. Participants suggested they made up less than 5% of the catch. Buyer information (Appendix 7) supports this, suggesting that cobia catch represents less than 3% of the total catch retained

when targeting Spanish mackerel. Participants indicated that cobia tend to be caught less often in the northern part of the fishery.

CFISH data (Appendix 4) shows that in 2004 a total of 2.5 tonnes of cobia were taken by operators who landed Spanish mackerel on the same days. The catch makes up less than 15% of the total Queensland catch of the species in 2004. The workshop agreed that cobia tend to be taken in larger numbers in the rocky reef fishery and the gulf inshore net fishery.

Cobia distribution extends across the entire State and worldwide. It was acknowledged that cobia aggregate to spawn in Moreton Bay and therefore may be more vulnerable. Grant (1997) supports this and suggests that some of the hot-spots are found close to Brisbane.

Trevally (Caranx and Carangoides spp)

Risk ranking: Low
Risk value: 1.2

Trevally are occasionally retained when incidentally caught, depending on the area caught and the marketability of the product at the time. They tend to be taken more frequently in the south compared to the north, but generally never make up more than 5% of the catch (by weight) while targeting Spanish mackerel. This is supported by buyer information (Appendix 7), which shows of the 10 tonnes of Spanish mackerel landed on 10 separate dates only 7 kg of trevally was retained.

CFISH data (Appendix 4) shows catches of trevally species of less than 20 tonnes on the same day as Spanish mackerel is caught. This represents less than 15% of the total Queensland catch of trevally species in 2004.

In terms of the risks to the species, the participants agreed that trevally are incredibly abundant, fast growing fish, and at low risk from this fishery.

Barracuda (Sphyraena spp)

Risk ranking: Low
Risk value: 0.9

Commercial operators indicated that barracuda are sometimes captured incidentally, a position supported by Grant (1985), who suggests they are known to be caught while trolling for mackerel. Only a certain amount is kept and sold as “mixed reef”, with the rest released. Risks associated with non-retained barracuda are dealt with in the section on non-retained species.

CFISH data suggests that only a small amount of barracuda is retained, with a total of only 40 kg recorded on the same day as Spanish mackerel was caught in 2004. Significantly more barracuda is taken in other fisheries, with the ECSMF contributing less than 1% to the total Queensland catch in 2004.

Barracuda is extensively distributed and relatively resilient to exploitation as a result of its fast growth and the fact the species does not generally aggregate. Therefore the consequence rating was quite low, while the likelihood was high.

Mackerel tuna (Euthynnus affinis) – south

Risk ranking: Low
Risk value: 2.4

Participants suggested that mackerel tuna are generally only caught in the southern section of the fishery. There is some demand for mackerel tuna fillets in the south of the State, so a small amount is sometimes retained for sale if incidentally caught while targeting Spanish mackerel. However, because of the time taken to land mackerel tuna, fishers often move location to avoid catching them after they are encountered.

CFISH data shows that in 2004, only 890 kg of mackerel tuna was retained on the same day that Spanish mackerel was caught (Appendix 4). This represents approximately 10% of the total Queensland catch. CFISH data supports participants' suggestion that the majority of the catch is taken in the net fishery.

Mackerel tuna are not generally retained in the north of the fishery. The risks associated with the released component are dealt with in the non-retained section.

Spotted mackerel (Scomberomorus munroi) – north

Risk ranking: Low
Risk value: 1.8

Spotted mackerel are very occasionally caught in the northern section of the fishery, resulting in a lower risk value than spotted mackerel in the south. Minimal overlap between Spanish mackerel and spotted mackerel schools is thought to occur in the north. The use of larger baits also results in a reduced incidental catch of spotted mackerel.

CFISH data (Appendix 4) shows that in 2004, 18 tonnes of spotted mackerel were taken on the same day as Spanish mackerel. Catch on the same day as Spanish mackerel contributes approximately 17% to the total Queensland catch of spotted mackerel.

It was recognised that spotted mackerel are relatively resilient in terms of their growth rates, but may be at risk of impact because of their schooling characteristics.

Spotted mackerel (Scomberomorus munroi) – south

Risk ranking: Low
Risk value: 2.4

Spotted mackerel are frequently caught while targeting Spanish mackerel in the south. However, the incidental catch in the Spanish mackerel fishery is minor compared to the targeted spotted mackerel catches. As stated above, catch of spotted mackerel recorded on the same day as Spanish mackerel is caught indicates that the catch in the fishery contributes less than 20% of the overall east coast catch. It should be noted that there is likely to be significant overlap in fisheries, with Spanish mackerel fishers also likely to have spotted mackerel quota, particularly in the southern part of the state. It's unlikely that all of the product caught on the same day as Spanish mackerel was taken incidentally while targeting Spanish mackerel. It's more likely that operators permitted to take both species target Spanish mackerel for part of the day and spotted mackerel for another part.

When assigning risk, participants took into account the fact spotted mackerel are currently managed separately under a total allowable catch and is a line-only species.

School mackerel (Scomberomorus queenslandicus)

Risk ranking: Low
Risk value: 2.4

Participants indicated that large school mackerel tend to be found in close association with Spanish mackerel. Workshop participants suggested that based on their combined experiences there is more overlap with school mackerel compared to spotted mackerel.

CFISH data shows that approximately 5 tonnes of school mackerel is taken on the same day that Spanish mackerel is caught. This represents less than 4% of the total Queensland catch in 2004. This is in contrast to the suggestion from participants that the catch of school mackerel is greater than spotted. However, it is likely that the estimated catch of spotted mackerel when targeting Spanish mackerel is confounded by an overlap in the two line fisheries. In addition, the data is limited in that information on which species is being targeted is not recorded in the logbook. Notwithstanding this, the catch of either species in the Spanish mackerel fishery is small compared to the catch in other fisheries.

School mackerel are relatively resilient, exhibiting high growth rates. However, because of their schooling behaviour the species may make them more vulnerable than other species.

Snapper (Pagrus auratus)

Risk ranking: Low
Risk value: 3

The likelihood of snapper being caught incidentally when targeting Spanish mackerel was considered low. Catches are generally restricted to the southern part of the State (i.e., south of The Swains (off Rockhampton)), mirroring the natural distribution of snapper.

Participants indicated that it was almost always larger snapper rising from depth to attack a trolled bait that were caught. Incidental catch of snapper in the Spanish mackerel fishery was considered to be very minor compared to the total take of snapper across fisheries, particularly by recreational anglers that target them specifically. CFISH data supported this comment, showing that the commercial catch of snapper on the same day as Spanish mackerel was minor (11 tonnes in 2004) and represented less than 8% of the total catch of snapper across Queensland in 2004.

It was acknowledged that the potential consequences on the species may be high given the slow growth and long life span of the species, its current overfished status, limited distribution in Queensland and the high catchability of snapper on discrete rocky reefs.

Coral reef finfish species in general

Risk ranking: Low
Risk value: 3

Participants indicated that coral reef finfish species managed under the *Fisheries (Coral Reef Finfish) Management Plan 2003* were sometimes caught incidentally while targeting Spanish mackerel.

However, in terms of consequence ratings, it was acknowledged that all catch was recorded against fishers' quota and was consequently explicitly managed via quotas for coral trout, red throat emperor and other coral reef finfish. In addition, those operators that do not hold an RQ or SM symbol and are restricted to the recreational in possession limit.

Non retained species

The consequence categories used for non-retained species excluded assessment of the contribution of the catch in the ECSMF to the overall catch of the species. It quickly became apparent during the workshop that the catch of these species was consistently negligible. In addition, it was hard to estimate the overall catch of non-retained species in all fisheries given bycatch figures are not collected on most of the finfish species. Instead, the consequence ratings focussed on the distribution of the species and its susceptibility to overexploitation or impacts due to its life history characteristics. Of particular focus was the species post release survival characteristics. It was acknowledged that the fishing method used to target Spanish mackerel means fishers are constantly in attendance of their lines, allowing for quick release of any unwanted species.

Not listed

Undersize Spanish mackerel (Scomberomorus commerson)

Risking ranking: Low
Risk value: 4

Participants indicated that the likelihood of catching undersize Spanish mackerel was low. The commercial fishing representative from the north estimated that around 1 in 100 Spanish mackerel caught were under the legal minimum size in the northern section of the fishery, while the representative from the south estimated it may be 5 out of every 100 Spanish mackerel in the southern section.

The low likelihood of capture is a result of a number of factors including:

- Undersize Spanish mackerel are usually found in inshore areas. In contrast, most commercial fishers operate in areas further offshore.
- The size of bait used by commercial fishers generally precludes the catch of small Spanish mackerel. This is supported by Tobin and Mapleston (2003), who showed that larger baits tend to catch larger Spanish mackerel.
- Smaller Spanish mackerel don't tend to aggregate with larger Spanish mackerel as they tend to be cannibalised.
- Commercial fishers almost always move on if they encounter a school of undersize Spanish mackerel. It is economically inefficient to continue expending time, fuel and bait fishing for product that can't be retained. In addition, it is common anecdote that commercial fishers will actively move away from schools of small though legal sized mackerel due to poor economic returns per captured fish (Tobin and Mapleston, 2003).

DPI&F Long Term Monitoring Program data indicates that the proportion of smaller fish caught is small across both the commercial and recreational sectors (see Appendix 6). If the catch of smaller fish was common, the data would show more of a knife-edge selection at the minimum size limit, rather than the declining smooth curve down to smaller sizes which is apparent. The data further demonstrates the targeted nature of the fishery and the ability of both sectors to select for the preferred size classes. Notwithstanding this, the recreational sector is slightly less selective, with marginally higher catches in the smaller size classes. It is also clear that they target the larger trophy fish. These characteristics of the recreational sector were reinforced by Tobin and Mapleston (2003).

The assertion that very few undersize Spanish mackerel are caught is also supported by reports from other jurisdictions where similar gear is used, namely in the Northern Territory (Grady, 2002) and Western Australia (Department of Fisheries Western Australia, 2004).

Based on their experiences, commercial and recreational fishers at the workshop suggested that the survival rate of undersize Spanish mackerel that are released was fairly good and estimated mortality to be only around 10% of those released. The consequence rating was therefore assessed as low.

Mackerel tuna (Euthynnus affinis) – north

Risk ranking: Low
Risk value: 4

Grant (1985) supports the notion that mackerel tuna are considered almost a nuisance fish on Spanish mackerel grounds. Participants suggested that the majority of mackerel tuna are released in the northern section of the fishery. The likelihood of catching mackerel tuna however is minimised in some respects, given Spanish mackerel fishers often move away from the area to avoid capturing them. Operators suggested they try and land them as quickly as possible to avoid wasting any further time on a significantly lower value species compared to Spanish mackerel.

Because heavy line is used, the fish is not played for a long period of time. Consequently, the post release survival of mackerel tuna is likely to be relatively high. It was noted that for recreational fishers who may play the fish for a longer time, that the mortality may be higher. Also influencing the consequence rating is the fact the species is thought to be extremely resilient due to its fast population doubling time (<15 months).

Trevally (Caranx and Carangoides spp)

Risk ranking: Low
Risk value: 2.5

Trevally are occasionally retained when incidentally caught, depending on the area caught and the marketability of the product at the time. The rest of the time they are released.

Trevally are extensively distributed and are highly resilient due to their fast growth. It was also acknowledged that the species is thought to have relatively high survival rates following release. These factors resulted in a low consequence rating.

Barracuda (Sphyraena spp)

Risk ranking: Low
Risk value: 1.5

Barracuda is occasionally captured incidentally when targeting Spanish mackerel, but is released for a number of reasons, including the poor odour of the flesh, lack of marketability and the risks associated with bringing such an aggressive species on deck.

Barracuda is extensively distributed and is relatively resilient to exploitation as a result of its fast growth and the fact the species does not generally aggregate. This resulted in a low consequence rating.

Northern blue fin tuna (Longtail tuna) (Thunnus tonggol)

Risk ranking: Low
Risk value: 4

Participants agreed that the incidental capture of northern bluefin tuna was expected to occur, but only infrequently.

The northern bluefin tuna is broadly distributed throughout tropical and subtropical parts of the Pacific Ocean. Grant (1997) suggests that highly localised aggregations build up in and around Moreton Bay in April.

The post release survival of northern bluefin tuna is, like many other pelagic fish, dependant on the amount of time they are played. Participants agreed that they become easily tired and stressed if not brought to the boat quickly, which increases the likelihood that they will die following release. These factors contributed to the group's assessment that the species has some life history characteristics that may make it more vulnerable to impacts. However, the overall risk rating was still low because of the low incidence of catch of the species.

Yellowfin tuna (Thunnus albacares)

Risk ranking: Low
Risk value: 4

It was acknowledged by participants that yellowfin tuna are taken when targeting Spanish mackerel, though only infrequently. From the perspective of recreational anglers, it was thought fishers may catch between one and two yellowfin tuna per season.

As with other pelagics, the post release survival depends on length of time to land and handling, and can sometimes be poor.

Marlin (Makaira spp) – commercial

Risk ranking: Low
Risk value: 4.5

Marlin are caught only very rarely by commercial fishers when targeting Spanish mackerel. Commercial fishers are not permitted to retain marlin, so are released.

Commercial operators considered that marlin were a relatively hardy species and consequently post release survival was fairly high. This is supported by studies in the US that found white marlin caught and released had a survival rate between 65% and 100%, depending on the type of hook used[3].

Participants acknowledged however that the species may be vulnerable to impacts of fishing as a result of being long-lived. In addition, black marlin have a single spawning ground off Lizard Island where they are targeted by marlin operators.

Marlin (Makaira spp) – recreational

Risk ranking: Low
Risk value: 6

Participants acknowledged that recreational fishers are likely to catch marlin more often than commercial fishers, who tend to be more targeted fishers. It was noted that recreational fishers sometimes catch smaller marlin off the south coast of Queensland (e.g., around Noosa and off Moreton Island). This consequently resulted in a slightly higher likelihood value compared to the commercial catch. The consequence value remained the same as the commercial component.

Wahoo (Acanthocybium solandri)

Risk ranking: Low
Risk value: 3

Participants indicated that the incidental catch of wahoo was dependant on the location and the time of year. Wahoo are more often captured incidentally around the Tweed, Point Lookout and Flat Rock areas in winter. It was suggested that the likelihood of capture by commercial fishers was 1 to 2 fish for every thousand Spanish mackerel taken. It was considered possible that this catch rate may be slightly higher in areas off the south coast.

CFISH data show that only a small amount of wahoo (less than 1 tonne) was retained by Spanish mackerel fishers in 2004 (Appendix 4)

Similar to some of the other pelagic species incidentally captured, wahoo are usually solitary animals that are relatively resilient due to their fast population doubling time. Consequently, the consequence rating for the species was low.

Undersize school mackerel (Scomberomorus queenslandicus) and spotted mackerel (Scomberomorus munroi) – commercial

Risk ranking: Low
Risk value: 3

Participants noted that the incidental capture of undersize school and spotted mackerel was unlikely, but was known to happen occasionally. The recreational catch of the two species was considered higher and was dealt with separately.

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[3] See the Released Fish Survival fact sheet on best practices for releasing billfish: http://www.info-fish.net/releasefish/files/5/Releasing%20Billfish.pdf

It was acknowledged that school and spotted mackerel have some characteristics that make them more vulnerable, such as schooling behaviour and sometimes poor survival following release. However, the species was considered fairly resilient due to its fast growth.

Undersize school mackerel (Scomberomorus queenslandicus)and spotted mackerel (Scomberomorus munroi) – recreational

Risk ranking: Low
Risk value: 4

The same consequence level was assigned to undersize school and spotted mackerel as was done for the commercial sector. The likelihood of capture by recreational fishers however was thought to be higher than the commercial. Consequently, the overall risk value was higher.

Coral reef finfish species taken by operators with no RQ symbol

Risk ranking: Low
Risk value: 6

Data from the DPI&F licensing system indicates that of the 298 fishers with an SM symbol, 187 are also endorsed with an RQ symbol[4]. Participants agreed that it is likely that some fishers would have to release coral reef finfish because they don't possess a valid fishery symbol. However, because the majority of active Spanish mackerel fishers are also permitted to retain coral reef finfish species, it was thought to be infrequent.

The consequence rating for coral reef finfish species was thought to be moderate, given they are known to aggregate to spawn, often have a small home range, and may have poor post release survival depending on the depth they are caught at. They also tend to be long-lived, slow growing, and hermaphroditic. The consequence rating also took into account the quota system that is in place for coral reef fin fish and the need to maintain its integrity. The consequence rating was reduced in some part by the wide distribution of most coral reef finfish.

Undersize or oversize coral reef finfish species

Risk ranking: Low
Risk value: 6

Participants agreed that occasionally while targeting Spanish mackerel (i.e., trolling) some coral reef finfish that were undersize or oversize were caught. Participants referred specifically to the incidental capture of oversized blue spot trout.

The consequence rating mirrored that of coral reef finfish in general, in acknowledgement of the ecological characteristics of reef fish and the quota system in place.

Sharks (not including grey nurse)

Risk ranking: Low-moderate
Risk value: 8

[4] Licensing information current as at December 2005.

Participants noted that the capture of sharks was a relatively infrequent occurrence. Sharks are often known to take a fish that is in the process of being landed, but are only rarely hooked. Sharks occasionally encountered included reef sharks, whalers, white tip sharks and bronze whalers. As an indicator of the number incidentally captured, participants noted that more wahoo are captured than sharks. Participants indicated that they generally released any shark species captured. However, it was considered possible that some Spanish mackerel fishers may occasionally retain some of the smaller shark species (i.e. reef sharks less than 4 ft) for sale.

The slow growth of most shark species and their limited reproductive capacity makes them particularly susceptible to overexploitation. Internationally there has been concern expressed for the survival of a range of shark species and the impacts different fisheries are having on their sustainability. Participants agreed that the ecological characteristics of sharks in general warranted a moderate risk to the species. This was balanced however by the wide distribution of most of the species referred to and the prolific numbers of some species, such as reef sharks.

It was specifically mentioned that the incidental capture of grey nurse sharks has not been known to occur in the commercial fishery, mostly because the fishery operates mainly in the north of the state and also because commercial and recreational fishers surface troll for mackerel, while grey nurse shark tend to sit on the bottom of sandy gutters.

Australian leaping bonito (Cybiosarda elegans)

Risk ranking: Low
Risk value: 3

Only on very rare occasions are bonito incidentally captured while targeting Spanish mackerel.

Bonito are known to have a wide distribution, and are fast growing and resilient fish. The consequence rating was therefore very low.

Remora (Remora remora)

Risk ranking: Low
Risk value: 3

Very occasionally remora are brought aboard attached to other target and non-target species.

Remora have a cosmopolitan distribution throughout tropical and subtropical waters and are usually reef-associated. No information could be obtained on their resilience or other ecological characteristics.

Listed species

It should be acknowledged that Spanish mackerel fishers are required to fill in a Species of Conservation Interest (SOCI) logbook to record any interactions with protected species. Since the introduction of the logbook in late 2003, no interactions have been recorded by Spanish mackerel fishers, demonstrating the low level of interaction occurring in the fishery.

Seabirds - boobies and gannets (Family Sulidae)

Risk ranking: Low
Risk value: 3

Participants noted that the likelihood of capturing seabirds while targeting Spanish mackerel was low but is known to have occurred. The species involved are usually restricted to boobies and gannets. Species that have attracted concern in other jurisdictions such as albatross are not generally caught in the Spanish mackerel fishery because of their limited natural distribution. Participants also agreed that because they are constantly in attendance of fishing gear, they are often able to pull the line away should they see a bird diving for the bait. This essentially avoids any chance of hooking a bird or having one become entangled in the line.

Boobies and gannets are known to have a relatively broad distribution. Neither species of seabird are currently listed as threatened under Commonwealth legislation. However, they are protected as Listed Marine Species and Listed Migratory Species under the EPBC Act. In terms of the consequence of the fishery, participants agreed that only a few individuals are impacted but there is likely to be only minimal impact on the populations of the species.

Participants noted that birds are often entangled in line or hooked in the foot, rather than hooked in the mouth. This is supported by anecdotal evidence from seabird rescue groups (Waterbird Rescue Queensland and DPI&F, 2005). These characteristics make it relatively easy to release the bird unharmed. Fishers at the workshop agreed that it was quite simple to keep the bird calm on the deck of the boat and remove the hook if necessary. The participants noted that the hook and line were almost always completely removed before the bird was released. No fishers had encountered a seabird being hooked in the mouth while targeting Spanish mackerel. In addition, it was noted that because of the nature of the fishery, fishers are in attendance of their lines at all times, so can respond quickly to any hooking or entanglement. Given these factors, the participants agreed that the survival rate of seabirds that were hooked was likely to be quite high.

It should be noted that DPI&F have recently distributed a DVD to both commercial and recreational fishers teaching them how to minimise interactions with seabirds and handle them should an interaction occur.

Dolphins

Risk ranking: Low
Risk value: 3

One fisher at the workshop noted he has on a single occasion hooked a juvenile dolphin. He stated however that it was likely a result of being close inshore in an area where he felt a number of dolphins had become tame and were used to feeding around humans. It was acknowledged by other participants that this was likely a very localised and rare event. The dolphin referred to was released unharmed.

In terms of the consequence rating, such an interaction is likely to have no impact on the stock. Nor is it likely to be socially unacceptable because it is released unharmed.

Pilot whale (Globicephala macrorhynchus)

Risk ranking: Low
Risk value: 2

Similar to the dolphin capture, one operator reported a pilot whale becoming entangled in line. It was noted that the interaction was the only one within 20 years of fishing experience, and was thought to be a result of curiosity by the whale. The whale broke free of the line and swam away unharmed. It was determined that the likelihood of similar encounters occurring in the Spanish mackerel fishery was extremely low.

In terms of the consequence rating, such an interaction is likely to have no impact on the whale population. Nor is it likely to be socially unacceptable because it is released unharmed.

Chinaman fish (Symphorus nematophorus)

Risk ranking: Low
Risk value: 3

While chinaman fish is not a listed species under Commonwealth legislation, it is a regulated species under Queensland fisheries legislation, making it a no-take species. Consequently, it was determined that it should be treated in a similar fashion as listed species.

Participants at the workshop indicated that chinaman fish was the only no-take species that was incidentally captured while targeting Spanish mackerel. Fishers indicated that the chance of a chinaman fish being caught was unlikely, but known to happen occasionally.

The consequence rating assigned to chinaman fish reflected the fact that it is a slow growing, late maturing and long lived species, and may be vulnerable to impacts from fishing.

Interaction but no direct capture

Whales (multiple species)

Risk ranking: Low
Risk value: 4.5

A number of fishers noted that whales have occasionally bumped into their boats whilst fishing for Spanish mackerel. It was acknowledged that this issue related more to boating in general rather than a specific impact of the Spanish mackerel fishery.

The likelihood of recreational or commercial fishers in boats colliding with whales, or whales colliding with boats, is increasing as a result of the increasing abundance of whales in Queensland waters.

It should be noted that DPI&F recently delivered a comprehensive education program to commercial and recreational fishers regarding ways of minimising interactions with protected species, including whales.

Sharks (multiple species, but not including grey nurse shark)

Risk ranking: Low
Risk value: 7.5

As noted in the non-retained section, sharks are often known to take a fish that is in the process of being landed. The likelihood rating reflects the fact that both recreational and commercial fishers acknowledged routinely having sharks take their catch before it can be brought to the boat.

The distribution of the shark species of concern is relatively broad. However, as stated earlier, some of the ecological characteristics exhibited by sharks make them susceptible to overexploitation. The overall consequence rating recognises these characteristics, but takes into consideration their broad distribution.

It is important to note that participants acknowledged that a shark taking a fish is likely to have a negligible impact on shark populations.

Preliminary performance measurement

The development of fishery specific objectives, performance indicators and performance measures is becoming increasingly important in fisheries management. Such a system can help provide clear goals for industry and management and help assess the effectiveness of management arrangements. Triggers can be put in place to help ensure major undesirable shifts in catches or other criteria are dealt with through appropriate management responses and within appropriate timeframes.

A short information paper has been compiled by DPI&F to help guide consistent development of performance measurement systems in a range of Queensland fisheries.

Objectives

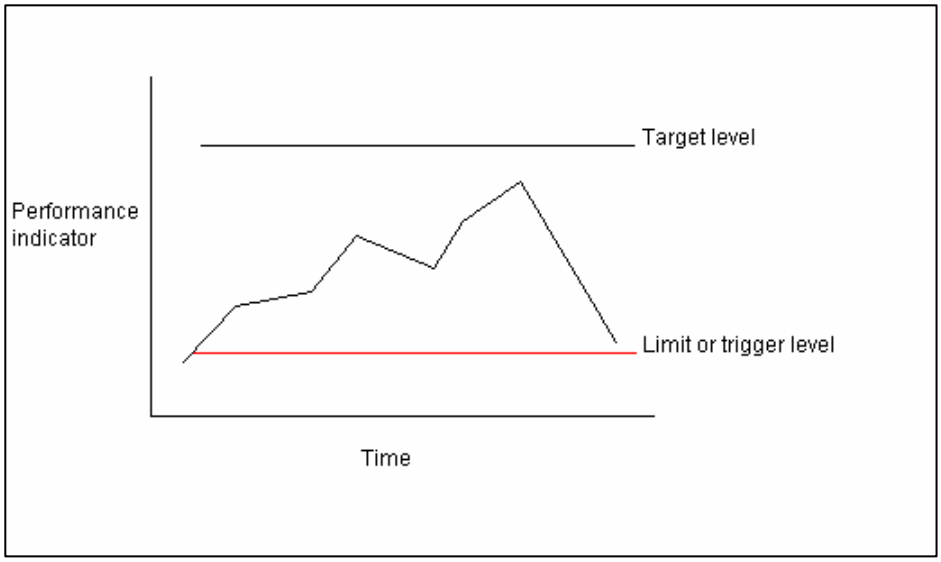
Objectives are an important part of performance measurement in that there needs to be an overall goal that management works towards.

Performance indicators

Indicators should be simple, meaningful and relatively easily monitored. It is ineffective to identify indicators that require a costly new monitoring regime which cannot be supported by the fishing industry.

Performance measures

Performance measures can be in the form of a target level, a limit, or a trigger for some form of review or action.



Management responses

Management responses should be included in any fishery performance measurement system. They should not be prescribed in a way as to restrict the capacity of fishery managers and industry to deal with the issue. However, they should ensure that appropriate management action is taken when a performance measure is triggered.

Draft Performance Measurement System

While participants didn't have the opportunity to discuss specific performance measures at the workshop, the risk assessment highlighted issues that need to be addressed and helped inform the type of indicators and measures that were required. DPI&F staff consequently drafted preliminary performance measures and sought feedback from participants. The draft performance measures in the following table signify the results of this collaboration.

Draft performance measurement system for bycatch and byproduct

	Objective	Performance Indicator	Performance measure	Management response
Bycatch	A low bycatch rate in the commercial fishery is maintained.	Bycatch data collected by independent observers on commercial fishing boats	Observer information from a quota year shows the amount of bycatch exceeds 10% of the total catch taken by commercial fishers with an SM fishery symbol when targeting Spanish mackerel (by whole weight).	The need for wider bycatch monitoring and improved gear selectivity to be reviewed by the DPI&F.
Byproduct	Major shifts in catch of byproduct species are avoided.	Logbook information on catch of lesser mackerels and other pelagics (not including any coral reef finfish species).	*Preliminary (i.e. prior to byproduct species being included in a logbook):* The amount of fish of species other than Spanish mackerel, not including coral reef finfish, taken on the same day that Spanish mackerel is caught and reported by authorised fishers is more than 10% of the amount of Spanish mackerel taken by those licensees in that quota year.	DPI&F to review the management arrangements in place to protect byproduct species.
			Following introduction of an expanded logbook: A significant shift (i.e., greater than 25% change) in the catch composition of byproduct species is detected.	

			Or The reported catch of any one byproduct species increases by more than 25% in consecutive years.	
Protected species	Extremely low levels of interactions with protected species are maintained.	SOCI logbook information on the number of interactions.	Greater than two interactions are recorded per year in the fishery.	DPI&F to review the measures in place to minimise interactions with protected species.
			Logbook validation activities undertaken by DPI&F demonstrates that interactions with protected species are not being accurately recorded by Spanish mackerel fishers	

Research and monitoring needs

Bycatch monitoring

The results of the risk assessment indicate that the level of risk is low enough that it may not warrant a comprehensive bycatch monitoring program. It is proposed that the level of bycatch in the commercial fishery be monitored through periodic observer trips to establish that low bycatch levels are being maintained. A similar methodology is used in NT, where up to six trips a year are undertaken to verify the negligible take of bycatch.

In terms of measuring performance in the fishery, observer data would allow monitoring of the level of bycatch in the commercial fishery to determine whether bycatch exceeds more than 5% of the total catch taken when fishers with an SM fishery symbol are targeting Spanish mackerel. A review of bycatch monitoring would be undertaken if this level was exceeded.

The risk assessment identified that it was more important to monitor any changes in the catch of byproduct species to detect shifts in targeting. An investigation into expansion of the compulsory logbooks to include the main byproduct species will be undertaken by DPI&F. This may include looking at the potential for development of a separate “pelagic” logbook.

Size selectivity research

Participants at the workshop agreed that given the low risks associated with the discard of undersize and large Spanish mackerel under current levels of fishing effort, the need for more size selectivity was not warranted. The proposed occasional observer trips will help to validate low catches of undersize and large fish.

The Scientific Advisory Committee (SAG) also considered the possibility of undertaking research into size selectivity through better gear technology. It was noted at the SAG that previous research suggested the size of bait was important in determining the size of fish captured (Tobin and Maplestone, 2003), and that hook size was less important. Based on the results of the risk assessment and research previously undertaken, the SAG resolved further research into gear selectivity would be of little value given that a reasonable amount of information suggests that there is limited catch of undersize fish. The SAG noted that there was a small proportion of Spanish mackerel taken which are immature even though they are above the minimum legal size limit. However, it was agreed that in general the fishery is highly selective for fish above the size at first maturity.

The LTMP continues to collect information from commercially caught Spanish mackerel, to monitor the size composition of the commercial catch, and allow DPI&F to ensure the proportion of pre-mature fish does not increase above 5% of the total allowable catch. The minimum size at which female fish mature and spawn is 790 mm (fork length). The proportion of fish caught by the commercial sector during the

2004/2005 financial year that were between the legal minimum size of 750 mm (total length) and the size at maturity (790 mm fork length) was 3%.

Appendix 1 – List of workshop attendees

Amos Mapleston	Researcher, Fishing and Fisheries, CRC Reef
Gavin Begg	Project Leader, Fishing and Fisheries, CRC Reef
Col Lound	Commercial fisher and processor (north) with 25 years Spanish mackerel fishing experience
Peter Truman	Commercial fisher and processor (south), who has operated out of both Point Lookout and Agnus Waters.
Jeff Mears	Recreational fisher (south), who works closely with the Long Term Monitoring Program frames project.
Anna Battese	Australian Government Department of the Environment and Heritage
Darren Rose	Fisheries Biologist, Long Term Monitoring Program, Department of Primary Industries and Fisheries
Kath Kelly	Fisheries Management Officer, Department of Primary Industries and Fisheries
Stephanie Slade	Senior Fisheries Management Officer, Department of Primary Industries and Fisheries
Claire Andersen	Fisheries Resource Officer and workshop facilitator, Assessment and Monitoring Unit, Department of Primary Industries and Fisheries

Apologies:

Andrew Tobin	Commercial fisher (north) and researcher previously with CRC Reef
Troy Jones	Charter operator (north)

Appendix 2 – Consequence and likelihood tables

Table 1: Consequence table for target species.

Level	Ecological sustainability of target species
Negligible (0)	Insignificant impacts to populations. Not measurable against background variability for this population.
Minor (1)	Detectable, but minimal impact on population size and none on dynamics (eg recruitment).
Moderate (2)	Full exploitation rate, but long-term recruitment/dynamics not adversely impacted.
Severe (3)	Affecting recruitment levels of stocks/or their capacity to increase.
Major (4)	Will cause local extinctions, if continued in longer term (i.e. probably requiring listing of species in an appropriate category of the endangered species list (eg IUCN category).
Catastrophic (5)	Local extinctions are imminent/immediate

Table 2: Consequence table for byproduct and bycatch species

Level	Ecological sustainability of Byproduct and bycatch species		
	Overlap in distribution of the fishery and the species of interest	***Contribution to overall Qld catch of the species of interest*[5]**	**Vulnerability of the species (ie due to life history characteristics)**
Negligible (0)	Area where fishing occurs is negligible compared to where the relevant stock of the species resides (< 1%) (ie minimal overlap between the species).	*Take in this fishery is negligible (< 10%), compared to total take by all fisheries and these species are covered explicitly elsewhere.*	The species does not have vulnerable life history traits.
Minor (1)	Area of capture by this fishery is small, compared to known area of distribution (< 20%).	*Take in this fishery is small (< 25%), compared to total take by all fisheries and these species are covered explicitly elsewhere.*	The species has some vulnerable life history traits, such as aggregating to spawn or poor survival following release.
Moderate (2)	Relative area of, or susceptibility to capture is suspected to be less than 50%.	*Levels of take in this fishery compared to the total take across all fisheries is moderate (>25%).*	The species is moderately vulnerable to overexploition due to its life history

[5] Only used when assessing byproduct, not bycatch.

			characteristics OR No information is available on the species vulnerability
Severe (3)	No information is available on the relative areas of distribution OR the overlap in distributions is thought to be high (>50%)	*Relative levels of capture/susceptibility suspected/known to be greater than 50% and species should be examined explicitly.*	The species is highly vulnerable to overexploitation or impacts of fishing as a result of its life history traits.
Major (4)	N/A Once a consequence reaches this point it should be examined using Table 1.	*N/A See Table 1*	N/A See Table 1
Catastrophic (5)	N/A See Table 1	*N/A See Table 1*	N/A See Table 1

Table 3: Consequence table for protected species

Level	Ecological (Protected species)
Negligible (0)	Almost none are impacted
Minor (1)	Some are impacted but there is no impact on stock
Moderate (2)	Levels of impact are at the maximum acceptable level
Severe (3)	Same as target species
Major (4)	Same as target species
Catastrophic (5)	Same as target species

Table 4: Likelihood table

Level	Descriptor
Likely (6)	Is expected to occur often
Occasional (5)	Is expected to occur moderately
Unlikely (4)	Is expected to occur only infrequently
Possible (3)	Unlikely, but has been known to occur elsewhere
Rare (2)	Happens only very rarely
Remote (1)	Never heard of, but not impossible

Table 5: Risk ratings matrix

		Consequence					
		Negligible	**Minor**	**Moderate**	**Severe**	**Major**	**Catastrophic**
Likelihood		0	1	2	3	4	5
Remote	1	0	1	2	3	4	5
Rare	2	0	2	4	6	8	10
Unlikely	3	0	3	6	9	12	15
Possible	4	0	4	8	12	16	20
Occasional	5	0	5	10	15	20	25
Likely	6	0	6	12	18	24	30

Table 6: Risk rankings

RISK	Reporting	Management Response
Negligible	Short Justification Only	Nil
Low	Full Justification needed	None Specific
Moderate	Full Performance Report	Continue Current Management Arrangements
High	Full Performance Report	Changes to management required
Extreme	Full Performance Report	Substantial additional management needed urgently

Appendix 3 – Risk ratings and rankings

Species	Consequence	Likelihood	Risk value	Risk ranking
Retained species				
shark mackerel (north)	1	4	4	Low
shark mackerel (south)	0.6	4	2.4	Low
cobia	0.6	4	2.4	Low
trevally	0.3	4	1.2	Low
barracuda	0.3	3	0.9	Low
mackerel tuna (south)	0.6	4	2.4	Low
spotted mackerel (north)	0.6	3	1.8	Low
spotted mackerel (south)	0.6	4	2.4	Low
school mackerel	0.6	4	2.4	Low
snapper	1	3	3	Low
Coral reef finfish species in general	1	3	3	Low
Non retained species				
Not listed species				
undersize Spanish mackerel	1	4	4	Low
mackerel tuna (north)	1	4	4	Low
trevally	0.5	5	2.5	Low
barracuda	0.5	3	1.5	Low
northern blue fin tuna	1	4	4	Low
yellowfin tuna	1	4	4	Low
marlin (commercial)	1.5	3	4.5	Low
marlin (recreational)	1.5	4	6	Low
wahoo	1	3	3	Low
undersize school mackerel (commercial)	1	3	3	Low
undersize school mackerel (recreational)	1	4	4	Low
undersize spotted mackerel (commercial)	1	3	3	Low
undersize spotted mackerel (recreational)	1	4	4	Low
Coral reef finfish species taken by operators with no RQ symbol	1.5	4	6	Low
undersize or oversize coral reef finfish species	1.5	4	6	Low
sharks (not including grey nurse)	2	4	8	Moderate
Australian leaping bonito	1	3	3	Low
remora	1	3	3	Low
Listed species				
seabirds - boobies and	1	3	3	Low

Species	Consequence	Likelihood	Risk value	Risk ranking
gannets				
dolphins	1	3	3	Low
pilot whale	1	2	2	Low
chinaman fish[6]	1	3	3	Low
Interaction but no direct capture				
whales	1.5	3	4.5	Low
sharks (not including grey nurse)	1.5	5	7.5	Low

[6] It is acknowledged that chinaman fish is not a listed species under the *Environment Protection and Biodiversity and Conservation Act 1999*, but was included in this section because it is a no-take fish under the Queensland *Fisheries Act 1994*.

Appendix 4 – information sourced from compulsory commercial logbooks

Compulsory daily logbooks maintained by DPI&F can provide information on the product caught on the same day as Spanish mackerel, and may help quantify the extent of byproduct in the fishery. It is difficult to identify all the byproduct caught in the ECSMF because of overlap with other line fisheries. However, as a broad rule, byproduct was estimated by calculating the catch of other species on the east coast by line method, recorded on the same day that operators reported catching Spanish mackerel.

Compulsory logbook data indicates that on more than 30% of the days when Spanish mackerel was caught, no other fish were taken (Figure 1). Of the remaining days, only a small number of other species were usually caught (ie less than 5). On a small number of days (<5%), up to twelve other species were caught.

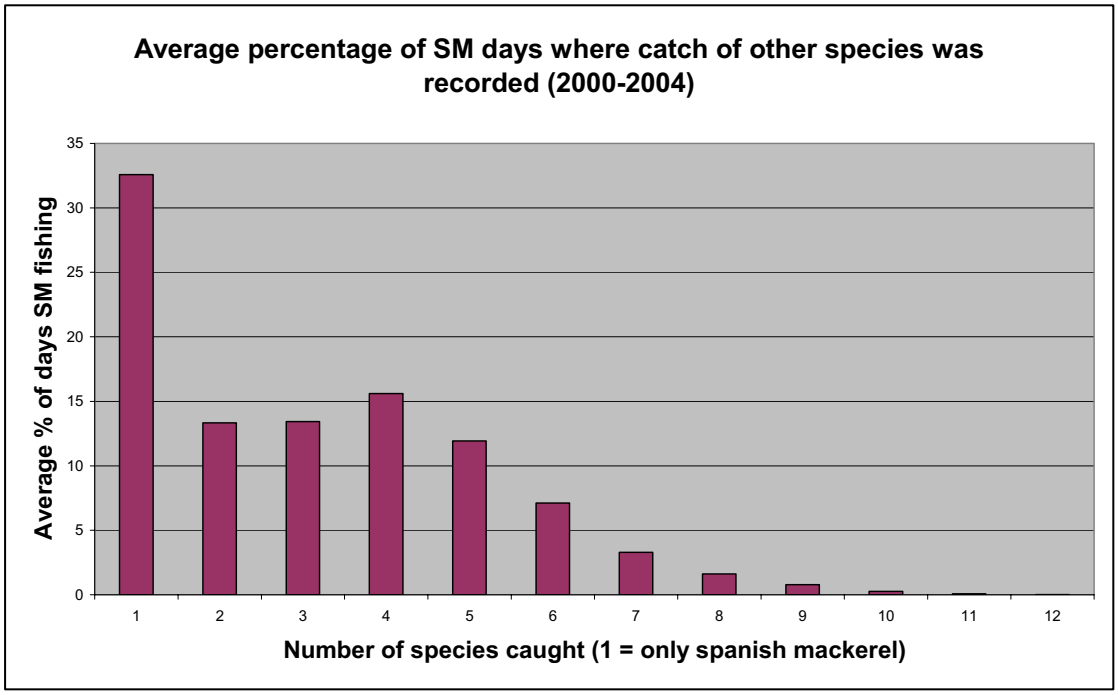


Figure 1

Table 1 shows the catch of species other than Spanish mackerel, taken on the same day as Spanish mackerel was caught (i.e. byproduct) in 2004. It also provides an indication of the catch of the species in the East Coast Spanish Mackerel Fishery, compared to the total Queensland catch of these byproduct species.

The data suggests that there is significant overlap between a number of line fisheries, namely the reef line fishery and the rocky reef fishery. It is assumed that a large proportion of coral reef finfish and rocky reef finfish caught on the same day as Spanish mackerel are taken under the relevant fishery symbol (i.e. RQ and L1 respectively), not as byproduct in the East Coast Spanish Mackerel Fishery.

Table 1: Byproduct catch characteristics

	Total annual catch (t) of species caught on the same day as Spanish mackerel was caught by line on the East Coast in 2004	Total Qld catch (t) of the species, by all methods and regions in 2004	Proportion of the total Queensland catch of the species that is taken as byproduct in the East Coast Spanish Mackerel fishery	Catch of byproduct species as a percentage of the Spanish mackerel catch for 2004
Shark - Cat	0.00[7]	0.00	100.0%	0.0%
Trevally - Bludger	**0.00**	**0.00**	**100.0%**	0.0%
Tuna - Yellowfin	**0.54**	**0.71**	**76.3%**	0.2%
Wahoo	**0.96**	**1.49**	**64.3%**	0.3%
Tuna - Dog tooth	0.04	0.06	60.4%	0.0%
Scad - Yellowtail	0.42	0.86	49.0%	0.1%
Mackerel - unspecified	0.95	2.63	36.1%	0.3%
Tuna - Long tail	**0.99**	**3.09**	**32.1%**	0.3%
Mackerel - Shark	**13.68**	**45.34**	**30.2%**	4.4%
Mackerel - Slimy	1.04	3.60	28.9%	0.3%
Jew - Mulloway	0.28	1.01	27.8%	0.1%
Kingfish - Yellowtail	0.62	2.92	21.2%	0.2%
Ray - Blue spotted	0.01	0.03	19.4%	0.0%
Mackerel - Spotted	**18.64**	**110.99**	**16.8%**	5.9%
Cod - Estuary	0.27	1.75	15.4%	0.1%
Kingfish - Black	**2.59**	**17.80**	**14.5%**	0.8%
Trevally - Unspecified	**18.13**	**127.11**	**14.3%**	5.8%
Trevally - Gold Spot	**0.08**	**0.56**	**13.4%**	0.0%
Tuna - Mackerel	**0.89**	**8.50**	**10.5%**	0.3%
Trevally - giant	**0.09**	**0.93**	**9.1%**	0.0%
Kingfish - Unspecified	0.23	2.57	8.7%	0.1%
Tuna - Unspecified	1.11	14.15	7.9%	0.4%
Snapper	**11.61**	**152.84**	**7.6%**	3.7%
Threadfin - unspecified	0.19	2.79	6.7%	0.1%
Fish - Unspecified	8.30	138.09	6.0%	2.6%

[7] Note that where a catch is equal to 0.00 tonnes, it means less than 10 kg of the species is caught.

	Total annual catch (t) of species caught on the same day as Spanish mackerel was caught by line on the East Coast in 2004	Total Qld catch (t) of the species, by all methods and regions in 2004	Proportion of the total Queensland catch of the species that is taken as byproduct in the East Coast Spanish Mackerel fishery	Catch of byproduct species as a percentage of the Spanish mackerel catch for 2004
Amberjack	0.46	9.04	5.1%	0.1%
Dolphin Fish	0.47	10.43	4.5%	0.1%
Jew - Silver	0.57	13.30	4.3%	0.2%
Perch - Pearl	2.20	54.25	4.1%	0.7%
Rainbow Runner	0.01	0.21	3.9%	0.0%
Mackerel - School	**5.29**	**139.11**	**3.8%**	1.7%
Jew - Teraglin	0.69	18.81	3.7%	0.2%
Bonito - unspecified	**0.87**	**23.91**	**3.6%**	0.3%
Sea Perch -Mangrove Jack	0.25	8.14	3.1%	0.1%
Emperor - grassy	0.01	0.34	2.0%	0.0%
Scad - Unspecified	0.37	30.42	1.2%	0.1%
Shark - Unspecified	6.19	513.24	1.2%	2.0%
Queenfish - Unspecified	0.83	173.85	0.5%	0.3%
Barracuda	**0.04**	**11.03**	**0.4%**	0.0%
Trevally - golden	**0.01**	**4.01**	**0.3%**	0.0%
Mackerel - Grey	1.43	709.75	0.2%	0.5%
Jew - Unspecified	0.03	30.53	0.1%	0.0%
Tailor	0.11	140.96	0.1%	0.0%
Shark - Hammerhead	0.04	161.13	0.0%	0.0%
Garfish - Unspecified	0.05	262.52	0.0%	0.0%
Shark - whaler unspecified	0.09	603.22	0.0%	0.0%
Shark - Black tip reef	0.04	305.98	0.0%	0.0%
Flathead - Unspecified	0.00	97.76	0.0%	0.0%
Grunter - unspecified	0.00	86.88	0.0%	0.0%

Appendix 5 – Ecological and other factors relating to each species identified[8]

Retained species

Criteria	Shark mackerel	Cobia	Trevally spp	Barracuda	Mackerel tuna	Spotted mackerel	School mackerel	Snapper	Coral reef finfish generally
Distribution	Western Pacific. Northern coasts of Australia – Qld, WA and northern NSW.	Worldwide in tropical and subtropical waters. More common in southern reefs of Qld	Indo-west pacific	Indo-pacific. Found along the entire Qld coastline	Indo-west Pacific.	Western Pacific. Abrohlos Islands, WA to Coffs Harbour, NSW, across the North of Australia.	Western Pacific. Shark Bay, WA north to PNG and south to Sydney.	Distributed widely around the Indo Pacific. In Australia from the Swains south to Tasmania and West to central WA.	Cosmopolitan distribution in tropical waters.
Catch compared to other fisheries	See Appendix 4								
Species resilience	Medium – population doubling time 1.4 – 4.4 yrs	Medium – population doubling time 1.4 – 4.4 yrs	High, minimum population doubling time less	Medium – population doubling time 1.4 – 4.4 yrs	High, minimum population doubling time less	Medium – population doubling time 1.4 – 4.4 yrs	Medium – population doubling time 1.4 – 4.4 yrs	Assumed to be low because of slow growth.	Medium – population doubling time 1.4 – 4.4 yrs

[8] Information sourced from Kaloila et al (1993), Frose and Pauly (2005), Bannister et al (1996), Grant (1985) and Grant (1997)

Criteria	Shark mackerel	Cobia	Trevally spp	Barracuda	Mackerel tuna	Spotted mackerel	School mackerel	Snapper	Coral reef finfish generally
			than 15 months		than 15 months				
Maturity	Around 2 years	42 cm	Varies between species	Around 2-4 years	Around 3 years	1-3 years (48-58cm depending on sex)	1-3 years (40-50cm depending on sex)	22-30cm (2-5 years)	Varies
Max age	10-14 years	unknown	unknown	10 years	unknown	10-14 years	10-14years	Up to 35 years	Varies
Catchability	Dense concentrations around individual cays and reefs.	May form dense shoals over reefs during summertime (Grants guide)	Juveniles may form small schools, but older individuals tend to be solitary.	Can sometimes be found in small aggregations, but usually solitary.	Highly migratory. Voracious feeders. Often a nuisance fish when targeting Spanish mackerel.	Form large schools which move close inshore along the Qld east coast	Form large schools which move close inshore along the Qld during midwinter and early spring.	Sometimes form schools to spawn. Extended spawning period (throughout winter)	A number of species aggregate to spawn.

Non retained species[9]

Non-listed species

[9] Note that undersize school and spotted mackerel and coral reef finfish species make up part of the non-retained species. Biological information on these species was provided in the retained species table.

Criteria	Undersize SM	Northern bluefin tuna	Yellowfin tuna	Marlin	Leaping bonito	Wahoo	Remora	Sharks (not including GNS)
Distribution	Indo-West Pacific. South Africa, SE Asia, China, Australia, Fiji.	Indo-west Pacific. Across northern Australia from WA to NSW	Inhabit all oceans. On the east coast range from Torres Strait to Tasmania	Length of both the west and east coasts of Australia.	Northern three quarters of Australia, extending to PNG	Atlantic, Indian and Pacific oceans	Cosmopolitan in tropical and subtropical waters	Tropical and subtropical distribution. Varies with species.
Species resilience	Medium – population doubling time 1.4 – 4.4 yrs	Medium, population doubling time 1.4 - 4.4 years	Medium – population doubling time 1.4 – 4.4 yrs	Medium – population doubling time 1.4 – 4.4 yrs	High, minimum population doubling time less than 15 months	Medium – population doubling time 1.4 – 4.4 yrs	Unknown, but thought to be relatively high	Generally low due to age of maturity and bearing few live young
Maturity	79cm	60-70cm FL	2 years (around 100cm)	Uncertain, but males thought to mature earlier than females.	unknown	unknown	unknown	Varies between 2-4 years (110cm) for tropical sharks, to 13-19 years for whalers
Max age	Around 14 years		8 years					Varies between 15 and 50 years
Catchability	Found in small schools	May form schools of varying size. Localised aggregations	Tuna smaller than 15kg form schools. Individuals larger than	Aggregate to spawn in the coral sea from September –	Forms schools of several hundred individuals	Frequently solitary or sometimes form small loose	May be caught while attached to other species	Some species form schools.

Criteria	Undersize SM	Northern bluefin tuna	Yellowfin tuna	Marlin	Leaping bonito	Wahoo	Remora	Sharks (not including GNS)
		in Moreton Bay in April.	15kg tend to be solitary.	December		aggregations		
Post release survival	Thought to have poor release survival, but depends on the length of time to land.	Unknown	Unknown	Survival thought to be fairly high based on tagging studies	Unknown	Unknown	Unknown	Unknown

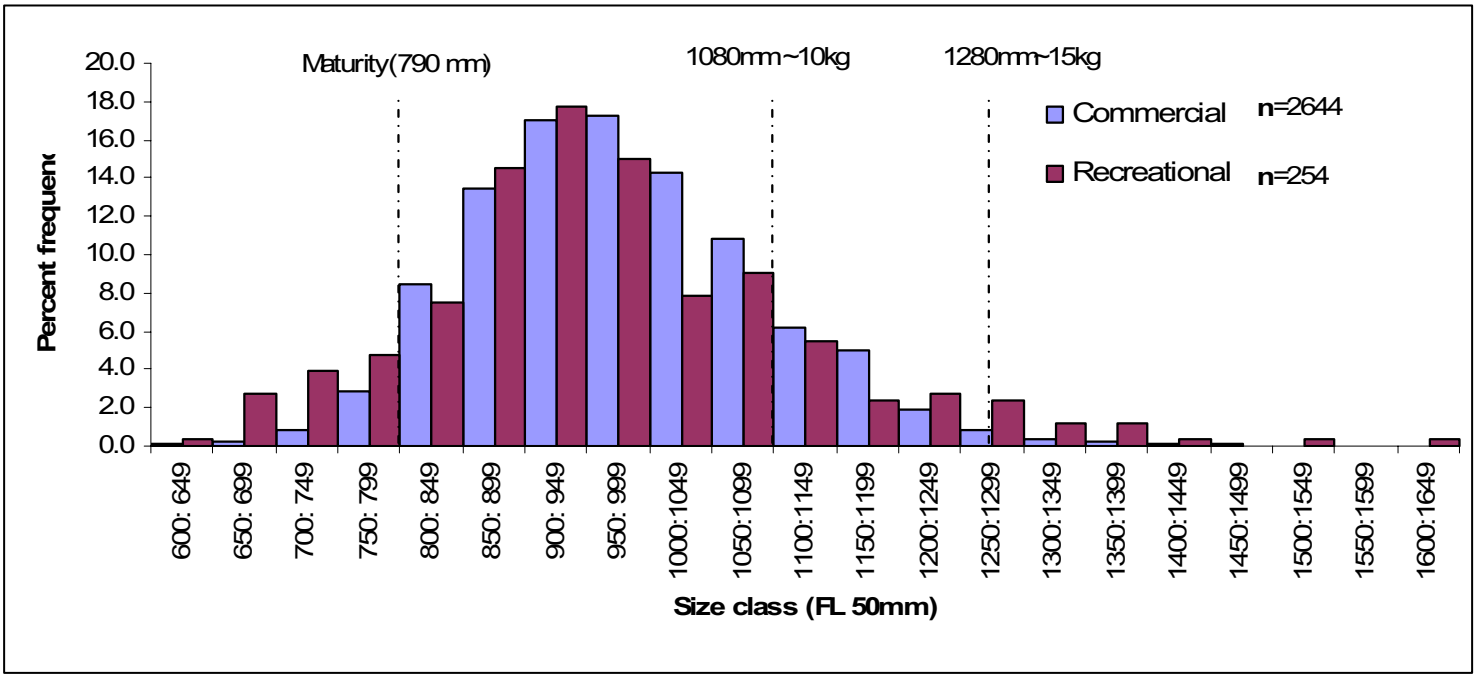
Listed species[10]

Criteria	Seabirds (boobies and gannets)	Common dolphin	Pilot whale	Chinaman fish
Distribution	Gannets and boobies have a wide distribution throughout Australia and internationally. Gannets tend to be more restricted to southern areas of Australia.	Wide distribution internationally and found throughout inshore and offshore Qld waters.	Widely distributed throughout equatorial regions.	Western Pacific. Fairly plentiful in northern GBR (Grants guide).
Catch compared to other fisheries	Thought to be low compared to other	Likely to be relatively low in all fisheries, but	Likely to be relatively low in all fisheries, but	Unknown

[10] It is acknowledged that chinaman fish is not a listed species under the *Environment Protection and Biodiversity and Conservation Act 1999*, but was included in this section because it is a regulated fish under the Queensland *Fisheries Act 1994*.

	fisheries (eg long lining in areas further south)	possibly higher in fisheries that use mesh nets.	possibly higher in fisheries that use mesh nets.	
Species resilience	Assumed to be low-medium due to the small number of offspring produced.	Assumed to be low due to low fecundity, age of maturity and giving birth to live young.	Assumed to be low due to low fecundity, age of maturity and giving birth to live young.	Medium – population doubling time 1.4 – 4.4 yrs
Maturity	6-7 years old	9-11 years	Approximately 17 years	
Max age	Some seabird species live up to 50 or 60 years	Approximately 30 years	Between 46 and 63 years	
Catchability	Usually solitary when feeding.	Are known to travel and feed in pods	Occur in small groups of 20 – 30 or in large herds of several hundred.	Occurs singly
Post release survival	Thought to be relatively high depending on handling and release time.	Unknown but highly dependent on type of gear and handling	Unknown but highly dependent on type of gear and handling	Unknown

Appendix 6 – Size composition of the commercial and recreational Spanish mackerel catch compiled through the DPI&F Long Term Monitoring Program.



Appendix 7 – Information provided by Lound's Fresh Seafoods on the catch composition of Spanish mackerel commercial fishers

Summary information has been provided by a Townsville-based wholesaler on the retained catch of several Spanish mackerel commercial fishers, operating out of Townsville. The figures help to demonstrate the amount of catch of species other than Spanish mackerel.

Date	Species retained by Spanish mackerel commercial fisherman, as a proportion of the total catch taken when targeting Spanish mackerel			
	Cobia	Shark mackerel	Shark	Trevally
21/09/2005	0.0%	0.0%	0.0%	0.0%
28/09/2005	0.0%	0.0%	0.0%	0.0%
2/10/2005	0.0%	0.0%	0.0%	0.0%
4/10/2005	1.6%	0.0%	0.0%	0.0%
11/10/2005	0.8%	0.0%	0.0%	0.6%
17/10/2005	1.8%	0.3%	0.0%	0.0%
19/10/2005	1.0%	0.9%	0.0%	0.7%
26/10/2005	0.2%	0.0%	0.4%	0.0%
29/10/2005	1.6%	4.2%	0.0%	0.0%
3/11/2005	2.8%	0.0%	0.0%	0.0%

Date	Catch of non-target species (kg) by Spanish mackerel commercial fishers, compared to the Spanish mackerel catch (kg) taken on the same day				
	Spanish mackerel (kg)	Cobia (kg)	Shark mackerel (kg)	Shark (kg)	Trevally (kg)
21/09/2005	445	0	0	0	0
28/09/2005	111	0	0	0	0
2/10/2005	640	0	0	0	0
4/10/2005	1274	21	0	0	0
11/10/2005	2286	18	0	0	14
17/10/2005	1402	26	4	0	0
19/10/2005	944	10	9	0	7
26/10/2005	1566	3	0	6	0
29/10/2005	406	7	18	0	0
3/11/2005	983	28	0	0	0

Other background information used for the assessment

Other jurisdictions

Western Australia

WA Fisheries stated in its ecological assessment of the Spanish mackerel fishery that some finfish species including queenfish, pike, tuna and shark are occasionally caught and discarded because they are unmarketable or of relatively low value. Species also caught and discard include tuna, billfish, sharks and demersal reef fish in the Pilbara and Kimberley sectors and are discarded because fishers are not licensed to retain them. WA assessed the impacts of the take of bycatch in the fishery as negligible risk.

DEH did not recommend that WA Fisheries monitor bycatch or improve on the level of bycatch information in this fishery. DEH did however recommend that WA *implement a system to improve the identification and recording of elasmobranch species that are taken as byproduct*. Bycatch information was provided by consulting the Spanish mackerel fishers and from monitoring programs in WA with similar fishing methods.

Northern Territory

NT stated in its ecological assessment that bycatch in the Spanish mackerel fishery is negligible, using a similar argument as WA Fisheries. Observers and fishery dependent research demonstrated a negligible take of bycatch.

DEH recommended to NT fisheries that it: *Monitor the species composition of bycatch and byproduct with a view to undertaking a more rigorous risk analysis, if there is a significant increase in the catch of individual species.*

The 2003 Spanish Mackerel fishery status report stated that during six observer trips, in which a total of 1586 SM were taken, bycatch consisted of 24 fish in total – 13 giant trevally, 6 barracuda, 1 coral trout and 4 tuna.

Information (including some anecdotal) available from Queensland

- Amos Mapleston advised that some observer trips were done in SE QLD (8-10 days). Whilst bycatch and discards weren't recorded he suggested that it's very limited. Bycatch was mainly composed of shark mackerel and long-tail tuna.
- Discussion with Geoff McPherson indicated that during independent monitoring surveys, limited bycatch was taken. He suggested that Spanish mackerel comprises one of the cleanest fisheries in terms of bycatch. He noted that the species discarded were generally barracuda and trevally. In regard to protected species he noted 1 interaction with a turtle and 1 with a seabird in 35 years of monitoring Spanish mackerel.

- Mapleston and Tobin (2003) identified that it is a common anecdote that commercial fishers will actively move away from schools of small though legal sized mackerel due to poor economic returns per captured fish.
- JCU (Gavin Begg) has advised in a letter to ReefMAC that the bycatch of seabirds during reef research trips was negligible.
- Byproduct information is available through commercial logbooks (most bycatch in the fishery is saleable product and is retained)
- A number of observer trips have been done in the reef line fishery. Spanish mackerel made up 0.5% of the catch (5 SM were caught in 20 observer days).

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