



Department of
Fisheries

ESD REPORT
SERIES No. 7



Western Australian Mackerel Fishery



Ecologically
Sustainable Development

Catching Sustainability

FRDC – Subprogram



Australian Government

Fisheries Research and
Development Corporation



Fish for the future

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Published by the Department of Fisheries, Western Australia
ESD Report Series No. 7, September 2010
ISSN: 1448 - 3599 ISBN: 1 921258 85 3

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1.0 INTRODUCTION

Ecologically Sustainable Development (ESD) is the concept that seeks to integrate short and longterm economic, social and environmental effects in all decision-making. The Western Australian Government is committed to the concepts of ESD and these principles are implicitly contained in the objectives of the Fisheries Resources Management Act 1994 (FRMA). More recently, the Minister for Fisheries released a “Policy for the Implementation of Ecologically Sustainable Development for Fisheries and Aquaculture within Western Australia” (Fletcher 2002) to articulate, in a practical manner, how the Department of Fisheries can demonstrate to both the government and the broader community that these requirements are being achieved.

A major element of this policy was the requirement for reporting on the progress of each commercial fishery against the major ESD objectives by the end of 2003. This document forms part of this process being the ESD report for the WA MACKEREL FISHERY.

The reporting framework used to generate these ESD reports is the National ESD Framework for Fisheries (see Fletcher et al., 2002 or www.fisheries-esd.com for details). This framework operates by identifying the relevant issues for a fishery within 3 main categories of Ecological wellbeing, Human wellbeing and Ability to achieve completing a risk assessment on each of the identified issues and then providing suitably detailed reports on their status.

Due to recent changes in the Australian Government’s environmental legislation administered by the Department of Environment and Heritage*, all export fisheries are now required to have an assessment on their environmental sustainability. As a consequence, the initial series of assessments for fisheries has concentrated on the environmental and governance components of ESD of this fishery. The social and economic elements of ESD will be covered in the next phase of assessments.

The reporting of performance for each fishery is the responsibility of the Department in conjunction with the relevant Management Advisory group and/or associated stakeholders. Consequently, the completion of this report has involved a substantial level of consultation and input from many groups including a public comment period. The list of participants involved in this development is located in Appendix 1.

This material has also been used as the basis to submit an application to Environment Australia to meet the requirements of the Commonwealths’ Guidelines for the Ecologically Sustainable Management of Fisheries. A copy of the application section of this submission is located in Appendix 2.

These ESD reports provide a comprehensive overview of the information pertaining to each fishery. A major element of which is the explicit determination of the operational objectives, performance measures and indicators that will be used to assess performance of the fishery. Most importantly these reports include appropriately detailed justifications for the levels chosen and the methods used. Therefore, the annual State of the Fisheries reports on the evaluation of performance of this fishery against these sets of “agreed” objectives/performance measures (ie the full justifications will not be presented in the SoF reports). This is summarised in Figure 1.

* Environment Australia (EA) is now called the Department of Environment and Heritage. Throughout this document references to EA should be taken to mean the DEH.

As stated in the Department’s ESD policy, it is expected that the ESD report, and therefore the objectives and performance measures, will be reviewed every 5 years to ensure that they remain relevant and

appropriate with current scientific protocols, social attitudes and prevailing environmental conditions. This will coincide with the next assessment cycle under the EPBCA. The material presented here relates to the time of the application, not time of publication.

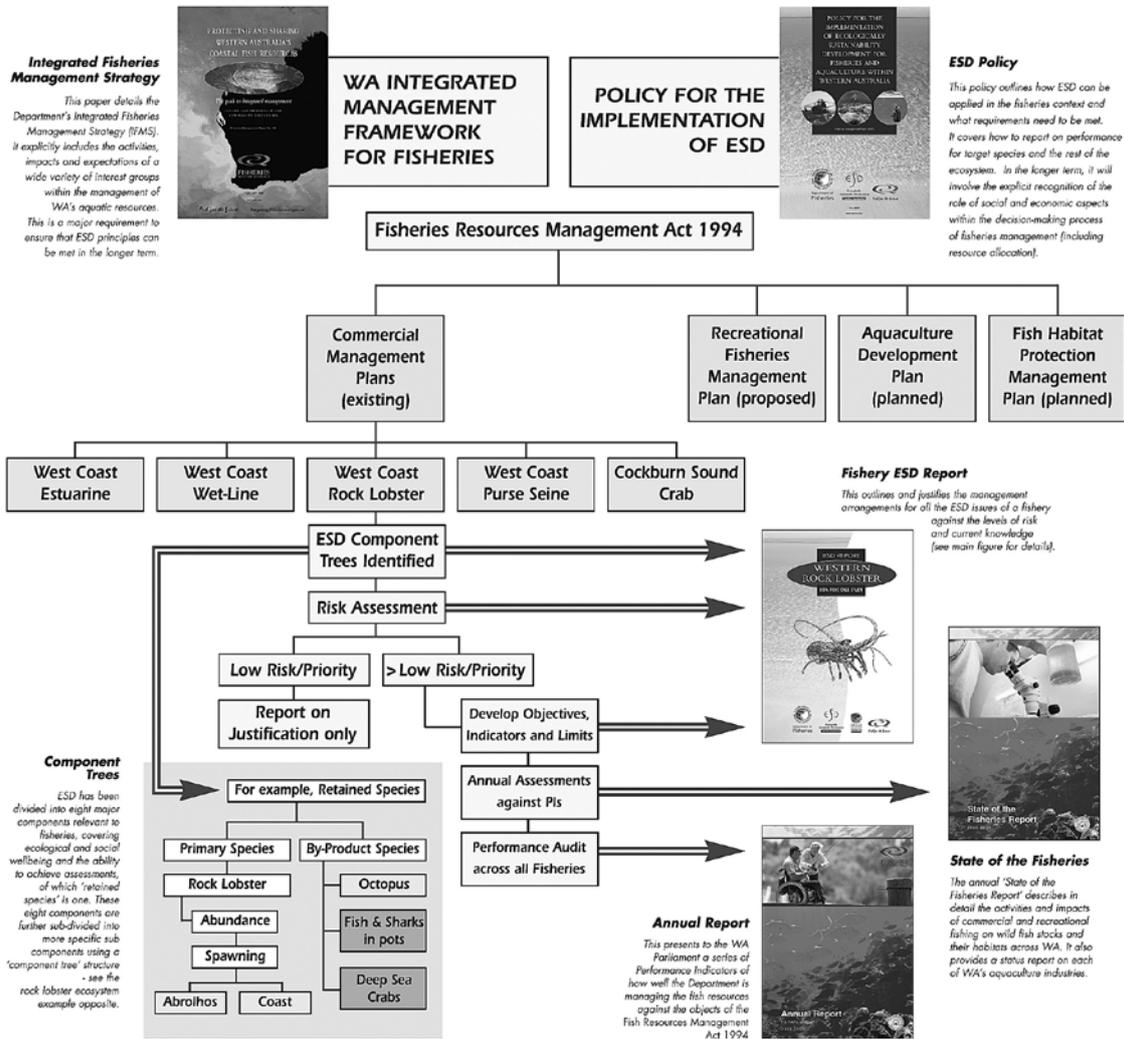


Figure 1 Summary of process for completing ESD reports and their relationship with the Annual Report and State of Fisheries Reports. (Example shown is for the West Coast Bioregion and the Western Rock Lobster fishery.)

2.0 Overview

The WA Mackerel Fishery (MF) consists of three management sectors (Kimberley, Pilbara and Gascoyne/West Coast) which encompass the entire coastline of Western Australia (WA) from the Northern Territory border to Cape Leeuwin in the South West. The primary species of the MF is the narrow-barred Spanish mackerel, which is fished commercially between Geraldton (in the Gascoyne/West Coast Sector) and the Northern Territory border (Kimberley Sector). Since 1980, total landings for the fishery have ranged from 97.9 tonnes (in 1980) to 467.9 tonnes in 2002. Landed value of the catch in 2002 was around \$2.7 million. The Department of Fisheries is currently developing the *Mackerel Fishery (Interim) Management Plan*, hereafter referred to as the Interim Management Plan (IMP), due to commence mid 2004.

The *Fish Resources Management Act, 1994* (FRMA) provides the legislative framework to implement the management arrangements for this fishery. The FRMA, the regulations in the *Fish Resources Management Regulations, 1995* (FRMR) and the specific interim management plan for this fishery, will adhere to arrangements established under relevant Australian laws with reference to international agreements as documented in Section 5.4.2.

The MF is at a transitional state as it is moving to being managed under an interim management plan. With the development and finalisation of a comprehensive interim management plan which will include input and output controls, the Department of Fisheries is confident in the maintenance of the mackerel species stocks as well as the successful continuation of the fishery.

Consequently, the management regime for the MF should meet the *Guidelines for the Ecologically Sustainable Management of Fisheries*. Detailed justification for this conclusion is documented within the remainder of this application.

3.0 Background on the Western Australian Mackerel Fishery

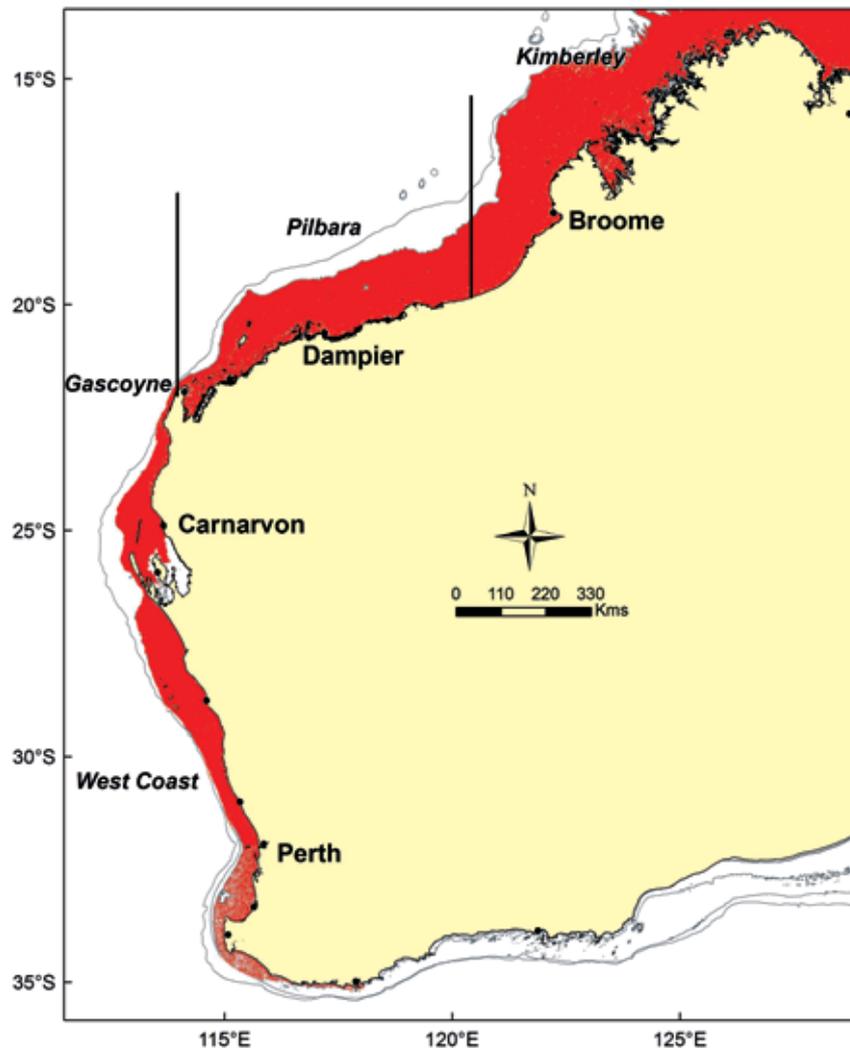


Figure 2 Relative distribution of Spanish mackerel (red) and location of proposed Management Areas within the Western Australian mackerel fishery.

3.1 DESCRIPTION OF THE FISHERY

3.1.1 Location Of The Fishery

Mackerel species (predominantly narrow-barred Spanish mackerel - *Scomberomorus commerson*) are fished commercially between Geraldton and the Northern Territory border.

3.1.2 Number of Licences

There are currently no formal management arrangements for the mackerel fishery so any holder of a WA Fishing Boat Licence may operate in this fishery. However, only a relatively small number of vessels have

caught mackerel per year and a formal management regime is currently being implemented (see below).

Since 1980, the number of boats that have recorded some catch of Spanish mackerel in any one year has varied substantially, from 4 to 20 boats in the Kimberley sector (8 in 2003), 17 to 53 boats in the Pilbara sector (19 in 2003), 13 to 56 boats in the Gascoyne sector (29 in 2003), and 10 to 40 boats in the West Coast sector (39 in 2003). Most of these catches were made opportunistically by boats operating within other fisheries, and at present there are only about 10 boats which specifically target mackerel.

Formal management arrangements for the mackerel fishery will be introduced in mid-2004 and will be fully operational by 1 January 2005. Under the new arrangements, the fishery will be divided into three management areas each with their own specific quotas, license restrictions and fishing seasons:

Area 1 (Kimberley) - WA/NT border to 121°E longitude; Area 2 (Pilbara) -121°E longitude to 114°E longitude; and Area 3 (Gascoyne-West Coast) -114°E longitude to Cape Leeuwin.

The number of permit holders allowed to fish for mackerel in each area will be limited according to criteria set down in the Interim Management Plan (IMP). The number of boats authorized to take mackerel will be significantly reduced under the new management arrangements and it is anticipated that <10 will be able to catch mackerel in each area.

3.1.3 Description of Gear

The main fishing method for mackerel is trolling. Baits or lures are also drifted or cast from anchored or drifting boats. Jigging methods are also used to catch grey mackerel in the Gascoyne and West Coast sectors. Trolling methods differ between sectors:

Kimberley sector: Dories (5 m – 6.5 m dinghies) troll 2-3 lines and work to a refrigerated mother boat. The mother boat is about 20 m in length and also trolls 6-7 lines. Fishing gear used in this sector is relatively heavy (8-10 mm rope with a 200+ kg mono line and wire trace). Crews comprise 3-5 fishers per fishing operation. *Pilbara sector:* Boats used in this sector are 9-15 m in length. They troll 6-7 lines and have 1-2 crew. The use of dories in this sector will be restricted under the new management arrangements to those who are authorised to fish in both the Kimberley and Pilbara and who are permitted to use dories in the Kimberley. Boats in this area use 180 kg mono line and wire trace. *Gascoyne/West Coast sector:* Vessels used in this sector are 7-15 m in length. They troll 2-4 lines and have 1-3 crew. Dories will not be permitted under the IMP. Gear used is rod and reel with 20-30 kg line and wire trace.

3.1.4 Operating Description

In Western Australia, most commercial fishing for mackerel occurs from May to October, with a peak in activity around July/August. The availability of mackerel in coastal areas is highly seasonal. The timing of the season varies between sectors, with the peak in fishing activity occurring earliest in the south. The Pilbara has the longest fishing season of all the sectors because, unlike in other sector, there are 2 fishers who target mackerel throughout the year in this sector. With implementation of the IMP the season will be restricted in each sector.

Fishing success is affected by various environmental factors. Trolling gear is most efficient in clear water and moderate sea conditions with good water movement. Environmental factors including moon phase, tidal regime and weather all affect water conditions and therefore impact on fishing success. Water temperature is also important, with optimum temperatures decreasing with southerly latitudes. In

the Gascoyne/West Coast sector, the optimum range of sea surface temperatures (SST) for catching *S. commerson* is probably between 22-25° C, which is generally below the minimum SST experienced in the north of the state (Mackie *et al.* 2003).

Fishing success is usually higher in the morning and late afternoon. Fishers targeting mackerel therefore aim to be over the fishing ground in the morning. Fishers will stay at a location until fish stop biting and a school may be fished for several hours. Fishers may then wait for tides and conditions to improve or travel to another location. Traveling is usually undertaken during the middle of the day. A crew may fish several locations per day. 'Part-time' mackerel fishers will usually only target mackerel when they are abundant. These fishers may troll for mackerel in the early morning and late afternoon, and may target other species during other times of the day. In the Pilbara and Kimberley sectors, electronic aids such as GPS, plotters and echo sounders are required to locate fish, which are often found over reefs and other submerged structures in these sectors. Fishing generally occurs along the side of the reef facing the current. Electronic aids are less important in the Gascoyne and West Coast sector where fishing is usually done around prominent areas of coastline.

A variety of baits, lures and jigs will usually be trolled. Whole garfish, or mullet which have had the backbone removed so they 'swim', are the main baits and are secured to a set of 3-4 ganged hooks (often size 10/0-12/0). Silver 'spoons' and various coloured 'smiths jigs' are also used. These are generally favoured over other types of lures that are more efficient but also more expensive and less robust. Baits are usually most successful and are used on about 70% of lines. Lines may be weighted to troll within about 1 m of the surface, but otherwise the baits lie near the surface. Paravanes are occasionally used to get baits deeper in the water, and trolling speed can be varied to alter fishing depth. Line length varies from about 5-30 m behind the stern of the boat. Trolling speed also varies from 3-7 knots depending on conditions, fish catchability and fisher preference. A shiny 'teaser' made from mirrors may also be towed to attract fish to the baits.

Hooked mackerel are retrieved as quickly as possible to the boat. In northern areas, where heavy fishing line is used, a strong effort is required to haul the fish to the boat and over the side. A gaff may be used to retrieve larger fish (preferably without damage to the fillet). In southern areas, where lighter lines and rods are used, fish are allowed to 'run' with the line before retrieval. Fish are then clubbed, spiked or throat cut so that hooks or lures can be removed. At this time fishers risk injury from sharp teeth and thrashing fish that are able to fling embedded hooks. Fish are placed as quickly as possible into brine to reduce the body temperature. Fish are headed and gutted or filleted for the Australian market, or left whole for the export market. Fish are mainly stored on board in an ice slurry. In the Kimberley sector, where trip durations are longest (typically 1-3 weeks), freezer boats are employed and almost all the mackerel are filleted and frozen. In the Pilbara sector, trip duration is usually >1 week, and the product is trunked and brined before being sold locally or sent to Perth markets. In recent years, the main catches from this sector have been landed at Port Hedland. In the Gascoyne and West Coast sectors, trip duration is 1-5 days. Fish caught by Carnarvon and Quobba-based fishers are usually kept whole in brine for export, whereas fish landed at other ports are usually trunked and sold locally or sent to Perth markets. Most catches in the West Coast sector occur in the Geraldton and Abrolhos areas.

3.1.5 Species Caught

Target. Spanish mackerel is the main target species and typically comprises at least 90% of the catch. It is the largest and most abundant of the four *Scomberomorus* species found in the coastal waters of Western Australia. Broad barred Spanish mackerel known as grey mackerel (*S. semifasciatus*) is targeted in the Gascoyne and West Coast sectors and comprise approximately 8% of the total catch. At

present grey mackerel is a byproduct species in the Pilbara and Kimberley sectors where catches of this species are low. However, allotment of a separate total allowable commercial catch (TACC) in the new management plan is likely to promote increased interest in this species.

Byproduct. Byproduct within the mackerel fishery is low. Main byproduct species include school mackerel (*S. queenslandicus*), spotted mackerel (*S. munroi*) and shark mackerel (*Grammatorcynus bicarinatus*), wahoo (*Acanthocybium solandri*), cobia (*Rachycentron canadum*), bonito (*Sarda australis*), blue- and yellowfin tuna (*Thunnus tonggol* and *T. albacares*), skipjack tuna (*Katsuwonus pelamis*), dolphinfish (*Coryphaena hippurus*), smaller sharks, various species of trevally and the occasional reef fish such as spangled emperor and coral trout.

Non-retained. Fishing for mackerel is conducted using specialised troll lines. This method is highly specific and involves limited discarding. Species occasionally caught and discarded include sailfish, billfish, pike, barracuda, shark, mackerel tuna, queenfish and trevally. Larger sharks may be captured when they attack a hooked mackerel and then become hooked themselves. Loss of mackerel to sharks can be considerable in some locations.

3.1.6 Biology Of Spanish Mackerel

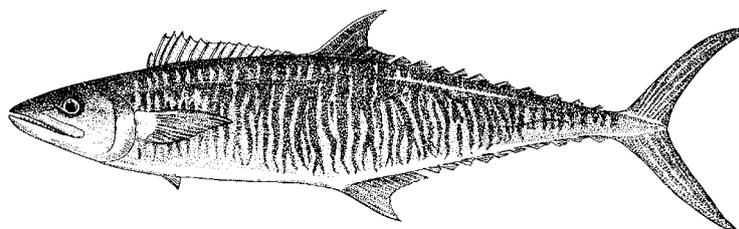


Figure 3 Spanish mackerel (*Scomberomorus commerson*).

Spanish mackerel are widely distributed throughout the Indo-West Pacific and West Africa, through to Fiji and north to China and Japan. It is fished in numerous countries including Indonesia, India, Egypt, Madagascar and Pakistan (Collette and Nauen, 1983). There is a single genetic stock along the northern Australian coast (including Western Australia and the Northern Territory), which is distinct to stocks around Indonesia and eastern Australia (Ovenden *et al.* in prep.). Genetic homogeneity of the stocks in north-western Australia is probably due to the along-shore dispersal of pelagic eggs and larvae, which generally drift southwards with the Leeuwin current. Larvae probably remain in the plankton for less than 3 weeks (Mackie *et al.* 2003).

There appears to be limited mixing of adult Spanish mackerel populations. Variations in otolith microchemistry and parasitic fauna suggest along-shore movement is restricted to <100 km in northern Australian waters. In the cooler, southern waters of Western Australia, where Spanish mackerel are at the edge of their range, along-shore movements up to 300 km may occur (Newman *et al.* in prep.). Overall Spanish mackerel across northern and western Australia are likely to exist as spatially discrete sub-populations of adults, which are genetically similar but function as distinct management units.

In winter and spring, adults aggregate to feed and spawn in coastal areas. At other times, fish probably disperse but remain in the same region. This dispersal may include some movement into deeper shelf waters. The peak reproductive period is October to January in the Pilbara sector and possibly one month earlier in Kimberley sector. Limited spawning is likely to occur south of Exmouth. Hence, the Pilbara sector is probably the source of recruitment for the Gascoyne and West Coast sectors. Annual

recruitment to the fishery varies considerably in each sector. The fishery targets spawning aggregations of Spanish mackerel. However, spawning probably occurs at a large number of sites over a protracted spawning season and so it is likely that many spawning aggregations escape fishing pressure each year.

Spanish mackerel are serial spawners and females are capable of producing a batch of eggs every 1-3 days during the spawning season (Mackie *et al.* 2003). Fecundity is positively related to female body size, e.g. a 10 kg female has a batch fecundity of about 750,000 eggs. Spawning occurs in the late afternoon/early evening. The timing is probably also influenced by environmental factors.

The composition of individual catches suggests that fish often school by sex and by size during the spawning season. The fishery catch mainly comprises young fish. Approximately 70% of the catch is between 1 and 4 years old. Males dominate older age classes in the catch, which may partly reflect the influence of spawning behaviour on catchability. Spawning females are rarely caught (Mackie *et al.* 2003).

Mackerel grow rapidly and are fully recruited to the fishery at 2 y. The age at which 50% of females and males are sexually mature is 1.4 y and 0.8 y, respectively. They do not undergo a sex change. Spanish mackerel reach 2.4 m and 45 kg. The maximum observed age in Western Australia is 22 years. Females grow faster and larger than males. Small mackerel (i.e. 1-5 years, <20 kg) tend to school and appear to be more mobile than larger fish.

Spanish mackerel are fast swimming, opportunistic predators. They feed in the water column and mainly consume pelagic fish and cephalopods. Larger fish tend to eat larger prey items. Total mortality (Z) is higher for females than males, and higher in the Kimberley sector than in the Pilbara sector. Mackie *et al.* (2003) estimated natural mortality (M) to be approximately 0.5 y^{-1} in the Kimberley sector, and 0.34 y^{-1} in other sectors. However, there is considerable uncertainty about these estimates.

3.1.7 Bait Usage and Packaging

Small schooling fish such as mullet, garfish and whiting are netted by at least 3 mackerel fishers in the West Coast and Pilbara sectors for use as bait when targeting Spanish mackerel. However, most mackerel fishers purchase bait. Garfish are the most commonly caught bait, and are used in large quantities by fishers in the Kimberley sector.

3.1.8 Traditional Involvement in The Fishery

Mackerel are large, conspicuous fish and were likely to have been targeted by visiting Indonesian fishers and others prior to European settlement. However, no historical records about traditional fishing are available.

3.2 HISTORY OF THE FISHERY

3.2.1 General

Commercial fishing for mackerel in Australia commenced along the Queensland coast during the 1920's and expanded rapidly after World War II. From the 1930s onwards, mackerel were targeted in northern Australian waters by Japanese, Russian, Chinese and Taiwanese fishers (Nowara and Newman, 2001). In particular, Taiwanese gill net fishers caught considerable amounts of Spanish mackerel throughout northern Australia, including Western Australia, until the declaration of the Australian Fishing Zone

in 1979. Catches of this species peaked at nearly 1000 t per year (Millington and Walter, 1981). After 1979, the fishing area was restricted and a catch quota was imposed. From 1979 to 1986, the total catch by Taiwanese gill net fishers in northern Australian waters ranged between approximately 100 and 500 t per year (Stevens and Davenport, 1991). In the same period, the Taiwanese gill net catch in Western Australian waters (i.e. region from Broome to approximately NT border) was between 5 and 80 t per year. Overall reductions in catch rate and mean fish size in the Taiwanese fishery during the early 1980s suggests that stocks may have been overfished (Stevens and Davenport, 1991).

In Western Australia, the earliest reports of commercial fishing for mackerel by Western Australian fishers are from the Geraldton area in the 1950s. Fishing effort gradually spread northwards of Geraldton during the 1960s and 1970s. Since the Australian Fishing Zone was declared, the Western Australian mackerel fishery has grown substantially, particularly in the north of the state. Since 1980, total annual landings of Spanish mackerel have ranged between 97.9 (in 1980) and 467.9 t (in 2002). In 2003, total landings of this species were 457.2 t.

3.2.2 Catch History

Mackerel fishing was previously reported under three sectors based on overall catches, fishing methods and anticipated boundaries of the IMP. However, as a result of ongoing consultation with industry over the IMP, the fishery is now reported in four sectors (see Figure 2).

Annual catches of Spanish mackerel in the Kimberley sector rose slowly between 1979 and 1990, before a significant increase in catches from 45.4 t in 1990 to 160.7 t in 1991 when two of the four main present-day operators entered the fishery (Fig. 4). During the period 1991 to 2003 the mean catch has been about 167 t. The peak catch during this period was 245.8 t in 2002 and the lowest in 2000 when only 123.8 t was caught. This low catch was probably due to environmental effects on the abundance of mackerel with fishers reporting an unusual distribution of mackerel, i.e. fewer fish observed in the Kimberley and more fish in the Pilbara than normal. Thus, in subsequent years the catch has again been above 200t.

Catches within the Pilbara sector have been steadily rising from a low of 47.1 t in 1988, which followed a period of high catches that peaked in 1984 at 136.9 t. In 2002, 136.8 t were caught in the Pilbara sector. Catch trends in the Gascoyne sector have seen a steady increase in recent years from a low of 8.7 t in 1992, which followed a period of high catches during the 1980s, including a peak of 110.6 t in 1987. In 2002 the total catch in this sector was 53.5 t. Annual catches in the West Coast sector are minor, and have ranged from 1.7 t in 1981 to 33.0 t in 2001.

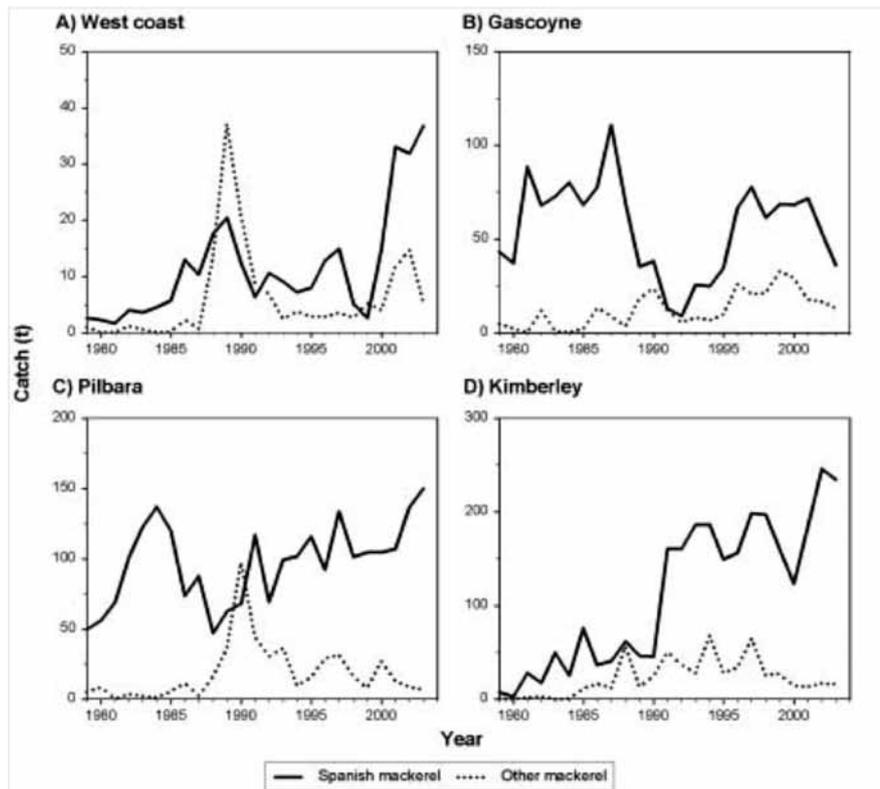


Figure 4 Annual catches of Spanish mackerel and other mackerel in each sector of the fishery, 1979 to 2003. ‘Other’ mackerel includes grey, school, spotted and shark mackerel, and wahoo. Note that catches of 5-90 t y⁻¹ by Taiwanese gill net fishers in the Kimberley sector are not included.

Fluctuations in the annual catch of ‘other mackerel’ are mainly due to variability in the capture of grey mackerel, because this species comprises over 80% of the byproduct catch. School and shark mackerel species each comprise approximately 7% of the ‘other mackerel’ catch. Catches of grey, school and spotted mackerel are currently recorded separately in the CAES database. However, prior to 2000, catches of these species were reported only as ‘other mackerel’. Catches of ‘other mackerel’ show year-to-year variability, especially in the Kimberley and Pilbara sectors. In 2001, a catch of 13.7 t in the Kimberley sector was the lowest since 1989 and the catch was also relatively low (13.3 t) in the Pilbara sector. In both sectors, there has been a downward trend in catches of ‘other mackerel’ since 1990 despite large fluctuations in catches between years. In contrast, catches of ‘other mackerel’ in the Gascoyne sector generally increased since 1980 before declining from a historic peak of 32.7 t in 1999 to 13.1 t in 2003. In the West Coast sector, catches of ‘other mackerel’ peaked in 1989 at 37.1 t, but have remained relatively low until 2001 and 2002 when they rose again to 15 t before a drop back to 5.5 t in 2003.

3.2.3 Effort and Catch Rate

Effort. The unit of effort used to estimate catch rate is ‘fishing day’. Unfortunately, fishing effort for mackerel is difficult to determine precisely. Monthly summaries of effort are reported by all commercial fishers, who report the total number of days spent fishing per month. This total includes effort by any method and includes effort spent targeting all species. Some fishers differentiate effort by method on their monthly returns, but many do not. Therefore it can be difficult to estimate specific effort spent

trolling for Spanish mackerel when other methods were used, or when numerous species were caught, in the same month. Also, even in months when only trolling is reported and only Spanish mackerel is caught, 'fishing day' is not an accurate measure of effort because of the variation in number of hooks trolled and number of hours fished per day by mackerel fishers. However, it is the most reliable measure of effort currently available.

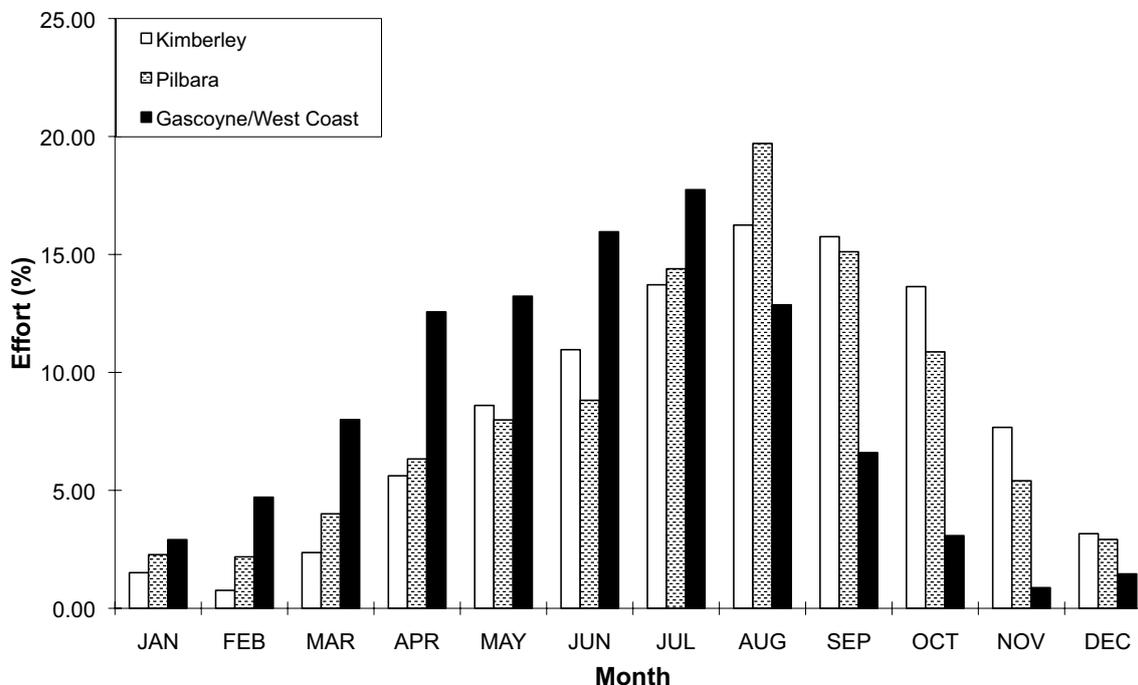


Figure 5 Distribution by month of annual fishing effort expended by vessels in the Spanish mackerel fishery. Data is pooled for all vessels for the years 1990-1999. Effort is days per month that Spanish mackerel were caught.

The seasonality of fishing effort is similar to that of catch. For the period 1990-2001, 83% of the total annual fishing effort within the Kimberley sector was expended between June and October, with a peak of 21% in August (data pooled among years) (Fig. 5). In the Pilbara sector, 65% of effort occurred from July to August (peak of 21% in August). In the Gascoyne sector, 85% of effort occurred between May and August (peak of 31% in July). In the West Coast sector, 71% of effort occurred between March and June (peak of 21% in May).

In the Kimberley sector, total annual effort has varied from 92 days in 1982 to 921 days in 1994. From 1979 to 1990, total annual effort was stable and averaged 262 days/year. In 1991, there was a considerable increase in effort, followed by another stable period from 1991 to 1997 when total annual effort averaged 789 days/year. Since 1997 fishing effort in this sector has declined slightly and was 646 days/year in 2003.

In the Pilbara sector, total annual effort peaked at 1963 days in 1984 and then followed a downward trend to 1443 days in 1997. After 1997 the rate of decline in annual fishing effort declined more dramatically to 467 days in 2001, but has since picked up to be 703 days in 2003.

Total annual effort in the Gascoyne sector reached peaks of 2476 and 2094 days in 1985 and 1987, respectively, and then declined sharply to 335 days in 1991. After 1991, total annual effort increased to 1265 in 1999 and has since fluctuated with 736 days spent catching Spanish mackerel in 2003.

Total annual effort in the West Coast sector peaked at 1148 days in 1988 and then declined. From 1989 to 2001, annual effort ranged between 330 and 835 days. Most recently, annual effort increased from 515 days in 2000 to 971 days in 2003.

The large differences in the number of fishing days between sectors reflect the number of vessels recording mackerel catches in each sector rather than the intensity of fishing effort. For instance, the few mackerel fishing vessels in the Kimberley sector focus almost exclusively on mackerel but have a relatively low combined total of fishing days. In contrast, most of the Gascoyne fleet do not target mackerel and may only catch a small number of them per day; but their combined tally of days on which mackerel were caught is relatively high.

Catch rate. Analysis of catch per unit effort is complicated by the fact that many fishers who catch Spanish mackerel do not normally target them, and so the effort they expend in catching mackerel is often combined with the effort expended to catch other species (see above for discussion about effort). For this reason, catch rates of vessels known to mainly target Spanish mackerel are used to estimate catch rates of all vessels in the fishery. The catch rate of each vessel is standardised prior to analysis to minimise the effect of increases in efficiency through time or between sectors (e.g. faster boats, GPS, use of dories) and differences in fisher experience (see Mackie *et al.* 2003 for details).

Average catch rates of Spanish mackerel in the Kimberley and Pilbara sectors are of similar magnitude. In the Kimberley sector, catch rates have ranged between 126 and 210 kg/d since 1989, and have exhibited a slight rising trend since 1996. Average catch rate was 190 kg/d in 2003. In the Pilbara sector, catch rates increased gradually after 1990, and then increased more sharply after 1996. Average catch rate was 238 kg/d in 2003. Catch rates in the Gascoyne/West Coast sectors (combined) are considerably lower than northern sectors and exhibit a cyclic pattern. A minimum average catch rate of 20 kg/d was observed in 1992. Average catch rate was 111 kg/d in 2003

3.2.4 Stock Assessment

Assessment of Spanish mackerel stocks includes estimates of catch by all fishing sectors (commercial, recreational and charter). Modelling of the biomass of Spanish mackerel has only been successful in the Gascoyne/west coast sector, due to a lack of contrast in catch and effort data in other sectors (Mackie *et al.* 2003). Modelling suggested that the carrying capacity of the West Coast sector was approximately 1115 t (95% confidence interval of 757-2116 t), and that biomass has been relatively stable at around 850 t since 1994. Annual commercial catches in the sector may therefore have varied between 9 and 11% of the total biomass since 1994. In 2001, the combined commercial and recreational catch was approximately 20% of the estimated biomass (915 t) in the sector. Although modeling was not successful in other sectors, the higher catch rates and larger catches that have come from these sectors suggest that the carrying capacities of the Kimberley and Pilbara sectors are likely to be substantially higher than the West Coast sector.

Recent work by Mackie *et al.* (2003) indicated that the daily egg production method is not a viable technique to apply in the stock assessment of Spanish mackerel, due to the difficulty in finding spawning sites and identifying precise times at which to sample eggs. Yield per recruit analyses were also conducted by Mackie *et al.*, but recommendations about optimum size and age at first capture were not made due to uncertainty about estimates of natural (M) and fishing

(F) mortality. Such analyses may be more useful in future if better estimates of M and F become available.

Overall, stock assessment suggests that Spanish mackerel in Western Australia is probably fully exploited at current catch levels. Anecdotal evidence suggests that grey mackerel is under-exploited in each sector, although catches are increasing.

3.3 THE RECREATIONAL SPANISH MACKEREL FISHERY

3.3.1 Summary

Because of its good fighting and eating qualities Spanish mackerel is a popular target of recreational fishers. Fishing gear is more varied than in the commercial fishery. Light rod/reel outfits and small boats are typically used, generally in combination with trolled lures or drifted baits. Shore-based fishing and spear fishing for mackerel is also popular at some locations.

Most recreational catches are taken between Perth and Dampier. Distance and isolation both limit recreational fishing in northern areas, where most of the commercial catch is taken. Anecdotal evidence indicates that recreational catches are highly variable among years, particularly at the southern limit of the species distribution.

Surveys of recreational fishing are undertaken periodically in Western Australia. Recreational survey data are available for the West Coast sector in 1996/97 (Sumner and Williamson, 1999), the Gascoyne sector in 1998/99 (Sumner *et al.* 2002) and the Pilbara sector in 1999/2000 (Williamson *et al.* in prep.). Data for the Broome area obtained during the Pilbara survey also provide an estimate of recreational catches for part of the Kimberley sector. In the West Coast sector, 12.9 t of Spanish mackerel (45% of the total recreational/commercial catch) and 0.4 t of other mackerel (12%) were caught in 1996/97. In the Gascoyne sector, 51 t of Spanish mackerel (45%) and 8.1 t of other mackerel (25%) were caught in 1998/99. In the Pilbara sector, 20.5 t of Spanish mackerel (16%) and 10.2 t of other mackerel (37%) were caught in 1999/2000. In the Broome area of the Kimberley sector, 2.7 t of Spanish mackerel (2%) and 0.4 t of other mackerel (2%) were caught. These recreational catches include mackerel that were taken by sharks before being landed. Shark attacks on hooked mackerel are common in the recreational fishery. The recreational data do not include fish that were caught and released, although mortality of released fish may be high. This is particularly the case with sportsfishers since Spanish mackerel are quickly exhausted when 'played' on light line and do not appear to recover well.

Most (80–100%) of the recreational charter boat catch of Spanish mackerel is taken in the Gascoyne and Pilbara sectors. Reported catches of Spanish mackerel by charter vessels have been relatively minor since 1990, ranging between 0.8 and 3.1 t per year (average of 1.8 t), with

0.9 t recorded during 2001. Compulsory catch reporting by charter vessels commenced during 2001. In 2002, the estimated catch of Spanish mackerel by charter vessels was 13.5 t in the Pilbara/Kimberley, 3.8 t in the Gascoyne and 0.6 t in the West Coast sector.

3.3.2 Issues in The Recreational Fishery

The recreational fishery for Spanish mackerel requires ongoing assessment as this is a growing sector that takes a significant proportion of the mackerel catch. Such an assessment will need to examine the usefulness of current minimum size limits and bag limits. A considerable number of mackerel (up to 50% of captures) are caught and released by recreational fishers. However, research fishing and tagging suggests that the survival of released fish is low.

Recent surveys indicate that the number of mackerel lost to sharks whilst being landed were about 7 and 15% of the total recreational catch in the Gascoyne and Pilbara sectors, respectively. Hence, in some areas the mortality of mackerel due to sharks taking hooked fish can result in a higher impact of recreational fishing than the bag limits imply. Commercial fishers lose few fish to sharks because they are more mobile and avoid areas where sharks are more numerous.

3.4 MAJOR ENVIRONMENTS

3.4.1 Physical Environment

Mackerel fishers operate in coastal waters adjacent to structures, such as reefs and headlands, where mackerel aggregate. Mackerel are pelagic feeders and usually prefer moving baits or lures, and so they are generally caught at/near the surface while trolling. Fishing gear does not interact with bottom habitats. Vessels do not anchor during fishing. However, some vessels undertake trips of several days duration and may spend nights anchored in sheltered locations over sandy areas. Vessels and gear are generally not hauled on to beaches or other intertidal areas. Nets used to catch bait may be set in shallow near-shore locations over sand or mud dominated areas inhabited by baitfish (one end of the net may be anchored ashore). These bait fishing trips may occur about 2-4 times per year, and on each occasion the net may be checked and cleared of fish several times.

3.4.2 Social Environment

Approximately 78 people were directly employed in the Spanish mackerel fishery during the 2003 mackerel fishing season. This estimate is based on those boats recording significant catches of Spanish mackerel (>500 kg in the Gascoyne, >1000 kg in the Pilbara and Kimberley). The average number of crew per boat is 2 in the Gascoyne and Pilbara, and 4 in the Kimberley sector. Fishers in the West Coast sector and other fishers catching minor amounts of mackerel in other sectors are not included because they are mainly employed in other fisheries. For most fishers included as employees of the mackerel fishery, the duration of employment is only about six months each year.

The main ports used by the fishery include Geraldton, Carnarvon, the Blow Holes, Denham, Exmouth, Point Samson, Onslow, Dampier, Port Hedland, Broome and Darwin (NT).

3.4.3 Economic Environment

In 2003, the estimated value (to fishers) of the Spanish mackerel annual catch was \$2.7 million. The value of the annual catch of grey and other mackerel was \$0.2 million. The value of the fishery is variable due to fluctuations in the quantity of annual landings.

In 2003, overall, ex-vessel prices paid by fish processors for Spanish, grey and other mackerel were around \$6.00, 6.15 and 3.00/kg, respectively, of whole weight. Actual prices paid to fishers for their product may reach over \$10/kg for fillets and trunks, particularly during summer when fewer mackerel are captured.

Most Spanish mackerel are taken by the fishery in the Kimberley and Pilbara sectors, from where they are either sent to Perth markets or sold locally. In the Gascoyne and West Coast sectors, most of the catch is exported. The export market was established by fishers in Carnarvon in the 1980s, and relies on short trip durations and rapid processing to maintain a fresh product. Export is mainly to Taiwan. The price paid to fishers for exported Spanish and grey mackerel is around \$6-7 /kg for whole fish.

3.5 CURRENT AND PROPOSED MANAGEMENT ARRANGEMENTS

3.5.1 Summary of Current Management Strategies and Justification

The mackerel fishery is currently open to all holders of an unrestricted Western Australian Fishing Boat licence. Only about 20% of these vessels report mackerel landings and so there is currently considerable latent effort associated with the fishery.

The capture of Spanish mackerel by commercial and recreational fishers is subject to a minimum legal size of 90 cm total length. At this length, 50% of females and 90% of males are mature. A recreational bag limit of 2 mackerel (Spanish or grey mackerel) per angler per day is in place in the West Coast and Gascoyne sectors. A recreational bag limit of 4 fish per angler per day applies in other sectors.

Commercial fishers are required to lodge monthly summaries of catch and effort with the Department of Fisheries. Charter fishing boats also report catch and effort data (including mackerel) to the Department of Fisheries.

Other than limits on the use of dories (only 2-3 per boat, and must remain within 5 nm of motherboat), there are currently no gear restrictions, closures or catch quotas imposed for management of mackerel.

Formal management of the fishery will commence in 2004 under the new IMP, which has been developed in consultation with the Mackerel Independent Advisory Panel (MIAP) and stakeholders. An assessment of the fishery, including recent annual catch statistics and performance measures, is published by the Department of Fisheries within the annual "State of the Fisheries Report". This report is available to the public in hard copy, or via the Department's website.

3.5.2 Interim Management Plan

Owing to concerns from Industry and research scientists about the trend of increasing catches in recent years and the considerable latent effort that existed in the fishery, a Mackerel Fishery Interim Management Plan (IMP) is being developed. The Plan is due to be implemented in mid 2004 and will be fully operational by 1 January 2005. The IMP is expected to be in effect until the end of 2009.

The IMP, which is still being drafted, will include the following broad elements:

- division of the fishery into three management areas (Kimberley, Pilbara and Gascoyne-West Coast);
- restrictions on the number of boats able to fish in each area according to criteria specified in the IMP;
- designated fishing season for each area;
- implementation of two TACCs for each area – one for grey mackerel and one for all other mackerel species covered by the IMP – noting that this latter TACC is based on Spanish mackerel as this is the most commonly caught species (1 January 2005);
- a requirement to use VMS (1 January 2005) and to land mackerel at designated ports in each area; and
- a requirement for permit holders to complete research logbooks.

The draft Plan does not include such instruments as a Bycatch Action Plan or a Threatened Species Recovery Plan because no relevant issues have been identified for this fishery. The IMP could be amended in the future to manage such issues if they arise.

3.5.3 Objectives of The Fishery

The fishery has the following general objectives (Rogers, 2001):

- Stabilise catch levels, and if necessary cut back fishing to levels consistent with the maintenance of healthy mackerel fishing stocks.
- Implement a monitoring system that adequately enables catch and effort trends in the fishery to be properly assessed.
- Introduce a regulatory framework for license holders that encourages economic efficiency.
- Minimise management and compliance costs, as the fishery is a non-cost recovered fishery.
- Ensure the exploitation of mackerel stocks and related matters are conducted in a manner consistent with the principles of ecological sustainable development.

3.5.4 Legislation and Policies Affecting The Fishery

Fish Resources Management Regulations 1995.
Fishing Boat Licence.

3.6 RESEARCH STRATEGY

3.6.1 Current Research

In 1998, a joint WA/NT/Qld FRDC-funded research project (FRDC1998/159) commenced to determine the stock structure of Spanish mackerel across northern Australia using genetic markers, stable isotope ratios in fish otoliths and the parasitic fauna. The final report for this project will be finalised in 2004 but a summary of the main points is detailed below.

The stable $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ isotopes in the sagittal otolith carbonate of narrow-barred Spanish mackerel, *Scomberomorus commerson* were investigated as indicators of population structure across northern and western Australia. Discrete location-specific stable isotope signatures were evident. These spatially explicit stable isotopic signatures indicate that at these spatial scales the population units sampled comprise functionally distinct independent management units or separate 'stocks' for many of the purposes of fisheries management. These results were supported by analysis of the parasite fauna of these fish. Spatial heterogeneity in allozyme frequencies for ten loci and mtDNA control region sequence data indicated that distinct genetic stocks of Spanish mackerel are present in Kupang and from the east coast of Queensland. There was no direct allozyme or mtDNA evidence of genetically distinct stocks among populations sampled from Shark Bay to the Gulf of Carpentaria. However, fish collected from the Torres Strait are most likely an historical mixture of adjacent stocks whose genetic distinctiveness has been preserved by restricted gene flow over a small spatial scale. This implies that localised genetic stocks may occur elsewhere in correspondence with the otolith and parasite results that suggest mackerel are spatially confined.

In 1999, another FRDC-funded project (FRDC1999/151) commenced to determine the status of Spanish mackerel stocks in Western Australian waters. Research was completed in 2002. The study reviewed catch and effort history of the fishery, and gathered biological information on reproduction, age, growth and diet. Biomass dynamic models were developed and preliminary stock assessments were undertaken in each sector. Results from the study were used to develop the IMP and will form the basis of future stock assessments.

3.6.2 Future/Proposed Research

Mackie *et al.* (2003) suggested the following areas for further research:

- implementation of a fishery specific logbook, to improve monitoring of mackerel catch and effort levels. Logbooks will need to be validated regularly by fishery-independent observers.
- development of an age-structured model to enable more reliable examination of population dynamics and simulation of management scenarios.
- further examination of Spanish mackerel biology and ecology, (including fecundity of large females, distribution/movement of adults outside the fishing season, distribution of spawning, more rigorous validation of opaque zone formation in otoliths), to increase certainty in modelling and management decisions.
- improved estimation of mortality rates.
- examination of the stock-recruitment relationship.

In recent years, grey mackerel have been increasingly targeted by this fishery and fetch high prices on export markets. However, the distribution and biology of this species is poorly understood. Research is required to generate the biological data needed to adequately manage the harvest of this species in the future.

4.0 OUTLINE OF THE REPORTING PROCESS

4.1 SCOPE

This application is based upon the ESD report for the MF. The ESD report was generated by assessing “**the contribution of the MF to ESD**”. This assessment examined the benefits and the costs of the MF across the major components of ESD (see Table 1). In doing so, it will eventually provide a report on the performance of the fishery for each of the relevant ecological, economic, social and governance issues associated with this fishery. Given the timeframes involved, only the criteria required for the “Guidelines for the Ecologically Sustainable Management of Fisheries”, which cover mainly the environmental elements of ESD (outlined below in Table 1) were generated for this application.

Table 1 Main National ESD Reporting Framework Components.

Nb: Only those ESD components in bold* are reported in this application.

National ESD Framework – ESD COMPONENTS
Contribution to Ecological Wellbeing
Retained Species*
Non-Retained Species*
General Ecosystem*
Contribution to Human Wellbeing
Indigenous Community Issues
Community Issues
National Social and economic Issues
Ability to Achieve
Governance*
Impact of the environment on the fishery

4.2 OVERVIEW

There were four steps involved in completing the ESD report for the MF. It was based upon using the National ESD Reporting Framework, which is outlined in detail in the WA ESD policy paper (Fletcher, 2002) and in the “*How to Guide*” (Fletcher *et al.*, 2002) located on the website (www.fisheries-esd.com):

The issues that needed to be addressed for this fishery were determined through an internal workshop held for the MF. This process was facilitated by adapting the set of “Generic ESD Component Trees” into a set of trees specific to the MF.

A risk assessment/prioritisation process was completed that objectively determined, which of these identified issues was of sufficient significance to warrant specific management actions and hence a report on performance. The justifications for assigning low priority or low risk were, however, also recorded.

An assessment of the performance for each of the issues of sufficient risk to require specific management actions was completed using a standard set of report headings where operational objectives, indicators and performance measures, management responses etc were specified. An overview assessment of the fishery was completed including an action plan for activities that will need to be undertaken to enable acceptable levels of performance to continue or, where necessary, improve the performance of the fishery.

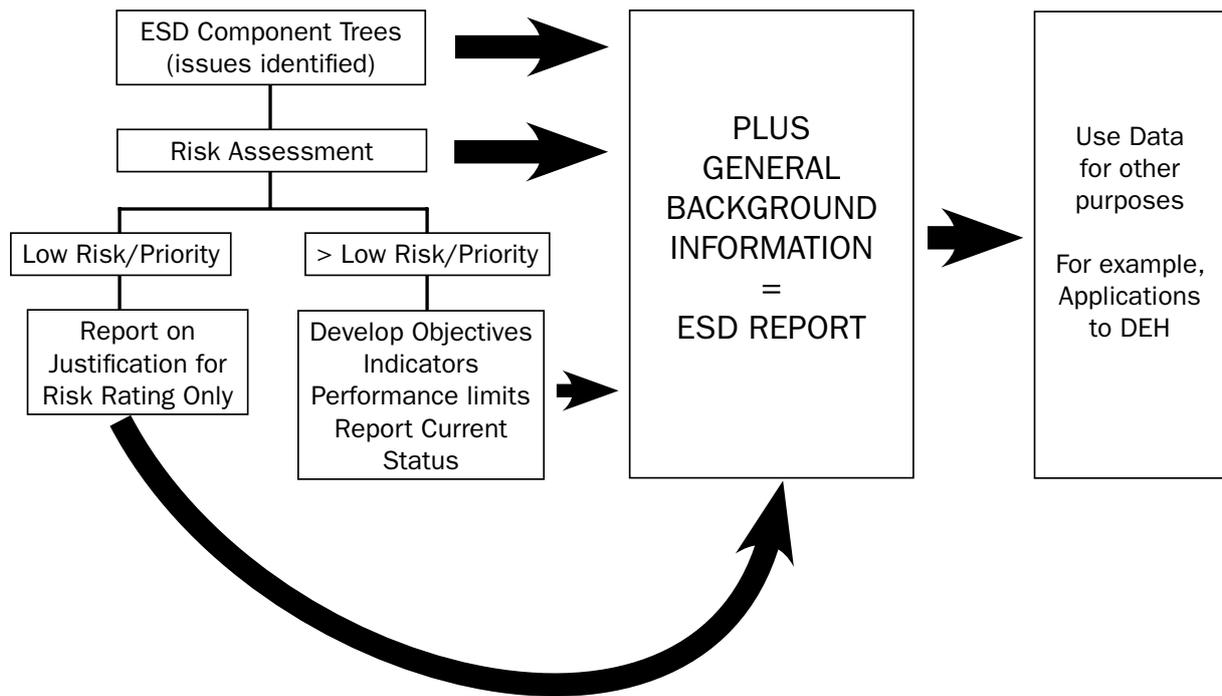


Figure 6 Summary of the ESD reporting framework processes.

4.3 ISSUE IDENTIFICATION (COMPONENT TREES)

The National ESD Reporting Framework has eight major components, which fall into three categories of the “contributions to ecological wellbeing”, “contributions to human wellbeing” and the “ability to achieve the objectives” (Table 1). Each of the major components is broken down into more specific sub-components for which ultimately operational objectives can be developed.

To maximize the consistency of the approach amongst different fisheries, common issues within each of the components were identified by the SCFA and ESD reference groups within each of the major component areas and arranged into a series of “generic” component trees (See Fletcher (2002) and the www.fisheries-esd.com web site for a full description). These generic trees were used as the starting point for identifying the issues. These trees were subsequently adapted into trees specific to the MF fishery by expanding (splitting) or contracting (removing/lumping) the number of sub-components as required (see Figure 7).

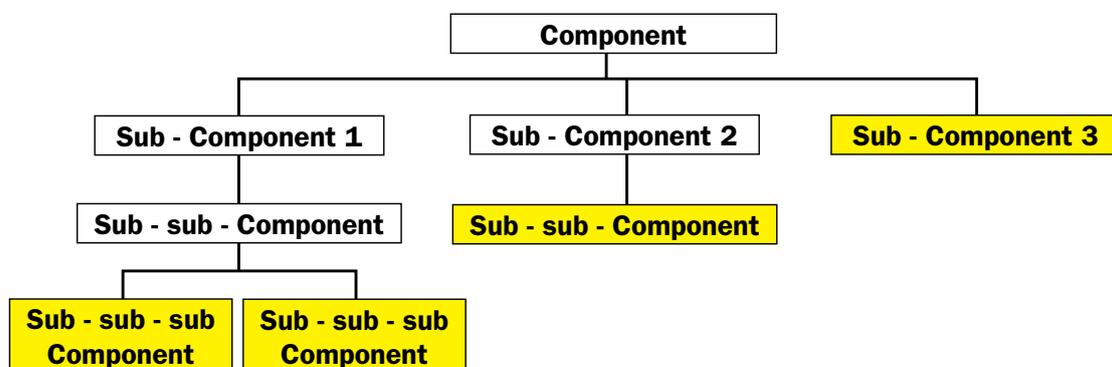


Figure 7 Example of a component tree structure.

4.4 RISK ASSESSMENT/PRIORITISATION PROCESS

After the components/issues were identified, a process to prioritise each of these needs was completed using a formal risk assessment process. The risk assessment framework that was applied at the internal workshop was consistent with the Australian Standard AS/NZS 4360:1999 Risk Management, concentrating on the risk assessment components. The general Risk Assessment process is well documented but in summary, it considers the range of potential consequences of an issue/activity and how likely those consequences are to occur. The combination of the level of consequence and the likelihood is used to produce an estimated level of risk associated with the particular hazardous event/issue in question.

An estimate of the consequence level for each issue was made by the group at this internal workshop. This level was from 0-5, with 0 being negligible and 5 being catastrophic / irreversible. This assessment was based upon the combined judgments of the participants at the workshop, who collectively had considerable expertise in the areas examined.

The level of consequence was determined at the appropriate scale for the issue. Thus for target species the consequence of the MF was based at the population not at the individual level. Obviously catching one fish is always catastrophic for the individual but not always for the population. Similarly, when assessing possible ecosystem impacts this was done at the level of the whole ecosystem or at least in terms of the entire extent of the habitat, not at the level of an individual patch or individuals of non-target species.

The likelihood of a consequence occurring was assigned to one of six levels from remote to likely. In doing so, again it was considered the likelihood of the “hazardous” event (consequence) actually occurring based upon collective wisdom, which included an understanding of the scale of impact required.

From these two figures (consequence and likelihood), the overall risk value, which is the mathematical product of the consequence and likelihood levels ($\text{Risk} = \text{Consequence} \times \text{Likelihood}$), was calculated. Finally, each issue was assigned a Risk Ranking within one of five categories: High, Moderate, Acceptable, Low and Negligible based on the risk value (see Table 2).

Table 2 Risk ranking definitions.

RISK	Rank	Likely Management Response	Reporting
Negligible	0	Nil	Short Justification Only
Low	1	None Specific	Full Justification needed
Moderate	2	Specific Management Needed	Full Performance Report
High	3	Possible increases to management activities needed	Full Performance Report
Extreme	4	Likely additional management activities needed	Full Performance Report

In general, only the issues of sufficient risk (Moderate, High & Extreme), - those that require specific management actions need to have a full performance reports completed. Nonetheless, the rationale for classifying issues as low risk or even negligible were also documented and formed part of the ESD report. This allows all stakeholders and interested parties to see why issues were accorded these ratings. This process is summarized in Figure 6 (above).

It is important to note that the Risk Assessment involves the completion of reports that contain the completed justifications for the scores generated. Thus, the scores determined within the meeting by themselves are insufficient.

4.5 COMPONENT REPORTS

Only the issues of sufficient risk or priority that require specific management actions have a full performance report completed (which form section 5 of this application). Nonetheless, the rationale for classifying issues as low risk/priority were also documented and forms part of the report so that stakeholders can see where all the identified issues have finished.

For each of the lowest level sub-components (assessed as being of sufficient risk/priority to address), a detailed assessment of performance is generated. The SCFA Working Group in conjunction with the ESD Reference Group agreed upon a set of 10 standard headings each of which need to be addressed (Table 3). Added to this list a further heading, “**Rationale for Inclusion**”, has been added. This specific heading allows the issues raised within the risk assessment process to be explicitly recorded. A full description of each of these headings is located in the WA ESD policy (Fletcher, 2002), which is available on the WA Fisheries website.

Table 3 The National ESD reporting framework headings used in this report.

1	Rationale for Inclusion
2	Operational Objective (+ justification)
3	Indicator
4	Performance Measure (+ justification)
5	Data Requirements
6	Data Availability
7	Evaluation
8	Robustness
9	Fisheries Management Response -Current -Future -Actions if Performance limit is exceeded
10	Comments and Action
11	External Drivers

The completion of these component reports was initiated in February 2003. Progress towards completing these reports was subsequently made by a variety of Departmental staff. The draft application was sent to DEH and stakeholders including industry groups for review. This final application was generated after the review process.

4.6 APPLICATION TO MEET EPBCA REQUIREMENT

The material generated by the ESD reporting process, which is contained with the risk assessment and performance reports was used to meet the requirements of the Commonwealth Environment Protection and Biodiversity Conservation Act (1999). This involved submitting an application that addressed each of the criteria of the Commonwealth guidelines for the assessment of sustainable fisheries. This information is provided in Appendix 4.

4.7 OVERVIEW TABLE

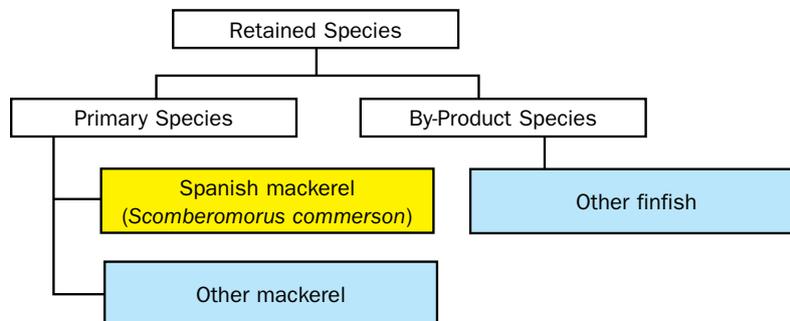
The following table provides a summary of the material present in this report.

Issue	Objective Developed	Indicator Measured	Performance Measure	Current Performance	Robustness	DEH Guidelines Covered	Actions
RETAINED SPECIES (Component Tree)							
5.1.1.1 Spanish mackerel	Yes	Annual total catch for each region of fishery.	Acceptable catch ranges based on historical records.	Acceptable	Low-Moderate	1.1 1.1.1 – 1.1.7	Full management package to be in place by 1 Jan 2005, includes better reporting of catch and effort in daily logbook.
5.1.1.2 Other mackerel	No- Low Risk	N/A	N/A	N/A	N/A	1.1.1 – 1.1.7	Also covered by new management, better reporting of catch and effort in daily logbook.
5.1.2.1 Finfish and sharks	No- Negligible Risk	N/A	N/A	N/A	N/A	1.1.1 – 1.1.7	Catches in new daily logbook will be monitored annually.
NON-RETAINED SPECIES (Component Tree)							
5.2.1 Unmarketable species	No- Negligible Risk	N/A	N/A	N/A	N/A	2.1 and 2.2 2.2.2 – 2.2.6	Catches in new daily logbook will be monitored annually.
5.2.2 Nonlicenced species	No- Negligible Risk	N/A	N/A	N/A	N/A	2.2.2 – 2.2.6	Interactions reported in new daily logbook, will be monitored annually.

Issue	Objective Developed	Indicator Measured	Performance Measure	Current Performance	Robustness	DEH Guidelines Covered	Actions
GENERAL ENVIRONMENT (Component Tree)						2.3	
5.3.1.1 Bait removal	No-Negligible Risk	N/A	N/A	N/A	N/A	2.3.1 – 2.3.5	Permits reviewed under new IMP.
5.3.1.2 Benthos	No-Negligible Risk	N/A	N/A	N/A	N/A	2.3.1 – 2.3.5	Review Risk at Next Major Assessment.
5.3.1.3 Trophic interactions	No-Negligible Risk	N/A	N/A	N/A	N/A	2.3.1 – 2.3.5	Investigate the development of research to identify any detectable changes in the structure of coastal fish communities in this region over the past 40 years.
5.3.2.1 Translocation by Vessel Hulls	No-Low Risk	N/A	N/A	N/A	N/A	2.3.1 – 2.3.5	Review Risk at Next Major Assessment.
5.3.2.2 Discarding/ Provisioning	No-Negligible Risk	N/A	N/A	N/A	N/A	2.3.1 – 2.3.5	Review Risk at Next Major Assessment.
5.3.2.3 Translocation by Bait	No-Negligible Risk	N/A	N/A	N/A	N/A	2.3.1 – 2.3.5	Review Risk at Next Major Assessment.

5.0 PERFORMANCE REPORTS

5.1 RETAINED SPECIES COMPONENT TREE FOR RETAINED SPECIES OF THE MACKEREL FISHERY



Yellow boxes indicate that the issue was considered high enough risk to warrant having a full report on performance. Blue boxes indicate the issue was rated as a low risk and no specific management is required – only the justification is presented.

5.1.1 Primary Species

5.1.1.1 Spanish mackerel

Rationale for Inclusion

Spanish mackerel (*Scomberomorus commerson*) is the main target species for this fishery.

ERA Risk Rating: Impact on breeding population (C2 L4 MODERATE)

The troll fishery is the main fishing sector in Western Australia that catches Spanish mackerel. Catch levels have increased in recent years and are currently high relative to historical levels. Reliable estimates of stock biomass are not available in all sectors, but available data suggest that the stock is fully fished. There is evidence of recruitment variability, but the stock-recruitment relationship is unknown. Spanish mackerel are moderately resilient to overfishing because they are relatively fast growing and mature at a young age. However, they aggregate to feed and spawn and so catch rates can appear stable when stock level may be declining.

Therefore, a ‘moderate’ impact by the fishery was considered ‘possible’. This resulted in a risk rating of MODERATE.

Operational Objective

To maintain the spawning stock of Spanish mackerel at or above a level that minimises the risk of recruitment overfishing.

Justification:

An operational objective that maintains the potential for recruitment to continue at historical levels is consistent with the statutory obligation under section 3 of the FRMA “to conserve, develop and share fish resources of the State for the benefit of present and future generations.”

Indicator

- 1) Total annual catch level.
- 2) Regional annual catch level

Catch is considered to be a more reliable index of abundance than catch rate because of current difficulties in measuring effort associated with the fishing activities for Spanish mackerel. Improved reporting of catch and effort data will coincide with the implementation of the IMP in 2004 and the move to daily logbooks. Indicators other than catch level are likely to be developed as a result.

Performance Measure

- 1) Acceptable total catch range of 246–410 tonnes.
- 2) Acceptable regional catch ranges:
 - Kimberley = 110-205 t,
 - Pilbara = 80-126 t,
 - Gascoyne/West Coast = 56 – 79t.

Justification:

These acceptable catch ranges are based on historic catch trends and take into account previous fishing pressure. The ranges are broad due to incomplete knowledge of the status of mackerel stocks and to allow for fluctuations in catch level due to natural variations in recruitment. The upper limit of the catch ranges is the same as the Total Allowable Commercial Catches for 'Other' mackerel species within each sector, based on the fact that Spanish mackerel is expected to comprise >95% of this catch (see Section 5.4.1.2).

In the Kimberley sector the long-term average catch is approximately 100 t, which includes years of relatively low effort. Hence, catches <110 t (the lower bound of the acceptable catch range) at current levels of effort may indicate overfishing. In the Pilbara sector the lower acceptable limit of 80 t is slightly below the long-term average (94 t) and is indicative of catch levels immediately following periods of high catches.

The acceptable catch range in the Gascoyne/west coast (combined) sector is supported by recent estimates of regional biomass (Mackie *et al.* 2003). Since 1994, estimated biomass in the Gascoyne/west coast sector has been relatively stable at around 850 t, and annual commercial catches in the sector have been equal to 9 - 11% of the total biomass. In 2001, the combined commercial and recreational catch was approximately 20% of the estimated biomass (915 t) in the sector. Although modelling of biomass has not been successful in other sectors, higher catch rates suggest that the carrying capacities of the Kimberley and Pilbara sectors are likely to be higher than the Gascoyne/west coast sector.

A limit of 20-30% of the fishable biomass has been recommended as a safe level of fishing for Spanish mackerel (Buckworth and Hall, 1993). Hence, the catch range in each sector is likely to represent a safe level of harvest.

An acceptable total catch range of 246-410 t is similar to the current catch level in the Northern Territory (NT), where 300 t of Spanish mackerel is caught per year. This is estimated to be approximately 10% of the NT stock. In the NT, a catch limit of <90% of the estimated sustainable yield (450 t) has been chosen as the performance limit for the Spanish mackerel fishery. These estimates and limits are based on the outcomes of several stock assessment workshops (Walters and Buckworth, 1997; Buckworth and Clarke, 2001) and have been accepted by Environment Australia for this fisheries' assessment under the EPBC Act (O'Grady, 2002).

Given that the distribution of Spanish mackerel in Western Australia is more than twice the area of the NT fishery, and the Western Australian catch level is <20% of the estimated exploitable biomass (Mackie *et al.* 2002), the Western Australian performance limit is likely to be very precautionary, particularly when combined with the individual limits present within each sector.

Data Requirement for Indicator (and Availability)

Data Required	Availability
Catch and effort of Spanish mackerel by the commercial troll fishery.	Summaries of monthly catch and effort are reported by all licenced commercial fishers. Data are reported by location and method. These data are available since 1979. After implementation of the IMP in 2004, specific logbooks will be issued to mackerel fishers and will yield more detailed catch and effort data.
Catch and effort of Spanish mackerel by the recreational and charter fisheries.	Charter operators submit a daily/monthly return detailing catch and effort by trip. Data available since 2002. Surveys of recreational catches in each sector are periodically undertaken by the Department of Fisheries.

Evaluation

Summary: The total breeding stock level for Spanish mackerel is considered adequate. Stock size is not measured directly but the catch, which mostly comprises mature fish, is a reflection of the size of the breeding stock. There are no indications from catch data of insufficient breeding stock in any sector.

Landings: Since 1990, when the catch was 164 t, the total annual catch of Spanish mackerel in WA has gradually been increasing with 468 t caught in 2002 (Fig. 8). From 1995 to 2001, the total annual catch averaged 351 t. Fluctuations in catch levels among years are likely to partly reflect natural variations in recruitment. High catches in the Kimberley sector in 2002 are thought to reflect strong recruitment.

Fishing effort: Fishing effort is measured by the number of fishing days. Most Spanish mackerel are taken by trolling. The effectiveness of fishing varies with the number of hooks trolled, fisher experience and number of hours fished per day by each vessel. Effectiveness also varies among sectors due to differences in gear and vessel type, and the seasonal availability of mackerel. Total reported fishing effort for Spanish mackerel in Western Australia for 2003 was 3056 days (=646 (Kimberley) + 703 (Pilbara) + 736 (Gascoyne) + 971 (West Coast)). However, this is likely to be an overestimate of the actual time spent fishing for mackerel and a poor indication of relative effort among sectors given the differing levels of targeting amongst regions.

Catch rate: Many fishers catch Spanish mackerel opportunistically and so effort reported to catch Spanish mackerel is often combined with effort expended to catch other species, i.e. fishers may use several fishing methods and target several species in a single day. Therefore, effort exclusively associated with mackerel catches is difficult to determine. To overcome this problem, the catch rate of a small number of vessels known to primarily target Spanish mackerel is used to estimate catch rate of all vessels. Catch rates in the Kimberley and Pilbara sectors have been gradually rising since 1996 (Fig. 7). In 2003 catch rates were estimated to be 238 and 190 kg/d in the Pilbara and Kimberley sectors, respectively. Catch rates in the Gascoyne/west coast sectors (combined) are considerably lower than in other sectors and were estimated to be approximately 86 kg/d in 2003.

Recreational component: Recreational fishing surveys in the West Coast (1996/97), Gascoyne (1998/99) and Pilbara/Kimberley (1999/00) sectors indicated that the recreational catch of mackerel was 45, 45 and 16%, respectively, of the total catch per sector. Mackerel catches by charter boats occur

mainly in the Pilbara and Gascoyne sectors but in total are relatively low. A total of 17.9 t of Spanish mackerel was reported by charter boats in Western Australia in 2002.

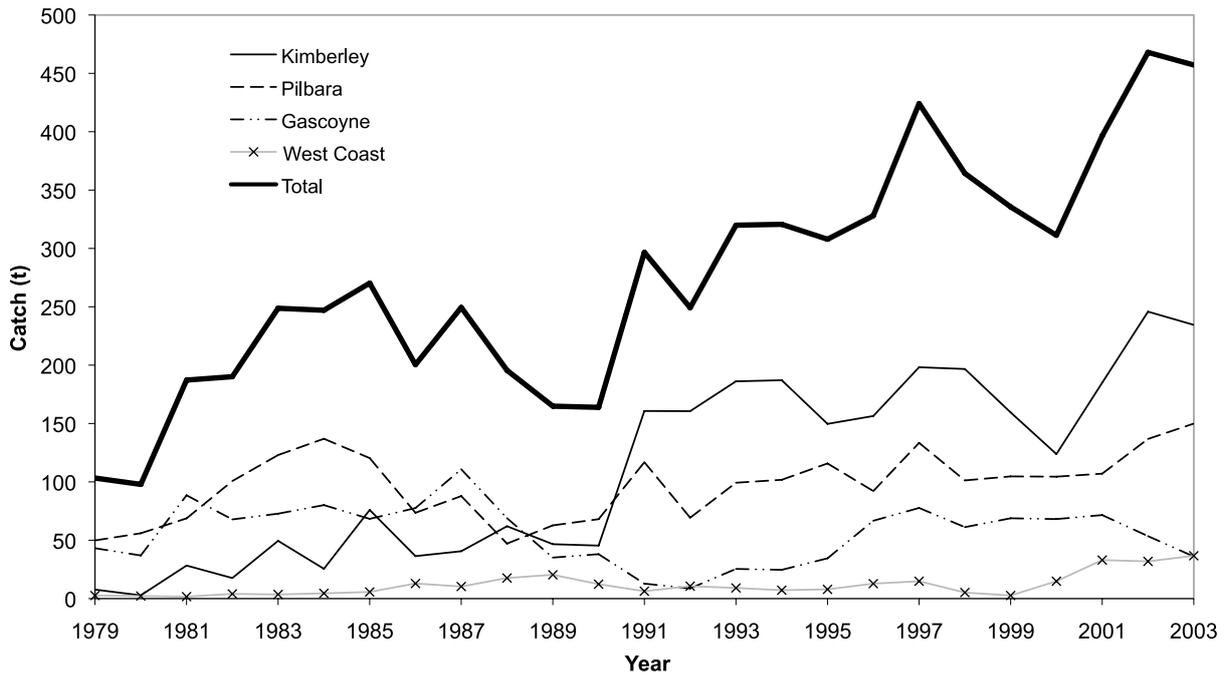


Figure 8 Annual commercial catch of Spanish mackerel in each sector of the Western Australian fishery, 1979-2001.

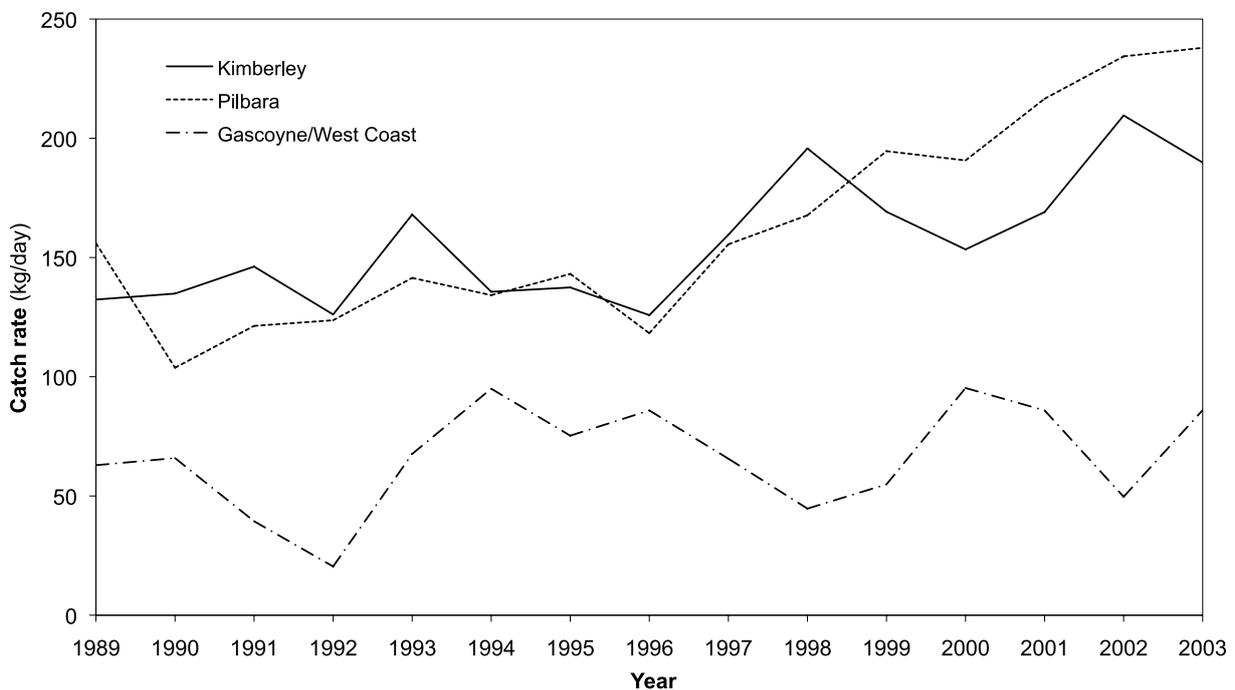


Figure 9 Average estimated catch per unit effort for vessels specialising in catching Spanish mackerel, 1989-2001. (effort data from only those vessels known to target the species).

Stock assessment: An assessment of Western Australian Spanish mackerel stocks has been made using catch and effort data, biological information, and biomass dynamics and yield-per recruit modeling

(Mackie *et al.* 2003). Biological attributes of fast growth and young age at sexual maturity (<2 years) indicate resilience to fishing pressure by Spanish mackerel. However, because individuals also become susceptible to fishing at an early age, are likely to be more site-attached than previously thought, and form aggregations that can be targeted by fishers, the species should still be managed in a conservative manner. Aggregating behaviour also causes bias in the catch rate data used as an index of abundance, further necessitating a cautious approach.

Biomass dynamics modeling was only possible for the Gascoyne/west coast (combined) sector, as there was insufficient contrast in the catch and effort data for the other sectors. The carrying capacity for Spanish mackerel in the Gascoyne/west coast sector was estimated to be 1115 t (95% confidence interval = 757 – 2116 t). Annual commercial catches in the sector have therefore varied between 9 and 11% of the total biomass since 1994. In 2001, the combined commercial and recreational catch was approximately 20% of the estimated biomass (915 t) in the sector. The biomass of mackerel in the other sectors is believed to be higher, as suggested by the higher catches in combination with higher catch rates.

Spanish mackerel rapidly attains sexual maturity and recruit to the fishery at a young age. Size at 50% maturity is 706 and 898 mm total length, for males and females, respectively. The minimum legal size is 900 mm total length. Age at 50% maturity is 0.8 and 1.4 y, for males and females, respectively. The age range of fish in catches is 0.5 to 22 y, but individuals older than 15 y are rare. Fish aged 1-4 y comprise approximately 70% of catches and fish aged 1-7 y comprise approximately 90% of catches. Less than 13% of the total catch is estimated to be immature (M. Mackie unpubl. data). Hence, the exploitable stock is likely to comprise a significant component of the breeding stock. Current rates of exploitation in Western Australia appear to be allowing sufficient survival of the breeding stock to maintain recruitment levels.

Yield-per-recruit analyses indicate that the appropriate fishing mortality for Spanish mackerel ($F_{0.2}$ to maximise YPR) is approximately 0.2 in the Pilbara and Gascoyne sectors, and 0.3 in the Kimberley sector, suggesting the need for conservative management in the Pilbara and Gascoyne sectors. Current fishing mortality is likely to be similar to or slightly above these target levels. The information available to date therefore indicates that stocks of Spanish mackerel in Western Australia are healthy.

Robustness : Low - Moderate

The acceptable catch ranges used to assess the fishery are based on historically proven levels of sustainable harvest and so are moderately robust indicators. Catch data are reported by commercial fishers and are considered fairly reliable. Effort data are also reported but are currently considered to be a poor indicator of real effort. After implementation of the IMP, fishery specific logbooks will improve the quality of reported effort data will facilitate more robust estimates of catch rate. In general, Spanish mackerel are likely to be moderately resilient to overfishing because they grow rapidly and mature at a young age. This level of robustness is appropriate given the low risk to this stock of recruitment overfishing, the biological characteristics of the species and the current precautionary management arrangements.

Fisheries Management Response

Current: The commercial trolling fishery has been in operation for decades and has reported mackerel catches since the 1970s, but is not formally managed. The fishery is currently open to all licenced Western Australian commercial fishers. In 2003, 75 boats reported catches of Spanish mackerel, but only about 12 boats specifically targeted this species. Of these, 2 boat in the Pilbara targeted mackerel all year. The other boats targeted mackerel for approximately six months and either targeted other species for the remainder of the year or did not fish.

Management instruments relevant to the fishery include the Fish Resources Management Regulations 1995 and the Fishing Boat Licence. There is a minimum legal size of 900 mm total length (TL) for Spanish mackerel and wahoo, 750 mm TL for grey mackerel, and 500 mm TL for spotted, school and shark mackerel. There are also recreational bag limits of 2 (wahoo, Spanish and grey mackerel) and 4 fish per person (spotted, school and shark mackerel). There are limits to the use of dories in the Kimberley sector only.

Future: In 2004, new management arrangements will be introduced under the provisions of the Mackerel Fishery MP. These management changes will be fully operational by 1 January 2005. Under the IMP, the fishery will ultimately be managed by regional quotas, and the fishery will be restricted to a designated season. Compulsory fisher logbooks and a vessel monitoring systems (VMS) will be implemented and provide additional catch and effort data. A recently completed FRDC-funded project (Mackie *et al.* 2003) provided biological data and developed regional biomass models. New data from logbooks will provide input to these models and increase the reliability of assessments.

Actions if Performance Limit is Exceeded: The following options will be available to the Department of Fisheries if the catch level moves outside the acceptable range:

1. Investigate why the acceptable catch level has not been met. Evaluate if there has been a shift in the targeting of mackerel through market forces or other non-biological factors that could explain the variation. Evaluate if there is evidence of a change in recruitment. If variation is due to an acceptable non-stock related explanation, then no action will be taken.
2. If indicators suggest a significant decrease in available stock, options under the IMP for protecting breeding stock will include:
 - reduction of regional quota allocations for the following season.
 - implementation of area closures, e.g. reefs known to be spawning sites.
 - implementation of additional temporal closures.

The ability to implement these options is provided for within the Fish Resources Management Act 1994 and Regulations and the Mackerel Fishery IMP (after January 2005).

Comments and Actions

The mackerel fishery is currently not formally managed. However, the Mackerel Fishery IMP is due to be implemented in mid 2004, with the full management package to be in place by 1 January 2005.

External Drivers

Domestic and international market forces have the potential to influence catch and effort levels in the fishery. For example, the timing of the Queensland mackerel fishing season partly overlaps with the Western Australian fishing season, placing the two fisheries in competition for several months. Also, product from the West Coast sector is exported to Taiwan. The development of new markets and the expansion of the recreational or charter boat fisheries in the future could increase pressure on stocks.

5.1.1.2 Other mackerel

Rationale for Inclusion

Several mackerel species, other than Spanish mackerel, are caught in minor quantities in the fishery.

ERA Risk Rating: Impact on breeding stocks (C1 L4 LOW)

Mackerel catches have been reported by species since 1999. However, since 1999 there has still been a significant portion of the mackerel catch not identified by species (Table 4). Catches reported in the CAES database as “other mackerel” include numerous species and possibly include some Spanish mackerel catches. In 2000, the total Western Australian catch of all mackerel, excluding Spanish mackerel, was 76.4 t (62.9 t by trolling). In 2001, the total catch was 57.1 t (35.5 t by trolling).

The vast majority (>80%) of other mackerel caught by the fishery are grey mackerel (*Scomberomorus semifasciatus*). In 2001, grey mackerel comprised approximately 3% of the total trolling fishery catch. In 2000 and 2001, a total of 21.6 t and 14.7 t, respectively, of grey mackerel were reported by commercial fishers (Table 4). Grey mackerel catches are distributed across the Kimberley, Pilbara and Gascoyne sectors, and so individual catches within each sector are relatively low (i.e. 2-10 t per sector per year). Grey mackerel are generally targeted by the same fishers that target Spanish mackerel, although grey mackerel are often caught by jigging rather than trolling.

The remainder of the mackerel catch includes school mackerel (*Scomberomorus queenslandicus*), spotted mackerel (*S. munroi*) and shark mackerel (*Grammatorcynus bicarinatus*). Catches of these species each comprised <0.2% of the total trolling fishery catch in 2001. Relatively minor quantities of each species are taken by commercial fishers in Western Australia. In 2001, approximately 786, 333 and 1 kg of spotted, shark and school mackerel, respectively, were caught by trolling, which represented 75, 32 and 50%, respectively, of the total Western Australian catch of each species (Table 4).

No formal assessments of grey, spotted, shark or school mackerel stocks have been conducted in Western Australia. It was considered ‘**possible**’ that the fishery could have a detectable impact on these stocks but, given the low catch levels of each species, that impact was likely to be only ‘**minor**’. This resulted in a risk rating of **LOW**. Also, each of these species is distributed widely across northern Australia and so the area of the fishery covers a relatively small proportion of the total distribution. Furthermore, mackerel (Scombridae) are characterised by fast growth, early maturity and moderate/high fecundity, which make them resilient to overfishing.

Table 4 Recent annual catches of species caught by trolling (as recorded in CAES database), percentage contribution of each species to total trolling catch in 2001, and percentage contribution of species catches by trolling to total Western Australian catch of each species. (contributions of individual species to catches reported as “other mackerel” in CAES database have been estimated from proportions of known catches and added to relevant species catches).

Catch by trolling (live weight, kg)		1995	1996	1997	1998	1999	2000	2001	% (by weight) of total troll catch, 2001.	Troll catch as % of total WA catch of species, 2001.
Common name Species	main troll catches *									
Spanish mackerel <i>Scomberomorus commerson</i>	K, P, G	314665	363133	477742	376269	362910	326888	381019	93.381	88.71
Grey mackerel, <i>S.semifasciatus</i>	K, P, G	1971	3012	4447	2240	2671	21162	12779	3.132	83.59
Tuna, other Scombridae	all regions	2119	2267	2601	4484	3480	2247	2433	0.596	17.85
Bonito <i>Sarda australis</i>	WC	72	3	38	1895	4860	156	1680	0.412	84.25

Catch by trolling (live weight, kg)		1995	1996	1997	1998	1999	2000	2001	% (by weight) of total troll catch, 2001.	Troll catch as % of total WA catch of species, 2001.
Common name Species	main troll catches *									
Cobia <i>Rachycentron canadum</i>	P, G	187	160	522	1151	1849	3885	409	0.100	1.46
Yellowfin tuna <i>Thunnus albacares</i>	G, WC	457	1187	494	1143	910	1447	672	0.165	19.49
Skipjack tuna <i>Katsuwonus pelamis</i>	P, G	181	519	247	1554	326	223	359	0.088	26.46
Northern bluefin tuna <i>Thunnus tonggol</i>	G	281	174	175	88	284	1026	250	0.061	2.41
Golden trevally <i>Gnathanodon speciosus</i>	K, P	530	205	320	39	34	591	181	0.044	0.92
Barracuda, pike Sphyræidae	P, WC	56	985	27	197	567	974	67	0.016	2.54
Queenfish <i>Scomberoides commersonianus</i>	K, P	142	452	288	115	26	25	19	0.005	1.24
Spotted mackerel <i>Scomberomorus munroi</i>	K, P, WC	67	103	151	76	91	370	786	0.193	74.73
Coral trout <i>Plectropomus maculatus</i>	P	700	13		130		38	27	0.007	0.12
Shark mackerel <i>Grammatorcynus bicarinatus</i>	P, G only	49	74	109	55	66	502	333	0.082	32.45
Mackerel tuna <i>Euthynnus affinis</i>	P, G		7		273	35	161	99	0.024	46.92
Dolphinfish <i>Coryphaena hippurus</i>	G, WC					90	186	101	0.025	16.40
Samson fish <i>Seriola hippos</i>	G, WC	76				143		49	0.012	0.05
Wahoo <i>Acanthocybium solandri</i>	P							190	0.047	80.51
Yellowtail kingfish, <i>Seriola lalandi</i>	WC only						28	12	0.003	2.84
School mackerel <i>S. queenslandicus</i>	WC only	1	2	3	1	2	21	1	0.000	50.42
Scalefish, other	K, P, G	7180	1035	1021	705	1856	19	110	0.027	-
Sharks	K, P	4169	9045	7540	1180	6906	9068	3763	0.922	-

*K - Kimberley, P - Pilbara, G - Gascoyne, WC - West coast.

5.1.2 Byproduct Species

5.1.2.1 Other Finfish and Sharks

Rationale for Inclusion:

A variety of finfish species, other than mackerel, and sharks are caught and retained as byproduct in the troll fishery.

ERA Risk Rating: Impact on breeding stocks (C0 L6 LOW)

Trolling is a highly specific fishing method, and so the number of species caught is low and the catches of byproduct species that are taken whilst trolling for mackerel are minor (Table 4). In 2001, the total non-mackerel finfish catch by trolling was 9.3 t and the total shark catch by trolling was 3.8 t (Table 4).

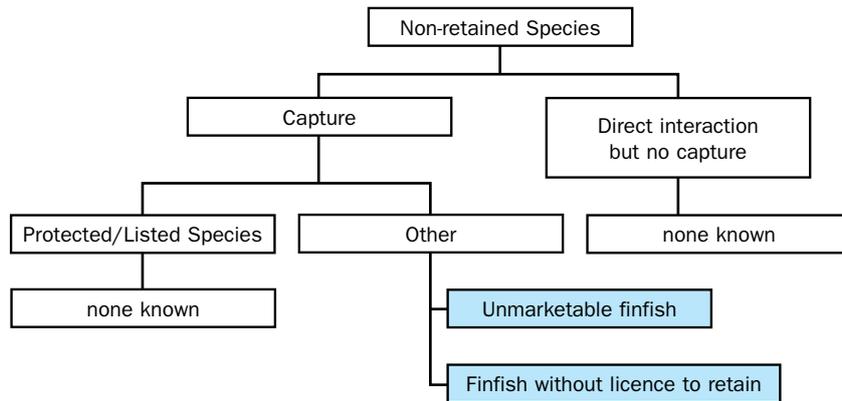
Non-mackerel byproduct species taken by the fishery include cobia (*Rachycentron canadum*), bonito (*Sarda orientalis*), blue- and yellowfin tuna (*Thunnus tonggol* and *T. albacares*), skipjack tuna (*Katsuwonus pelamis*), dolphinfish (*Coryphaena hippurus*), smaller sharks, various species of trevally and the occasional reef fish such as spangled emperor and coral trout. Catches of individual species typically contribute <0.5% of the total trolling catch per year. In 2001, catches by trolling of individual byproduct species were each <1 t except for the catch of bonito, which was 1.7 t (Table 4).

In Western Australia, >80% of bonito and cobia and almost 50% of mackerel tuna are caught by the troll fishery. The minor catch levels of the troll fishery are unlikely to impact significantly on the stocks of these species, which have distributions that greatly exceed the range of the fishery. Cobia and mackerel tuna are distributed widely throughout northern Australia and bonito occur in Western Australia southwards of Shark Bay (Allen, 1997).

Other byproduct species, including sharks and tunas, are retained in greater quantities by other fisheries, which are responsible for the management of these species. As a consequence, the assessment and management of these byproduct species will be dealt with elsewhere, in the environmental assessment of the relevant fishery. The minor catches of these species taken by the mackerel fishery and catches by all other sectors (e.g. recreational) will be included in these assessments.

Given the minor quantities of byproduct finfish and shark species caught by the troll fishery, it was considered 'likely' that the fishery has a 'negligible' impact on stocks of byproduct species, resulting in a risk rating of **NEGLIGIBLE**.

5.2 NON-RETAINED SPECIES COMPONENT TREE FOR THE NON-RETAINED SPECIES



Blue boxes indicate the issue was rated as a low risk and no specific management is required – only the justification is presented.

5.2.1 Unmarketable Species

Rationale for Inclusion:

A small number of finfish species are caught by the troll fishery and discarded because they are of low value.

ERA Risk Rating: Impact on breeding stocks (C0 L6 NEGLIGIBLE)

Some finfish species including queenfish, pike, tuna and shark are occasionally caught and discarded because they are unmarketable or of relatively low value (M. Mackie, *pers. comm.*). However, trolling is a highly specific fishing method and so the number of species caught is low and the catches of non-target species that are taken whilst trolling for mackerel are minor (Table 4). Also, a high proportion of the above species are expected to survive capture and release by the fishery. Consequently, it was considered ‘likely’ that the fishery has a ‘negligible’ impact on stocks of discarded species, resulting in a risk rating of NEGLIGIBLE.

5.2.2 Species that Mackerel Fishers are Not Licenced to Retain

Rationale for Inclusion:

A small number of finfish species are caught by the troll fishery and discarded because fishers do not possess a license to retain them.

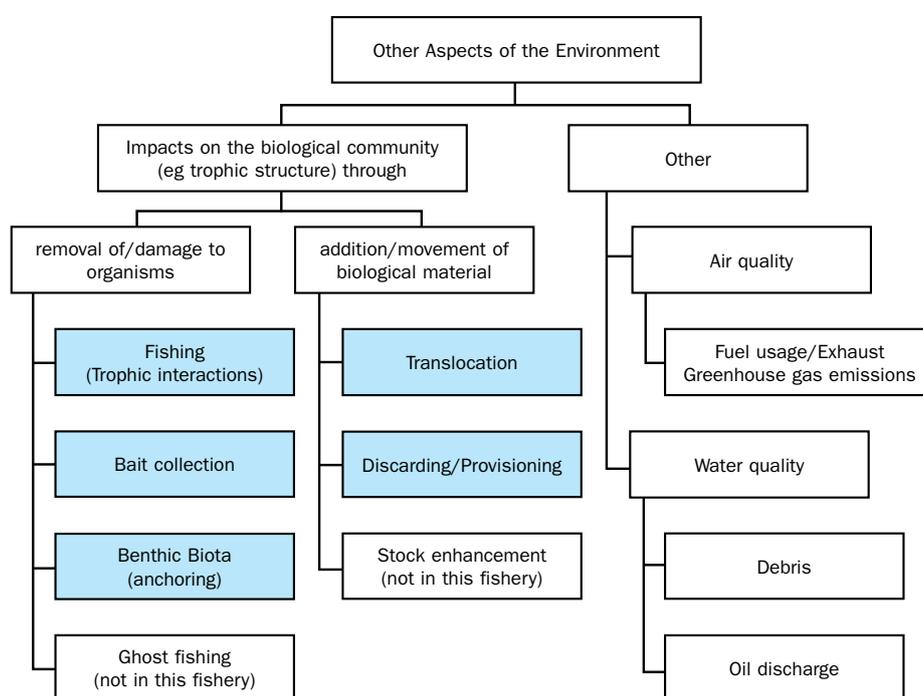
ERA Risk Rating: Impact on breeding stocks (C0 L6 NEGLIGIBLE)

Some fish species are occasionally caught and discarded because fishers are not licenced to retain them. These species may include tuna, billfish, sharks and demersal reef fish in the Pilbara and Kimberley sectors (M. Mackie *pers. comm.*). Such species are under formal management arrangements in other state or Commonwealth fisheries and may only be retained by fishers licenced in the relevant fishery. A small allowable quantity of bycatch of some species may be retained by mackerel fishers. Trolling is a highly specific fishing method and so the number of species caught is low and the catches of non-

target species that are taken whilst trolling for mackerel are minor. Also, a high proportion of the above species are expected to survive capture and release by the fishery. Consequently, it was considered **‘likely’** that the fishery has a **‘negligible’** impact on stocks of these species, resulting in a risk rating of **NEGLIGIBLE**.

These non-retained fish are targeted by other managed fisheries (e.g. Northern Shark Fishery), which are responsible for the management of these species. As a consequence the assessment and management of these non-retained species will be dealt with in the environmental assessment of the relevant fishery. The catches of these species taken by the mackerel fishery and all other sectors (e.g. recreational) will be included in these assessments.

5.3 GENERAL ENVIRONMENT COMPONENT TREE FOR THE GENERAL ENVIRONMENT



Blue boxes indicate the issue was rated as a low risk and no specific management is required – only the justification is presented.

5.3.1 Impacts From Removal of/Damage to Organisms

5.3.1.1 Bait Collection

Rationale for Inclusion:

Some mackerel fishers catch their own bait for use in the troll fishery.

ERA Risk Rating: Impact on breeding stocks of bait fish (C0 L6 NEGLIGIBLE)

In most sectors, mackerel fishers purchased bait and do not catch their own bait. Kimberley fishers mainly purchase garfish, while Gascoyne/West Coast fishers mainly purchase mullet for use as troll bait. Some bait is purchased by Pilbara fishers.

The practice of catching bait for use in the troll fishery is largely restricted to the Pilbara and Gascoyne/ west coast sectors, where gill nets are used to catch small, coastal fish including mullet, garfish and whiting. There are at least 3 major mackerel fishers who catch their own bait, although only 2 are known to do so on a regular basis. These fishers do not currently report monthly catches of bait and so quantities taken are not known. It is estimated that <1 t and <0.5 t of bait are caught in the Pilbara and Gascoyne/West Coast sectors, respectively (M. Mackie *pers. comm.*). Total quantities of bait caught are likely to be small relative to the stock size of each *bait* species. Therefore, it was considered ‘**likely**’ that the fishery has a ‘**negligible**’ impact on the stocks of bait species, resulting in a risk rating of **NEGLIGIBLE**.

Baitfish used by mackerel fishers, whether purchased or self-caught, is caught and used within the same sector.

The collection of bait by mackerel fishers is currently being reviewed in conjunction with implementation of the IMP. It is anticipated that any bait collection permits that are issued under the IMP will be restricted to those fishers who can demonstrate a significant history of bait collection in the fishery. The conditions of the permit will include a requirement to report all catches of bait in logbooks.

5.3.1.2 Benthic Biota

Rationale for Inclusion:

Vessels within the fishery occasionally anchor while at sea.

ERA Risk Rating: Impact on the environment (CO L6 NEGLIGIBLE)

Anchoring of vessels is largely restricted to the Pilbara and Kimberley sectors. The duration of fishing trips is several days in these sectors and fishers will anchor overnight whilst at sea. Vessels operating in the Gascoyne and West Coast sectors undertake shorter trips and generally do not anchor. Anchoring occurs in shallow, sheltered locations over sand habitats. Vessels do not anchor in precisely the same location each time and so the impact on the benthos is widely spread across the general area. Shallow sand habitats are naturally dynamic due to environmental influences, and so the infauna are adapted to be resilient to occasional physical disturbances such as anchoring. Therefore, it was considered that the impact of the fishery on the benthos was ‘**likely**’ to be ‘**negligible**’, resulting in a risk rating of **NEGLIGIBLE**.

5.3.1.3 Trophic Interactions

Rationale for Inclusion:

The assessment of potential indirect ecosystem impacts that could result from the removal of target species by a fishery should always be assessed. All species caught by the method of trolling are fast swimming, pelagic carnivores and therefore are similar in their trophic functions. There is no evidence that any of these species play a ‘keystone’ role in the ecosystem. It is therefore appropriate to consider the impact of total removals by the fishery.

ERA Risk Rating: Impact on the environment (CO L6 NEGLIGIBLE)

Mackerel are generalist carnivores and consume a wide range of fish and invertebrates from pelagic and demersal habitats (Mackie *et al.* 2003). Therefore, the impact of any reduction in mackerel abundance would be spread across many prey species. Also, mackerel are just one of many medium sized carnivore

species in the northern waters of WA, and so any reduction in mackerel abundance would have little impact on the total biomass of carnivores in each sector. Therefore, it was considered that the trophic impact of total removals by the fishery was ‘likely’ to be ‘negligible’, resulting in a risk rating of **NEGLIGIBLE**.

Tropical and sub-tropical waters, including those of WA, are characterised by high species diversity. In a review of scientific studies on the effects of fishing on marine ecosystems, Jennings and Kaiser (1998) concluded that “where the functional and species diversity of fishes is relatively high, the indirect effects of fishing on the abundance of unfished prey species appears to be minor”.

Although the trophic impact of this fishery was rated as **NEGLIGIBLE**, the Department of Fisheries recognises that an assessment of trophic impacts by fisheries at a regional level, rather than at the individual fishery level, would be beneficial. Consequently, the Department will investigate the development of research to identify any detectable changes in the structure of coastal fish communities over the last 40 years.

5.3.2 Addition/Movement of Biological Material

5.3.2.1 Translocation of Organisms

Rationale for Inclusion:

Some vessels used in the fishery travel between sectors and could potentially be a vector for exotic species and diseases.

ERA Risk Rating: Impact on the environment (C3 L2 LOW)

The hulls of vessels moving between sectors could provide an opportunity for translocation of organisms. However, hulls are regularly anti-fouled. Also, most vessels in the fishery operate in only one sector and do not travel outside that sector. Two vessels travel from Darwin, where they are based, to fish in the Kimberley sector. Another vessel that operates in the Kimberley occasionally travels to Perth for maintenance. Vessels in the fishery do not contain water ballast.

All bait used in the troll fishery, either collected by mackerel fishers or purchased, is caught and used within same sector (M. Mackie pers. comm.).

The Leeuwin current flows along the length of the Western Australian coastline, transporting biological material and resulting in a high level of biological connectivity between sectors. Therefore, vessels in the fishery are unlikely to translocate organisms beyond the range of dispersal that would occur through natural processes. Therefore, although the impact is potentially ‘severe’, the likelihood of translocation of organisms by the fishery is quite low (‘rare’), resulting in a risk rating of **LOW**.

Under the new IMP, vessels will be zoned, which will impose restrictions on the movement of vessels and further reduce the potential for translocation of organisms between sectors.

5.3.2.2 Discarding/Provisioning

Rationale for Inclusion:

The discarding of fish, either as processed waste, as bycatch or as unwanted bait, by the fishery results in a food source that would not normally be available to other organisms.

ERA Risk Rating: Impact on the environment (CO L6 NEGLIGIBLE)

The majority of biological material discarded by the fishery is processed fish waste. This tends to sink after being discarded, and could therefore provide an additional food source for pelagic and benthic communities. Discards occur over a wide area. Also, discards are likely to disperse as they sink in the water column due to currents, and so the impact of discarding will be diffuse. The total quantity of biological material discarded by the fishery is low, relatively to the biomass of available food sources naturally available to carnivores and scavengers in each sector. Therefore it was considered that the impact of discarding of biological material by the fishery was ‘**likely**’ to be undetectable (‘**negligible**’) against natural variations, resulting in a risk rating of **NEGLIGIBLE**.

In the Kimberley sector, mackerel are filleted at sea and frames are discarded. A frame is equivalent to approximately one third of the weight of a whole fish. Using this relationship, the weight of processed mackerel waste discarded in the Kimberley sector in 2003 was 78 t. In the Pilbara sector, mackerel are trunked at sea and the heads discarded (equivalent to about 10% of the total body weight). Therefore, approximately 15 t of processed mackerel waste was discarded in this sector in 2003. In the Gascoyne/ west coast sector, a few mackerel are trunked at sea, but the majority of the catch is retained whole for export and so discards of processed fish waste are minimal.

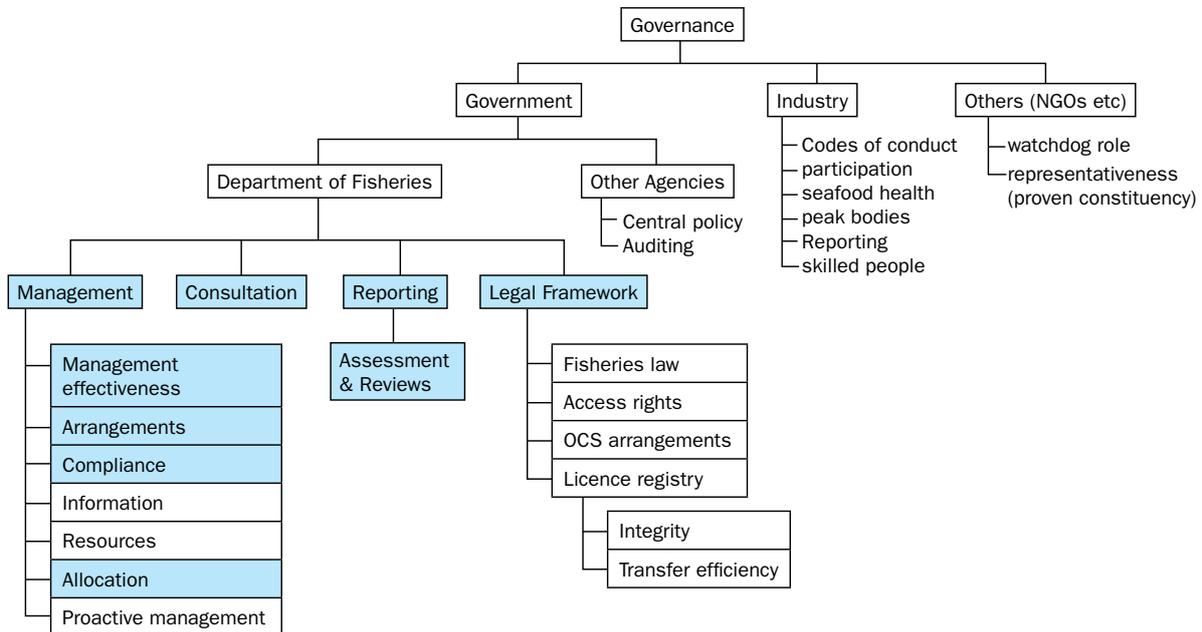
Trolling is a highly specific fishing method and so the catches of non-mackerel species are low. Some non-mackerel species are caught and retained by the fishery and some of these fish may be processed at sea. However, because the total catch of non-mackerel species is small, the quantities of processing waste from these fish will be minor. Similarly, the number of non-retained species caught and discarded by the fishery is low. Some non-retained species have a high likelihood of survival after capture and release by the fishery and so do not contribute to biological provisioning by the fishery.

Very minor quantities of unused bait are discarded by the fishery. Bait is kept frozen or iced on board vessels and so unused bait can be retained for use on future trips.

There are some anecdotal reports suggesting that sharks have increased in abundance around some reefs, as a result of aggregating to feed on hooked fish or discarded fish waste. For example, sharks are reported to aggregate around reefs off Dampier and along the cliffs at Quobba, to feed on mackerel hooked by recreational fishers (M. Mackie *pers. comm.*). However, the number of locations where this is reported to occur is low, and the total quantity of food made available to sharks is relatively small (see above estimates of fish waste).

5.4 GOVERNANCE

COMPONENT TREE FOR THE GOVERNANCE OF THE WESTERN AUSTRALIAN MACKEREL FISHERY



NB- no generic components have been removed from the tree but only those boxes that are coloured blue will be reported in this application.

5.4.1 Department of Fisheries – Management

On 16 October 2002, following extensive consultation, recommendations from the MIAP and advice from the Department of Fisheries, the State’s Minister for Agriculture, Forestry and Fisheries approved management arrangements for drafting into an interim management plan. Following further discussions with industry in 2003, in December of that year and March 2004, the Minister made some further announcements about the form of, and strategy for implementing, management.

The Department of Fisheries is currently developing the Mackerel Fishery IMP due to commence in mid 2004, with some aspects of the management package to come into effect immediately and other (TACCs, VMS and minimum holdings) to commence on 1 January 2005.

The Minister approved the development of the IMP on the basis of the following considerations:

- Commercial catches continue to rise and there is growing interest in mackerel fishing as access to other fisheries becomes restricted.
- There are no significant levels of mixing of Spanish mackerel (primary mackerel species) across long lengths of coastline (eg. from Exmouth to Broome). However, despite limited alongshore mixing of juveniles and adults, genetic relationships are thought to span broader regions. Hence the effects of fishing in one zone are likely to have flow-on affects in the other zones.
- It would be inappropriate to manage the fishery by size limit alone, as mortality of released fish is likely to be high, as is mortality due to sharks, both of which may add substantially to the fishing pressure on the fish.

- These species schools in large numbers, in well-known locations, and hence can be captured in large quantities. Catch rates of schooling pelagic species can remain high until stock sizes have decreased significantly. This makes it vulnerable to fishing pressure.

Long-term commercial mackerel fishers had raised concerns about the mackerel stocks.

- There is growing interest in targeting grey mackerel by fishers in some areas and the management package needs to allow the development of this fishery to be explored in a way which does not compromise sustainability and which allows improved data on this species to be gathered.
- It was also the view of the majority of the commercial and recreational fishers consulted during the process that the fishery should be managed.

5.4.1.1 Management Effectiveness (Outcomes)

Rationale for Inclusion:

The effectiveness of management activities will ultimately be reflected by the extent to which the fishery performs after the IMP is implemented.

The expected performance for the mackerel fishery is that the Total Allowable Commercial Catch (TACC) set for Spanish and other mackerel (excluding grey mackerel) for each area of the fishery (Kimberley, Pilbara and Gascoyne/west coast) be attained with economic efficiency and within the legislated limited season. It is expected that the commercial fishermen should be able to catch this TACC regardless of external factors (for example, recreational catch). Any reduction in the ability of the fleet to meet this TACC that cannot be readily explained (by natural recruitment variability, negative market forces etc) may reflect a reduction in management effectiveness and raise concerns about the ongoing sustainability of the commercial fishery.

The separate TACC for grey mackerel has been set at a level to encourage development of the fishery for this species. It is therefore not expected that fishers will attain the initial TACC set for this species, West Coast is already targeted. This grey mackerel TACC will be revised as new catch and biological information for this species becomes available following implementation of the IMP.

Operational Objective

To introduce a comprehensive interim management plan for the mackerel fishery that will enable the sustainable harvesting of mackerel species, both biologically and economically.

Justification:

The comprehensive management plan will have appropriately prescribed Total Allowable Commercial Catches (TACCs) set for (1) Spanish and other mackerel, and (2) grey mackerel. The TACC for Spanish and other mackerel will effectively ‘buffer’ external factors (such as recreational catch and the influence of other commercial fisheries) and as such each zone should attain the TACC with economic efficiency within the limited catching season. The TACC for grey mackerel will initially encourage development of the fishery for this species, but will be revised as new data becomes available as per rationale for the Spanish and other mackerel TACC.

In the event that commercial fishermen were unable to attain the TACC for species other than grey mackerel then the reason(s) would need to be identified and explained.

Indicator

That management arrangements exist to permit the take of a prescribed, sustainable quantity of mackerel within a prescribed season (noting that the TACC for grey mackerel has been set to encourage development of the fishery for this species).

Performance Measure

The IMP is due to commence in mid 2004 and management arrangements will be fully implemented by 1 January 2005. It will define the management arrangements for the fishery and by January 2005 will include TACCs for each zone of the fishery.

5.4.1.2 Management Arrangements

Rationale for Inclusion:

A number of instruments are used to articulate the management arrangements for Western Australian fisheries. The *Fish Resources Management Act 1994* provides for the creation of Management Plans, Orders, Regulations, Ministerial Policy Guidelines and Policy Statements.

To date, the Minister has approved the following management arrangements for drafting into the Mackerel Fishery (Interim) Management Plan:

- division of the fishery into three management areas – **Area 1 (Kimberley)** - WA/NT border to 121°E longitude; **Area 2 (Pilbara)** -121°E longitude to 114°E longitude; and **Area 3 (Gascoyne-West Coast)** -114°E longitude to Cape Leeuwin.
- restrictions on the number of boats able to fish in each area according to criteria specified in the IMP;
- designated fishing season for each area as follows – **Area 1** – 1 June to 30 November **Area 2** – 1 April to 30 September **Area 3** – 1 March to 30 September
- an upper limit on the number of dories and a prohibition on them being used outside the Kimberly, except where a Kimberley fisher is also authorized to fish in the Pilbara;
- implementation of two TACCs for each area – one for grey mackerel and one for all other mackerel species covered by the IMP – noting that this latter TACC is based on Spanish mackerel as this is the most commonly caught species (1 January 2005);
- a requirement that a specified minimum level of “other” (excluding grey) mackerel quota is held in order to operate to assist compliance (1 January 2005);
- a requirement to use VMS (1 January 2005) and to land mackerel at designated ports in each area (to assist compliance); and
- a requirement for permit holders to complete research logbooks.

Under the IMP TACCs for each area of the fishery will be determined by the Executive Director having taken into account advice from the Director of Fisheries Research. TACCs will not normally be reviewed on an annual basis, but biological reference points with respect to the TACC for species other than grey mackerel will be put in place and if they are breached in two consecutive years a review process will be triggered.

The decision to introduce separate TACCs for grey mackerel was made in recognition that there is increasing interest amongst industry members in exploring the development of this resource. The separate TACCs, and the requirement to complete research logbooks will allow this development to be monitored and provides a mechanism for regulating catch of this specific species.

The Department will carefully monitor the development of the grey mackerel fishery so that appropriate changes can be made to the developmental TACC as the level of information available on which to base such decisions increases.

The following TACCs are likely to apply in 2005:

Kimberley	-Grey Mackerel 60 tonnes (whole weight) -Other Mackerel 205 tonnes (whole weight)
Pilbara	-Grey Mackerel 60 tonnes (whole weight) -Other Mackerel 126 tonnes (whole weight)
Gascoyne-West Coast	-Grey Mackerel 60 tonnes (whole weight) -Other Mackerel 79 tonnes (whole weight).

The TACCs recommended for “other mackerel” are based on 95% of the long-term average Spanish mackerel catch – noting that this is the dominant species taken. As indicated above, the recommended grey mackerel TACCs have been set to allow development of this fishery in a way which also facilitates good data collection and monitoring.

The IMP is expected to remain in place until the end of 2009.

Operational Objective

In consultation with industry members, peak bodies and other stakeholders the Department will periodically review the management framework to ensure it remains relevant and aligned with the fishery’s management objectives.

Justification:

Management arrangements should enable the sustainable exploitation of mackerel for a commercial purpose. This plan will prescribe TACCs for each zone of the fishery and will define how the mackerel resource is allocated within the commercial sector.

Indicator

The extent to which the management arrangements address each of the issues and has appropriate objectives, indicators and performance measures along with planned management responses.

Evaluation

Formal evaluation of the management arrangements for the State’s mackerel fishery will be undertaken after the first full season of operation, that is, after 1 December 2005.

Robustness High

The management arrangements for the mackerel fishery are comprehensive. Once the plan has commenced all management arrangements will require regular review to ensure sustainability requirements are met.

5.4.1.3 Compliance

Rationale for Inclusion:

Effective compliance is vital to achieve the management objectives of any fishery. The management arrangements for the mackerel fishery, to be introduced under the IMP, are a balance between compliance integrity and cost control in the quota-managed fishery. The restricted season will allow compliance officers to inspect boats (with and without mackerel permits) and processing factories more effectively as resources will be concentrated during the fishing season. In addition, out of season operations will be conspicuous.

Similarly, the requirement for mackerel to be unloaded only at specified ports in each area of the fishery will assist compliance staff in undertaking landing inspections more efficiently and landings at other than designated ports will be conspicuous.

VMS will be a valuable aid in compliance, ensuring not only the integrity of the zones but also providing a secure communication channel for providing advice on landings.

Operational Objective

To have sufficiently high levels of compliance associated with the management plan to lend credibility to recorded catch data.

Justification:

The activities of the commercial sector need to be consistent with the legislation in order that the expected outcomes and objectives of the fishery can be achieved.

Indicator

The indicators of compliance with the management plan will include a proportion of offences to inspections and the degree of understanding and acceptance of rules governing the operation of the fishery by the commercial sector.

Performance Measure

The performance of the compliance program for the fishery will be a measure of the proportion of offences to the number of inspections.

Data Requirements for Indicator

1. Number of inspections of boats within the managed fishery.
2. Number of inspections of boats outside the managed fishery.
3. Number of processing factory inspections.
4. Number of offences.
5. Types and severity of offences.
6. Comparative data on the relative effectiveness of certain compliance techniques.

Robustness Medium

The Department has limited compliance resources dedicated to the mackerel fishery (when considering

competing compliance requirements in other fisheries), however VMS and a restricted season increase the integrity of the proposed compliance program.

Comments and Action

The Department will continue to provide a high standard of compliance service within budgetary and resource constraints. It is expected that after the first season of operation the Department will be better able to direct resources to further increase the effectiveness of limited compliance resources.

5.4.1.4 Allocation Among Users

Rationale for Inclusion:

The Government recognises that the mackerel fishery is important to both the recreational and commercial fishing sectors. The majority of recreational fishing is thought to occur close to shore and near the larger population centres along the coast. Regardless of the motivation for extractive fishing it should be noted that the sustainability parameters of the resource remain the same. It is therefore important that all extractive users are considered when implementing arrangements designed to secure the resource and ecological sustainability.

Operational Objective

To ensure that an adequate management plan is in place for the commercial sector. This will form a basis for resource sharing discussions and provide the framework for the commercial sector to access their allocation.

Resources sharing issues will be the subject of investigation in the State's Integrated Fisheries Management Review where alternative management frameworks and principles for allocating fish stocks to ensure maximum benefit to the community will be examined.

Indicator

Allocation decisions should aim to maximise the overall benefit to the Western Australian community from the use of mackerel stocks and take account of economic, social, cultural and environmental factors.

Indicators will include:

- The percentage of catch taken by each sector (recreational and commercial).
- The level of resource sharing conflict amongst user groups.
- The level of participation of interested groups / parties in any focused resource sharing process.

Performance Measure

The integrated management system must be open and transparent, accessible and inclusive, flexible, effective and efficient.

Data Requirements for Indicator

The development and funding of a comprehensive research and monitoring program encompassing all user groups is essential to provide the necessary information for sustainability and allocation issues to be addressed under an integrated framework.

Basic data requirements include:

- Recreational sector catch.
- Commercial sector catch.
- Incidental mortality as a result of fishing.
- Projected potential increases in recreational fishing effort.
- The costs associated with various management options and the identification of potential funding sources – particularly relevant for those measures targeted at the recreational sector.

Robustness Medium

Presently, there is no specific allocation made to the recreational sector. However, reduced bag limits for the recreational sector commenced October 2003, reducing the bag limit for Spanish and Wahoo mackerel to two mackerel per day per fisher in the West Coast and Gascoyne sectors. The interim management plan to commence mid 2004 will prescribe TACCs for the commercial sector from 1 January 2005.

Fisheries Management Response

Current:

Recreational fishers interests are catered for through the Recreational Fishing Advisory Committee that advises the Minister for Fisheries on matters relating to recreational fishing, including recreational mackerel fishing.

Reduced bag limits for the recreational sector commenced October 2003, reducing the bag limit for Spanish mackerel and Wahoo to two per day per fisher from the previous bag limit of four per fisher per day.

Future:

It should be noted that an inquiry into the Department's proposed approach for the implementation of Integrated Fisheries Management, headed by Justice Toohey has been completed. This process was charged with determining a more explicit process of allocation amongst the sectors.

Government's final response to the recommendations of this process is expected shortly.

Comments and Actions

With respect to allocation issues, the Minister for Fisheries has indicated that until Government finalises its position on Integrated Fisheries Management and this process has been allowed to run its course, fisheries will be managed responsibly within existing catch ranges.

5.4.2 Department Of Fisheries – Consultation

5.4.2.1 Consultation

Rationale for Inclusion:

There are sections in the FRMA that relate to the development of a management plan (Section 64) and to the amendment of a management plan (Section 65).

Section 64 states:

“ Before determining a management plan for a managed fishery under section 54(1) the Minister must –

- (a) consult with –*
 - (i) any advisory committee established in respect of the fishery; and*
 - (ii) such other advisory committees or persons, if any, as the Minister thinks appropriate; and*
- (b) consider any representations made under subsection (3).*

• *Section 65 states:*

(1) A management plan must specify an advisory committee or advisory committees or a person or persons who are to be consulted before the plan is amended or revoked.

(2) Before amending or revoking a management plan the Minister must consult with the advisory committee or advisory committees or the person or persons specified for that purpose in the plan.

(3) Despite subsection (2), the Minister may amend a management plan without consulting in accordance with that subsection if, in the Ministers opinion, the amendment is –

(a) required urgently; or

(b) of a minor nature

(4) If–

(a) the Minister amends a management plan; and

(b) the amendment is made without consultation because it is, in the Minister’s opinion , required urgently,

• *the Minister must consult with the advisory committee or advisory committees or the person or persons specified for that purpose in the plan as soon as practicable after the plan has been amended.*

In developing his position on the IMP the Minister has consulted with the MIAP, industry. and the Department of Fisheries.

Two rounds of public consultation were undertaken by the Department of Fisheries prior to the establishment of the MIAP. The MIAP then undertook its own public consultation process. It held public meetings in Geraldton, Carnarvon, Karratha, Broome and Fremantle and accepted submissions from stakeholders. Since this time, the Minister has also received and considered further representations from industry and advice from the Department.

Before amending or revoking the management plan (depending on the material significance the amendment) the Minister is likely to consult with permit holders, the Western Australian Fishing Industry Council, Recfishwest, the Conservation Council, the Recreational Fisheries Advisory Committee (RFAC) and relevant Regional RFACs and any other relevant peak body and/or stakeholders.

Operational Objective

To administer a consultation process that is in accordance with the requirements of the FRMA and allows for the best possible advice from all relevant stakeholders to be provided to the decision maker (Minister/ED) in a timely manner.

Indicators

The Minister (or the Department on his behalf) conforms to the consultation requirements of the FRMA and the level to which permit holders consider that they are adequately and appropriately consulted.

Performance Measures

Proper consultation procedures have been followed in any amendment of the management plan.

Data Requirements

When an amendment is proposed, documentation of the formal consultation procedures.

Evaluation

Consultation on management of the mackerel fishery will be conducted in an open, accountable and inclusive environment where all sectors and the Department's managers collectively identify and discuss appropriate courses of action.

Decision makers are provided with advice based on this consultation and reasons are provided for decisions that vary from consultation-based advice.

Robustness High.

The stakeholders in the mackerel fishery will be the same as those in other finfish fisheries in the State already familiar with Departmental and Ministerial consultation processes. These processes are well understood with high levels of participation.

Fisheries Management Response

The Department will continue to provide a commercial fisheries management officer for the mackerel fishery. This officer will be responsible for coordinating consultation processes for the fishery.

5.4.3 Department of Fisheries- Reporting

5.4.3.1 Assessments and Reviews

Rationale for Inclusion:

It is important that the outcomes of the fisheries management processes administered by the Department for the mackerel fishery are available for review by external parties. It is also important that the community is sufficiently informed on the status of the fishery, given that industry is utilising a community resource.

The status of the mackerel fishery will be reported annually in the State of the Fisheries Report, the Annual report to the Auditor, the ESD report, and this application to DEH.

Operational Objective

To continue to report annually to the Parliament and community on the status of all fisheries including the mackerel fishery and to prepare a framework for reporting on ESD for all Western Australian fisheries.

Indicators

- The extent to which external bodies have access to relevant material.
- The level of acceptance within the community.

Performance Measure

General acceptance of the management arrangements by the community.

Data Requirements

The majority of data required to generate reports is already collected in the course of pursuing resource management objectives. The Department conducts an annual survey of the community with respect to its opinion on the status of the State's fisheries and their attitudes to the performance of the Department.

Evaluation

The Department has been the recipient of a number of awards for excellence for its standard of reporting - Premiers Awards in 1998, 1999 for Public Service excellence, Category Awards in Annual Reporting in 1998, 1999, 2000; Lonnie Awards in 2000, 2001.

Reporting arrangements for the mackerel fishery will include:

State of Fisheries

Annual reporting on the performance of the fishery against the agreed objectives within the "State of the Fisheries Report". This document is available in hard copy format but is also available from the Department's web site in PDF format.

Annual Report

The Department also produces an Annual Report, which is tabled in Parliament. The Annual Report includes Performance Indicators that are reviewed by the OAG.

ESD

The Department is currently completing a full ESD report (of which the material presented in this application is a subset), which will cover not only the environmental aspects of the Snapper fishery but the full social and economic issues. Once completed this too will be available from the web site.

Robustness High

Fisheries Management Response

Current:

For many years the Department has produced substantial and high quality documents that report on the operation of the Department and the status of its fisheries.

Future:

The Department is working with the EPA to prepare a framework for reporting on ESD for all Western Australian fisheries. It is proposed that this framework will be linked to a regular audit cycle involving the EPA and periodic reporting to the OAG. The Department is working to combine the processes for reporting to the States and the Commonwealth and believes that this can best be achieved by using a Bilateral Agreement with DEH under the EPBC.

Comments and Actions

The processes already established and those new external review processes that are all but established ensure that there will be many opportunities for appropriateness of the management regime and the importantly the results it produces to be reviewed.

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7.0 APPENDICES

APPENDIX 1 TERMINOLOGY

Terminology for trolling

Bait	one hook or one set of interlinked or ganged hooks with bait attached to the hook or hooks
Dory or Auxiliary boat	means a licensed fishing boat used in conjunction with a mother boat and both boats are specified on the same permit
Gaff	long pole with large hook at end used to lift fish from water
Jigging	line fishing that uses rod and reel to drop and retrieve a lure vertically
Lead core line	rope with a string of small leads running through the centre
Lure	not more than one lure with hooks attached to the lure only
Mother boat	means the licensed fishing boat used primarily for or in conjunction with fishing under the authority of a permit
Paravane	device attached to line while trolling to get the lure or bait deeper in the water column
Teaser	device attached to line while trolling to attract fish, has no hooks
Trolling	line fishing which uses baits or lures dragged behind a vessel at between 2 and 10 knots

APPENDIX 2 NATIONAL ESD CONSEQUENCE LEVELS AND LIKELIHOOD DEFINITIONS FOR RISK ASSESSMENT

Scope

- Retained/Non Retained/Protected species – assessed at level of locally reproducing population –unit stock
- Ecosystem – indirect impacts due to flow on effects on food chain assessed at the Regional/ Bioregional level
- Habitat (attached species – eg seagrass) assessed at the regional habitat level defined as the entire habitat equivalent to that occupied by the exploited stock.

A2.1 Table– Risk Matrix

		Consequence					
		Negligible	Minor	Moderate	Severe	Major	Catastrophic
Likelihood		0	1	2	3	4	5
Remote	1	0	1	1	1	1	1
Rare	2	0	1	1	1	2	2
Unlikely	3	0	1	1	2	2	3
Possible	4	0	1	2	2	3	4
Occasional	5	0	1	2	3	4	4
Likely	6	0	1	2	3	4	4

A2.2 Table Summary Consequence Definitions

Level	Ecological
<p>Negligible</p>	<p>General - Insignificant impacts to habitat or populations, Unlikely to be measurable against background variability Target Stock/Non-retained: undetectable for this population By-product/Other Non-Retained: Area where fishing occurs is negligible compared to where the relevant stock of these species reside (< 1%) Protected Species: Relatively few are impacted. Ecosystem: Interactions may be occurring but it is unlikely that there would be any change outside of natural variation Habitat: Affecting < 1% of area of original habitat area <i>No Recovery Time Needed</i></p>
<p>Minor</p>	<p>Target/Non-Retained: Possibly detectable but little impact on population size but none on their dynamics. By-product/Other non-retained: Take in this fishery is small (< 10% of total) compared to total take by all fisheries and these species are covered explicitly elsewhere. Take and area of capture by this fishery is small compared to known area of distribution (< 20%). Protected Species: Some are impacted but there is no impact on stock Ecosystem: Captured species do not play a keystone role – only minor changes in relative abundance of other constituents. Habitat: Possibly localised affects < 5% of total habitat area <i>Rapid recovery would occur if stopped - measured in days to months.</i></p>
<p>Moderate</p>	<p>Target/Non Retained: Full exploitation rate where long term recruitment/ dynamics not adversely impacted By-product: Relative area of, or susceptibility to capture is suspected to be less than 50% and species do not have vulnerable life history traits Protected Species: Levels of impact are at the maximum acceptable level Ecosystem: measurable changes to the ecosystem components without there being a major change in function. (no loss of components) Habitat: 5-30 % of habitat area is affected. :or, if occurring over wider area, level of impact to habitat not major <i>Recovery probably measured in months – years if activity stopped</i></p>
<p>Severe</p>	<p>Target/Non Retained: Affecting recruitment levels of stocks/ or their capacity to increase By-product:Other Non-Retained: No information is available on the relative area or susceptibility to capture or on the vulnerability of life history traits of this type of species Relative levels of capture/susceptibility greater than 50% and species should be examined explicitly. Protected Species: Same as target species Ecosystem: Ecosystem function altered measurably and some function or components are missing/declining/increasing outside of historical range &/or allowed/facilitated new species to appear. Habitat: 30- 60 % of habitat is affected/removed. <i>Recovery measured in years if stopped</i></p>

Level	Ecological
Major	<p>Target/Non Retained: Likely to cause local extinctions</p> <p>By-product/Other non-retained: N/A</p> <p>Protected Species: same as target species</p> <p>Ecosystem: A major change to ecosystem structure and function (different dynamics now occur with different species/groups now the major targets of capture)</p> <p>Habitat: 60 - 90% affected</p> <p><i>Recovery period measured in years to decades if stopped.</i></p>
Catastrophic	<p>Target/NonRetained: Local extinctions are imminent/immediate</p> <p>By-product/Other Non-retained N/A</p> <p>Protected Species: same as target</p> <p>Ecosystem: Total collapse of ecosystem processes.</p> <p>Habitat: > 90% affected in a major way/removed</p> <p><i>Long-term recovery period will be greater than decades or never, even if stopped</i></p>

A2.3 Table – Likelihood Definitions

Level	Descriptor
Likely	It is expected to occur
Occasional	May occur
Possible	Some evidence to suggest this is possible here
Unlikely	Uncommon, but has been known to occur elsewhere
Rare	May occur in exceptional circumstances
Remote	Never heard of, but not impossible

APPENDIX 3 ACRONYMS

ALC	Automatic Location Communicator
CAES	Catch and effort statistics
CPUE	Catch per unit effort
CSIRO	Commonwealth Scientific & Industrial Research Organisation
DEH	Department of Environment and Heritage
EPA	WA Environment Protection Agency
EPBC	Environment Protection and Biodiversity Conservation Act 1999
ESD	Ecologically Sustainable Development
FRMA	Fish Resources Management Act 1994
FRMR	Fish Resources Management Regulations 1995
IFMRC	Integrated Fisheries Management Review Committee
ITE	Individual transferable effort
MAC	Management Advisory Committee
MARPOL	International Convention for the Prevention of Pollution from Ships
NDSMF	Northern Demersal Scalefish Managed Fishery
OAG	Office of the Auditor General
OCS	Offshore Constitutional Settlement
SFDs	Standard Fishing Days
TACs	Total Allowable Catches
TSC	Total Sustainable Catch
VMS	Vessel Monitoring System
WAFIC	Western Australian Fishing Industry Council

APPENDIX 4 MATERIALS SUPPLIED TO ENVIRONMENT AUSTRALIA AGAINST THEIR SPECIFIC GUIDELINES

4. ASSESSMENT OF THE MACKEREL FISHERY MANAGEMENT REGIME AGAINST THE COMMONWEALTH (DEH) GUIDELINES FOR ASSESSING THE ECOLOGICALLY SUSTAINABLE MANAGEMENT OF FISHERIES

4.1 GENERAL REQUIREMENTS OF THE DEH GUIDELINES

The management arrangements must be:

Documented, publicly available and transparent;

As per the FRMA (1994) “the Executive Director is to cause a copy of every order, regulation and management plan in force under this Act:

-To be kept at the head office of the Department; and

-To be available for inspection free of charge by members of the public at the office during normal office hours.”

In addition to these legislative requirements, the future interim management plan, as documented in the formal set of management regulations, can be purchased by interested parties from the State Law Publisher.

Currently there is no management plan for this fishery. In October 2002, following extensive consultation, recommendations from the Mackerel Independent Advisory Panel (MIAP) and advice from the Department of Fisheries, the State’s Minister for Agriculture, Forestry and Fisheries approved management arrangements for drafting into an interim management plan. It is anticipated that the interim plan will commence mid 2004.

Of more relevance, is that any discussion papers and proposals for modifications to these management arrangements are distributed widely to stakeholder groups automatically and other interested individuals by request in hard copy format. Where appropriate, they are now also available from the Departmental web site www.fish.wa.gov.au.

Finally, once completed, the full ESD Report on the Fishery will be made publicly available via publication and electronically from the Departmental website. This will provide increased transparency through explicitly stating objectives, indicators, performance measures, management arrangements for each issue and how the fishery is currently performing against these criteria.

There is also a proposal to formally publish the relevant objectives and performance measures for each fishery, including the MF, in a series of Ministerial Guidelines, which would form an adjunct to the management plan.

Developed through a consultative process providing opportunity to all interested and affected parties, including the general public;

Two rounds of public consultation (including meetings and calls for submissions) were undertaken by the Department of Fisheries prior to the establishment of the MIAP. The MIAP then undertook its

own public consultation process. It held public meetings in Geraldton, Carnarvon, Karratha, Broome and Fremantle and accepted submissions from stakeholders. Following extensive consultation, recommendations of the Mackerel Independent Advisory Panel (MIAP) and advice from the Department of Fisheries, the Minister approved a number of management arrangements for drafting into the IMP for the Mackerel Fishery. Following further discussions between the Department, industry and the Minister, the Minister approved some minor modifications to this package in late 2003 and early 2004.

Under the new IMP, there will be a minimum requirement to consult with permit holders, before any amendments to the plan or the revocation of the plan in accordance with S64 and S65 of the FRMA. The FRMA defines the requirement with respect to consultation which must be undertaken before a management plan is amended or revoked.

Ensure that a range of expertise and community interests are involved in individual fishery management committees and during the stock assessment process;

The MF does not have a management advisory committee, nor is one planned at this stage of the Fishery's development. As a matter of Departmental policy however, all stakeholders including industry, the Western Australian Fishing Industry Council (WAFIC), Recfishwest, the Recreational Fishing Advisory Committee (RFAC), Regional RFACs, the Conservation Council and any other relevant groups, are consulted before the development of any management program.

The groups that have been involved in the review of the information contained within this application include:

Department of Fisheries, WA;
The industry; and
Western Australian Fishing Industry Council (WAFIC).

The general consultation methods used for this fishery are summarised in the Governance Section 5.4.3.1.

Be strategic, containing objectives and performance criteria by which the effectiveness of the management arrangements is measured;

The ESD Component Reports (see Section 5) contains the objectives, indicators and performance measures for determining the effectiveness of the management arrangements for the MF¹. For some components, the objectives, indicators and performance measures are already established and the data are available to demonstrate levels of performance over time. For other components, the objectives, indicators and performance measures have only just been developed and/or the necessary data collection is only just being initiated. The status of this information is documented within each of the individual component reports within the ESD Reports in Section 5.

¹ These will also be formally published in Ministerial Policy Guidelines.

Be capable of controlling the level of harvest in the fishery using input and/or output controls;

The FRMA, and specifically the future IMP for the MF provides the legislative ability to control the level of harvest within this fishery. This is achieved through the use of an effective combination of input control measures including limiting entry, temporal closures and output controls such as total allowable commercial catch.

The process of implementing the IMP (to commence mid 2004) will allow the development of the fishery and a thorough assessment of the level of fishing effort necessary to maintain sustainability.

Contain the means of enforcing critical aspects of the management arrangements;

The challenge is how best to determine the appropriate level and nature of fishing within sustainable parameters and subsequently ensure that these management arrangements are cost effective and allow the commercial sector to operate in an economically efficient manner. Logbooks are essential for the Department's Research Division to monitor the take of fish. However, such documentation alone is not adequate for the compliance requirements of monitoring quota across all zones of a fishery as widespread as mackerel. It is essential that Compliance Officers have the capacity to conduct real time inspections to validate the documentation.

A restricted season is essential for compliance integrity and cost control in the quota-managed fishery. A limited season will allow compliance officers to inspect boats (with and without mackerel permits) more effectively as resources will be concentrated during the fishing season. In addition, out of season operations will be conspicuous.

In addition, VMS will be a valuable aid in compliance. While the VMS may be more appropriate for some zones than others, it will be a valuable operational tool in all zones, ensuring not only the integrity of the zones but also providing a secure communication channel for providing advice on landings.

It is important to note that all management arrangements require regular review to ensure sustainability requirements are met. The Mackerel IMP will regulate the Fishery from Cape Leeuwin to the Northern Territory border and therefore, a variety of mackerel fishing operations.

Given the value of the licenses, fishers themselves are also a source of information on illegal activities. A full summary of these compliance activities and their effectiveness is provided in Section 5.4.1.3.

Provide for the periodic review of the performance of the fishery management arrangements and the management strategies, objectives and criteria;

There is an annual review of the performance for the major aspects of the Fishery through the completion of the "State of the Fisheries" report. This is updated and published each year including periodic reviews by the Office of the Auditor General (OAG). It forms an essential supplement to the Department's Annual Report to the WA Parliament with the latest version located on the Departmental website www.fish.wa.gov.au.

The ESD Component Reports contain comprehensive performance evaluations of the Fishery based upon the framework described in the Fisheries ESD policy (Fletcher, 2002). This includes the development of objectives, indicators and performance measures for most aspects of this fishery and includes status reports for those components that are not subject to annual assessment. This full assessment, including an examination of the validity of the objectives and performance measures, is planned to be completed and reviewed externally every five years.

Be capable of assessing, monitoring and avoiding, remedying or mitigating any adverse impacts on the wider marine ecosystem in which the target species lives and the fishery operates;

Capabilities for the assessment, monitoring and avoidance, remedying or mitigating any adverse impacts on the wider marine ecosystem are documented in "General Environment" [Section 5.3](#). No issues were identified as posing greater than a minor risk and hence there is currently no need to implement specific monitoring for such impacts.

Require compliance with relevant threat abatement plans, recovery plans, the National Policy on Fisheries Bycatch, and bycatch action strategies developed under that policy;

The future management regime for MF complies with all the relevant threat abatement plans for species where there are significant interactions. Details are provided in the ‘non-retained species’ section of this application (Section 5.2.).

4.2 PRINCIPLE 1 OF THE COMMONWEALTH GUIDELINES

OBJECTIVE 1. MAINTAIN VIABLE STOCK LEVELS OF TARGET SPECIES

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

The component tree detailing the stocks of retained species relevant for this fishery is shown above. There are two primary species/groups for this fishery, Spanish mackerel (*Scomberomorus commerson*) and other mackerel species. Each of these species and species group has been assessed with the appropriately detailed reports having been completed. The full reports are located in Section 5.1.

The internal risk assessment workshop determined that the fishery was of **Moderate risk** to Spanish mackerel stocks and a **Low risk** to other mackerel species.

The MF will be managed through a series of input controls including seasonal closures along with output controls such as quota management. Although this is not yet in place, the current performance by the MF demonstrates that the Spanish mackerel and other mackerel species are being maintained above levels necessary to maintain ecologically viable stock levels in each area. Thus, in summary:

The legal minimum size of 900 mm for Spanish mackerel in Western Australia is at the size when 80% of male fish and 50% of female fish are reproductively mature.

Stock assessments have shown that current rates of exploitation in WA appear to be allowing sufficient survival of the breeding stock to maintain recruitment.

The information available to date indicates that the stocks of Spanish mackerel in WA are healthy.

The other mackerel species are by-product species of this fishery. Due to the species wide distribution across northern Australia as well as their biological characteristics (fast growth, early maturity and moderate/high fecundity) there are relatively resilient to overfishing.

Upon the commencement of the Interim Management Plan for the fishery the Spanish mackerel, an overall TACC as well as regional TACCs will be used to manage stocks. In addition, the performance measures of acceptable ranges for the overall catch as well as the regional catches will be implemented and used to assess the stocks of Spanish mackerel. This performance measure may well be expanded overtime to include indicators other than catch level.

Consequently, this fishery is meeting the requirements of Principle 1. The information relevant to this principle for these species is detailed below.

Information Requirements

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

Data has been collected through a combination of fishery-independent and fishery-dependent means; the latter having been in place since 1979. In 1998, a joint WA/NT/QLD FRDC-funded research project (FRDC1998/159) commenced to determine the stock structure of Spanish mackerel across northern Australia using genetic markers, stable isotope ratios in fish otoliths and the parasitic fauna. The final report for this project will be finalised in 2004.

In 1999, another FRDC-funded project (FRDC 1999/151) commenced to determine the status of Spanish mackerel stocks in WA waters. Research was completed in 2002. The study reviewed catch and effort history of the fishery and gathered biological information on reproduction, age, growth and diet. Results from the study were used to develop the IMP and will form the basis of future stock assessments.

Currently, the fishery dependent data collection systems monitor the catch and effort of Spanish mackerel by the commercial troll fishery. All licenced commercial fishers report summaries of monthly catch and effort to the Department. Data is reported by location and method. After the implementation of the IMP in 2004, specific logbooks will be issued to mackerel fishers and will result in more detailed catch and effort data being collected.

The specific data requirements needed to assess performance for each of the relevant objectives are detailed in the relevant sections of the ESD report, which is in Section 5.1. Retained Species. These requirements are summarised as follows:

Monitoring Program	Information Collected	Robustness
FRDC Project 1998/159	Stock structure of Spanish mackerel across northern Australia.	High
FRDC Project 1999/151	Reviewed catch and effort history of the fishery, and gathered biological information on reproduction, age, growth and diet.	High
Catch and effort data	Monthly Catch, effort and CPUE. (this will move to daily logbooks when the IMP takes effect)	Moderate
Climatic data	Rainfall data; Wind data; and Swell Height conditions.	High

Assessments

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

There are two primary species groups for the Fishery, Spanish mackerel and other mackerel species. An FRDC Project 1999/151 commenced to determine the status of Spanish mackerel stocks in WA waters and research was completed in 2002. These data will be used to determine the appropriateness of the current management regime including setting of the TACC and the use of total catch levels to assess the stocks. The assessments for the Spanish mackerel and other mackerel species are detailed in Section 5- Performance Reports.

Modeling of the biomass of Spanish mackerel has only been successful in the Gascoyne/West Coast sector, due to a lack of contrast in catch and effort data in other sectors (Mackie *et al.* 2003). Modeling suggested that the carrying capacity of the West Coast sector was approximately 1115 t (95% confidence interval of 757-2116 t), and that biomass has been relatively stable at around 850 t since

1994. Annual commercial catches in the region have therefore varied between 9 and 11% of the total biomass since 1994. In 2001, the combined commercial and recreational catch was approximately 20% of the estimated biomass (915 t) in the sector. Although modeling was not successful in other sectors, higher catch rates suggest that the carrying capacities of the Kimberley and Pilbara sectors are likely to be higher than the West Coast sector.

Recent work by Mackie *et al.* (2003) indicated that the daily egg production method is not a viable technique to apply in the stock assessment of Spanish mackerel, due to the difficulty in finding spawning sites and identifying precise times at which to sample eggs. Yield per recruit analyses were also conducted by Mackie *et al.*, but recommendations about optimum size and age at first capture were not made due to uncertainty about estimates of natural (M) and fishing

(F) mortality. Such analyses may be more useful in future if better estimates of M and F become available.

Overall, stock assessment suggests that Spanish mackerel in Western Australia is probably fully exploited at current catch levels. Anecdotal evidence suggests that grey mackerel is under-exploited in each sector, although catches are increasing.

An assessment of the status of Spanish mackerel stocks in each of the zones will be completed and reported each year in the State of Fisheries Report.

Spanish Mackerel

The risk of the fishery to Spanish mackerel was considered **Moderate**. The current legal minimum size is 900 mm. The future catches will be managed by a total annual catch levels as well as a regional annual catch level. This TACC will be set every three years for the fishery. In addition, total and regional acceptable catch ranges will be used as a performance measures for the fishery to ensure that the spawning stock is maintained at acceptable levels. Improved reporting of catch and effort data will coincide with the implementation of the IMP and this is likely to result in indicators other than catch level being developed for the fishery. The full performance report is located in Section 5.1.1.1.

Other Mackerel Species

The risk to other mackerel species was considered **Low**. This group is made up of several mackerel species including grey, school, spotted and shark. The risk was considered Low given the low catch levels of each species. Also, each of the species is distributed widely across northern Australia and so the area of the fishery covers a relatively small proportion of the total distribution. Furthermore, mackerel are characterised by fast growth, early maturity and moderate/high fecundity, which make them resilient to overfishing. There is also a legal minimum size in place for the school, spotted and shark mackerel species, which is 500 mm. The full performance report is located in Section 5.1.1.2.

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

The distribution of Spanish mackerel is well documented. It is widely distributed throughout the Indo-West Pacific and West Africa, through to Fiji and north to China and Japan. There are numerous countries that fish Spanish mackerel including Indonesia, India, Egypt, Madagascar and Pakistan (Collette and Nauen, 1983). As previously discussed in 1.1.1, two projects have been undertaken in the MF. The FRDC Project 1998/159 commenced in 1999 to determine the stock structure of Spanish mackerel across northern Australia using genetic markers, stable isotope ratios in fish otoliths and the

parasitic fauna. There is a single genetic stock along the northern Australian coast (including Western Australia and the Northern Territory), which is distinct to stocks around Indonesia and eastern Australia (Ovenden *et al.* in prep). Genetic homogeneity of the stocks in north-western Australia is probably due to the along shore dispersal of pelagic eggs and larvae, which generally drift southwards with the Leeuwin current.

In Australia there appears to be limited mixing of adult Spanish mackerel populations. Variations in otolith microchemistry and parasitic fauna suggest along-shore movement is restricted to <100 km in northern and western Australia are likely to exist as spatially discrete subpopulations of adults, which are genetically similar but function as distinct management units.

As a result of the stock structure and distribution for the Spanish mackerel, it is proposed that an overall TACC will be set for the fishery as well as regional TACCs. The setting of an overall TACC as well as a regional TACC will take into account the subpopulation of adults within the Spanish mackerel stock.

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

Spanish mackerel is taken by recreational fishers and recreational charter vessels in addition to commercial fishers. All licenced commercial fishers report summaries of monthly catch and effort to the Department. Data are reported by location and method and is available since 1979. As was previously mentioned, after the implementation of the IMP in 2004, specific logbooks will be issued to mackerel fishers and will yield more detailed catch and effort data. All recreational take, commercial and charter boat take is factored into the stock assessments.

Most recreational take of Spanish mackerel by recreational fishers is between Perth and Dampier. The recreational take is limited in the northern areas where most of the commercial catch is taken because of the distance and isolation of the area. Surveys of recreational fishing are undertaken periodically in Western Australia. Recreational survey data are available for the West Coast sector in 1996/97 (Sumner and Williamson, 1999), the Gascoyne in 1998/99 (Sumner *et al.* 2002) and the Pilbara in 1999/2000 (Williamson *et al.* in prep). The recreational catches for each area include mackerel that were taken by sharks before being landed but does not include fish that were caught and released. Catches by recreational fishers are controlled through means of a legal minimum size and bag limit.

Recreational charter vessels also catch Spanish mackerel although the catch is relatively minor. In 2002, a total of 17.9 t of Spanish mackerel was reported by charter boats. Most (80%-100%) of the charter catch is taken in the Gascoyne and Pilbara sectors.

The monitoring programs outlined above for the MF covers the catch by the commercial fishers, recreational fishers, recreational charter vessels and any illegal fishing activities, which are obtained on a daily and yearly basis respectively.

Sector	Catch Data Collected	Frequency
Commercial	Catch and effort data	Monthly (soon to be daily)
Recreational	Surveys	Periodically
Recreational charter vessels	Catch and effort data	Daily/Monthly
Indigenous	National recreational and indigenous fishing survey	2000/01
Illegal	Estimated from compliance data.	Annually

1.1.5 There is a sound estimate of the potential productivity of the fished stock/s and

the proportion that could be harvested.

An assessment of Western Australian Spanish mackerel stocks has been made using catch and effort data, biological information, and biomass dynamics and yield-per-recruit modelling (Mackie *et al.* 2003). Biological attributes of fast growth and young age at sexual maturity (<2 years) indicate resilience to fishing pressure by Spanish mackerel. However, because individuals also become susceptible to fishing at an early age, are likely to be more site-attached than previously thought, and form aggregations that can be targeted by fishers, the species should still be managed in a conservative manner. Aggregating behaviour also causes bias in the catch rate data used as an index of abundance, further necessitating a cautious approach.

Biomass dynamics modelling was only possible for the Gascoyne/West Coast (combined) sector, as there was insufficient contrast in the catch and effort data for the other sectors. The carrying capacity for Spanish mackerel in the Gascoyne/West Coast sector was estimated to be 1115 t (95% confidence interval = 757 – 2116 t). Annual commercial catches in this sector have therefore varied between 9 and 11% of the total biomass since 1994. In 2001, the combined commercial and recreational catch was approximately 20% of the estimated biomass (915 t) in this sector. The biomass of mackerel in the other sectors is believed to be higher, as suggested by the higher catches in combination with higher catch rates.

Spanish mackerel rapidly attain sexual maturity and recruit to the fishery at a young age. Size at 50% maturity is 706 and 898 mm total length, for males and females, respectively. The minimum legal size is 900 mm total length. Age at 50% maturity is 0.8 and 1.4 y, for males and females, respectively. The age range of fish in catches is 0.5 to 22 y, but individuals older than 15 y are rare. Fish aged 1-4 y comprise approximately 70% of catches and fish aged 1-7 y comprise approximately 90% of catches. Less than 13% of the total catch is estimated to be immature (M. Mackie unpubl. data). Hence, the exploitable stock is likely to comprise a significant component of the breeding stock. Current rates of exploitation in Western Australia appear to be allowing sufficient survival of the breeding stock to maintain recruitment levels.

Yield-per-recruit analyses indicate that the appropriate fishing mortality for Spanish mackerel ($F_{0.2}$ to maximise YPR) is approximately 0.2 in the Pilbara and Gascoyne sectors, and 0.3 in the Kimberley sector, suggesting the need for conservative management in the Pilbara and Gascoyne sectors. Current fishing mortality is likely to be similar to or slightly above these target levels. The information available to date therefore indicates that stocks of Spanish mackerel in Western Australia are healthy.

Data from past and future research projects will continue to be used in stock assessments. In particular, the preliminary results from the 1998 joint WA/NT/QLD FRDC-funded research project (FRDC1998/159) the 1999 FRDC-funded project (FRDC 1999/151) were used to develop the IMP and will form the basis of future stock assessments.

Management Responses

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

The Spanish mackerel stock in the MF will be monitored using total annual catch and regional annual catch levels. Catch is considered to be a more reliable index of abundance than catch rate because of current difficulties in measuring the effort associated with catches of Spanish mackerel. Improved reporting of catch and effort data will coincide with the implementation of the IMP in 2004. Indicators other than

catch level are likely to be developed as a result. Any new information stemming from the current FRDC Projects (mentioned above) will be incorporated into the management regime for this fishery.

The trigger points are in the forms of acceptable catch ranges for the Spanish mackerel catch in the MF. For the Kimberley, Pilbara and West Coast sectors these have been based on minimum and maximum catches from 1991 to 1997 (the criteria period for fisher catch history within the IMP), whereas for the Gascoyne sector they have been estimated from catches between 1981 and 1987 because of very low catches during the criteria period. With implementation of the IMP the upper bounds of the acceptable catch ranges will set at the Total Allowable Commercial Catch for 'other' mackerel species, noting that Spanish mackerel will comprise > 95% of this catch (see Section 5.4.1.2). In keeping with the IMP, the acceptable catch ranges for the Gascoyne and West Coast sectors will also be combined. From 2004, the acceptable catch ranges are, therefore:

1. Acceptable total catch range of 246-410 tonnes.
2. Acceptable regional catch ranges:
 - Kimberley 110-205 tonnes,
 - Pilbara 80-126 tonnes,
 - Gascoyne/West Coast 56 – 79 tonnes.

There are no reference points in place for grey mackerel at this time. However, the fact that a separate TACC for this species will be determined under the IMP recognises the interest which exists in developing the fishery for this species and hence the need for the catch to be specifically monitored.

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

Currently the mackerel fishery is part of the Wetline fishery and therefore is not formally managed. Formal management of the fishery will commence in 2004 under the new IMP, which has been developed in consultation with the MIAP and stakeholders. An assessment of the fishery, including recent annual catch statistics and performance measures, is published by the Department of Fisheries within the annual "State of the Fisheries Report". A full discussion of the main regulations and their justifications are located in Section 2.2. The following is a summary of the current management arrangements for the Fishery:

Minimum size limits for each species;

Recreational bag limits;

Commercial fishers are required to submit monthly summaries of catch and effort with the Department;

Recreational charters also report catch and effort data to the Department; and

Restrictions use of dories (e.g. and must remain within 5 nm of motherboat).

Compliance policing.

The future management arrangements for the MF under the IMP, which is to commence in 2004 and which will be fully operational by 1 January 2005, will consist of the following elements:

division of the fishery into three management areas (Kimberley, Pilbara and Gascoyne-West Coast);

restrictions on the number of boats able to fish in each area according to criteria specified in the IMP;

designated fishing season for each area;

implementation of two TACCs for each area – one for grey mackerel and one for all other mackerel species covered by the IMP – noting that this latter TACC is based on Spanish mackerel as this is

the most commonly caught species (1 January 2005);
a requirement to use VMS (1 January 2005) and to land mackerel at designated ports in each area; and
a requirement for permit holders to complete research logbooks.

Section 5.4.1.2 of this application further outlines the management arrangements, which the Minister has approved for the drafting into the Mackerel Fishery (Interim) Management Plan.

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

A variety of finfish species, other than mackerel, and sharks are caught and retained as by-product in the MF (Section 5.1.2.1). Trolling is a highly specific fishing method, and so the number of species caught is low and the catches of by-product species that are taken whilst trolling for mackerel are minor (see Table 5). In 2001, the total non mackerel finfish catch by trolling was 9.3 tonnes and the total shark catch by trolling was 3.8 tonnes. This is taken across >15 species. Catches of individual species typically contribute <0.5% of the total trolling catch per year. The minor catch levels of the troll fishery are unlikely to impact significantly on the stocks of these species, which have distributions that greatly exceed the range of the fishery. Other by-product species, including sharks and tunas, are retained in greater quantities by other fisheries, which are responsible for the management of these species. As a consequence, the assessment and management of these species will be dealt with in the environmental assessment of the relevant fishery.

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

As was previously mentioned, the MF has been a part of the Wetline Fishery and therefore is not formally managed. Currently there are no gear restrictions, closures or catch quotas imposed on the mackerel fishers but this will change with formal management of the fishery commencing in 2004 under the new IMP. When the IMP becomes fully operational (1 January 2005) the management of the MF will be based on quota management, gear restrictions, seasonal closures and legal minimum sizes.

If the catch level moves outside the acceptable range and if the variation is not due to an acceptable non-stock related explanation the strategies available to offer further protection for the spawning stock would include:

- Reduction of regional quota allocation for the following season.
- Implementation of area closures, e.g. reefs known to be spawning sites.
- Implementation of additional temporal closures.

The ability to implement these strategies is provided for within the FRMA, FRMR and the soon to be introduced Mackerel Fishery Interim Management Plan . These actions could be initiated within the season or, if appropriate prior to the beginning of the next season.

OBJECTIVE 2. RECOVERY OF STOCKS

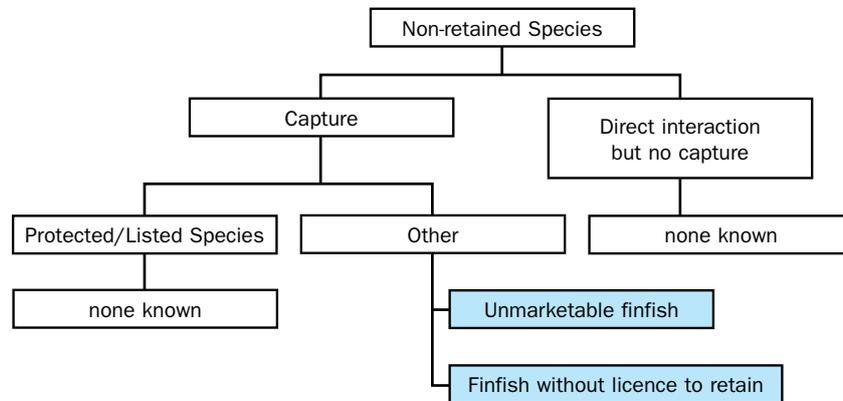
Where the fished stocks are below a defined reference point, the fishery will be managed to promote recovery to ecologically viable stock levels within nominated timeframes.

There are no stocks within the Fishery that are currently below defined reference points/limits.

4.3 PRINCIPLE 2 OF THE COMMONWEALTH GUIDELINES

OBJECTIVE 1. BYCATCH

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



Two non-retained species/groups were identified for this fishery. The impacts of the fishery were identified as having a **Negligible risk** to both of the species/groups and therefore only a brief justification was required (Section 5.2). In addition, there are no known interactions or captures of protected/listed species in the fishery and this will be covered in objective 2.2. The remaining non-retained (bycatch) species will be covered under objective 2.1.

A comprehensive report on the bycatch species is presented in [Section 5.2 Non-Retained Species](#). This assessment indicates that the performance of the MF is currently adequate in not threatening the bycatch (non-retained) species and is therefore meeting Objectives 1 and 2 of Principle 2.

Information Requirements

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

Since trolling is a highly specific fishing method the number of species caught is low and as a result the catches of non-target species that are taken whilst trolling for mackerel are minor (Table 5). Information on the composition and abundance of bycatch has been obtained through personnel communication with the fishers themselves in the MF and monitoring programs in other WA fisheries with similar fishing methods.

Assessments

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

A risk assessment for the identified non-retained/bycatch species (including those that the fishery has direct interaction with but does not result in capture) was completed (see Section 3.4 for details). As previously mentioned, none of the non-retained species were given beyond a **Negligible risk** rating.

Unmarketable Species– Summary

ERA Risk Rating (C0 L6 Negligible)

A small number of finfish including queenfish, pike, tuna and shark species are caught by the troll fishery and returned because they are of low market value. However, trolling is a highly specific fishing

method resulting in a low number of species being caught and a minor catches of non-target species taken whilst trolling. Also, a high proportion of the above species are expected to survive capture and release by the fishery. Therefore, this fishery is a **Negligible risk** for this issue.

Species that mackerel fishers are not licenced to retain- Summary

ERA Risk Rating (C0 L2 Negligible)

A small number of finfish are occasionally caught by the troll fishery and returned because fishers do not possess a licence to retain them. These species may include tuna, billfish, sharks and demersal reef fish in the Pilbara and Kimberley sectors (M. Mackie *pers. comm.*). Such species are under formal management arrangements in other state or Commonwealth fisheries and may only be retained by fishers licenced in the relevant fishery. The catches of these species taken by the MF and all other sectors (e.g. recreational) will be included in the relevant fishery assessments. Additionally, due to the highly selective fishing method used in the MF low numbers of species are caught resulting in minor catches of non-target species. Also, a high proportion of the above species are expected to survive capture and release by the fishery. This resulted in an overall **Negligible risk** for this issue.

Management Responses

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

Not applicable.

2.1.4 An indicator group of bycatch species is monitored.

Due to the minimal risks associated with these groups of non-retained species, it is not necessary to monitor any of these species in the longer term.

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

The risks associated with these groups of species will be reassessed at the next major review of this fishery. This will occur within five years, as a requirement of the WA ESD policy.

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

Given the relatively low levels of interactions of the Fishery with non-retained species and the relatively selective method of fishing used in the fishery it is likely that the level of interaction will continue to be only minimal with only acceptable levels of impact occurring.

OBJECTIVE 2. PROTECTED, THREATENED AND ENDANGERED SPECIES

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

Information Requirements

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

The information provided in this submission regarding the interaction of this fishery with endangered, threatened and/or protected species is from fishers within this fishery.

Assessments

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

A formal risk assessment for each of the identified non-retained/bycatch species/groups (including those with direct interaction but no capture) was completed (see Section 3.4 for details). The assessment concluded that the MF did not capture or interact with any endangered, threatened or protected species.

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

There are no threatened ecological communities associated with the Fishery.

Management Responses

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

There are no measures in place because to date there has been no reported captures or interactions between the fishery and any endangered, threatened and/or protected species.

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

Not applicable.

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

There have been no reported interactions (including captures) of endangered, threatened and/or protected species with this Fishery therefore it is unlikely that this fishery is having any unacceptable impacts on these species. Nonetheless, if they are inappropriate and/or the level of interactions increases, appropriate alterations to practices will be taken.

OBJECTIVE 3. GENERAL ECOSYSTEM

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

The issues that relate to the broader ecosystem, which were identified for this fishery are shown below in the component tree. An internal risk assessment process subsequently assessed each of these issues with the information relating to each issue detailed in Section 5.3.

There were five issues identified, four which were given a **Negligible risk** rating. The issue of translocation of organisms was given a **Low risk** rating. Consequently, the Fishery's current performance is meeting Objective 3 and this acceptable performance is likely to at least continue or improve in the future due to the implementation of further management arrangements.

Information Requirements

2.3.1 Information appropriate for the analysis in 2.3.2 is collated and/or collected covering the

fisheries impact on the ecosystem and environment generally.

Appropriate levels of information have been obtained for most of the issues identified, which has allowed for a sensible assessment of the level of risk to be determined. This information includes data collected directly related to the Fishery – in terms of the catch and effort. In addition, current and future research in this fishery and other similar fisheries has and will continue to provide the Department of Fisheries with relevant information to allow for the development of appropriate management responses.

Assessments

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

A risk assessment was completed (see Section 5.3 for details) on each of the identified issues relevant to the Fishery (see component tree for issues). The identified issues that were assessed and a summary of the outcomes are located in Table 4- complete justification are located in the performance reports in Section 5.3.

Table 5 Summary of risk assessment outcomes for environmental issues related to the MF.

ISSUE	RISK	SUMMARY JUSTIFICATION	FULL DETAILS
Impact from removal/damage to organisms:			5.3.1
Bait Collection	Negligible	In most sectors, fishers purchase bait and do not catch their own bait. There are at least 3 mackerel fishers that catch their own bait, although only 2 are known to do so on a regular basis. It is estimated that <1 tonne and <0.5 tonne of bait are caught in the Pilbara and Gascoyne/West Coast sectors, respectively (M Mackie pers. comm.). The collection of bait by mackerel fishers is currently being reviewing in conjunction with the implementation of the IMP. It is anticipated that any bait collection permits that are issued under the IMP will be restricted to those fishers who can demonstrate a significant history of bait collection in the fishery. Conditions of the permit will include a requirement to report all catches of bait in logbooks.	5.3.1.1
Benthic Biota	Negligible	Anchoring of vessels is largely restricted to the Pilbara and Kimberley sectors. The duration of fishing trips is several days in these sectors and fishers will anchor overnight whilst at sea. Anchoring occurs in shallow, sheltered locations over sand habitats. Shallow sand habitats are naturally dynamic due to the environmental influences, and so the infauna are adapted to be resilient to occasional physical disturbances such as anchoring.	5.3.1.2

Trophic Interactions	Negligible	All species caught by the method of trolling are fast swimming, pelagic carnivores. There is no evidence that any of these species play a 'keystone' role in the ecosystem. In a review of scientific studies on the effects of fishing on marine ecosystems, Jennings and Kaiser (1998) concluded that "where the functional and species diversity of fishes is relatively high, the indirect effects of fishing on the abundance of unfished prey species appears to be minor". The Department recognises that an assessment of trophic impacts by fisheries at a regional level, rather than at the individual	5.3.1.3
		fishery level, would be beneficial. Consequently, the Department will be investigating the development of research to identify any detectable changes in the structure of coastal fish communities over the last 40 years.	
Impact from addition/movement of biological material:			5.3.2
Translocation of Organisms	Low	Some vessels used in this fishery travel between sectors and could potentially be a vector for exotic species and diseases. However, hulls are regularly anti-fouled. Also, most vessels in the fishery operate in only one sector and do not travel outside that sector. The Leeuwin Current flows along the length of the WA coastline, transporting biological material and resulting in a high level of biological connectivity between sectors. Therefore, vessels are unlikely to translocate organisms beyond the range of dispersal that would occur through natural processes. Under the new IMP, vessels will be zoned which will impose restrictions on the movement of vessels and further reduce the potential for translocation of organisms between sectors.	5.3.2.1
Discarding/Provisioning	Negligible	The majority of biological material discarded by the fishery is processed fish waste. This tends to sink after being discarded and is likely to disperse as they sink in the water column due to the currents, so the impact of discarding will be diffused. The total quantity of biological material discarded by the fishery is low, relatively to the biomass of available food sources naturally available to carnivores and scavengers in each sector. It has been estimated that the weight of mackerel waste discarded in the Kimberley sector in 2001 was 64 tonnes, approximately 12 tonnes in Pilbara sector and discards of processed mackerel is minimal in the Gascoyne/West Coast sector because the majority of catch is retained whole for export. Additionally, trolling is a highly selective fishing method therefore total catch of non-retained species is small and some of the fish have a high likelihood of survival after capture and so do not contribute to biological provisioning in the fishery.	5.3.2.2

Thus, all of these issues were rated as **Negligible or Low risk**.

Management Responses

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

The most important management methods required to ensure that there is minimal impact on the broader ecosystem include maintaining significant stock/biomass levels of mackerel species. In most cases this serves to achieve both objectives of having a sustainable fishery and minimizing the potential for any trophic interactions. Other management measures such as quota management, legal minimum sizes, seasonal closures, gear restrictions and future research also further minimise the potential for impacts.

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

None of the issues were of sufficient risk to require specific target levels as they are effectively covered by the other management arrangements and trigger points.

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

Given that the risk assessment identified that under current management arrangements there have been minimal or negligible impacts from the Fishery on the broader ecosystem even after around 30 years of fishing, it is highly likely that the fishery will continue to meet the objectives of having only acceptable levels of impacts.

APPENDIX 5 APPROVAL AND RECOMMENDATIONS FROM EA

Commonwealth of Australia

Environment Protection and Biodiversity Conservation Act 1999

Accreditation of a Plan of Management for the Purposes of Part 13

I, Ian Cresswell, Assistant Secretary, Wildlife Trade and Sustainable Fisheries Branch, as Delegate of the Minister for the Environment and Heritage, being satisfied that:

The *Western Australia Mackerel Fishery Interim Management Plan 2004*, made under the *Western Australian Fish Resources Management Act 1994*, requires persons engaged in fishing under the management regime to take all reasonable steps to ensure that members of listed threatened species, listed migratory species, cetaceans and listed marine species are not killed or injured as a result of the fishing; and

The fishery to which the management regime relates does not, or is not likely to, adversely affect:

the survival or recovery in nature of any listed threatened species; or

the conservation status of a listed migratory species, cetacean, or listed marine species or a population of that species, hereby accredit the *Western Australia Mackerel Fishery Interim Management Plan 2004*, pursuant to sections 208A, 222A, 245 and 265 of the *Environment Protection and Biodiversity Conservation Act 1999* for the purposes of Divisions 1, 2, 3 and 4 of Part 13 of the Act.

Dated this 11th day of November 2004

[signed]

Ian Cresswell

Delegate of the Minister for the Environment and Heritage

Commonwealth of Australia
Environment Protection and Biodiversity Conservation Act 1999
Amendment of List of Exempt Native Specimens

I, Ian Cresswell, Assistant Secretary, Wildlife Trade and Sustainable Fisheries Branch, Delegate of the Minister for the Environment and Heritage, pursuant to subsection 303DC(1) of the *Environment Protection and Biodiversity Conservation Act 1999* (the Act), hereby amend the list of exempt native specimens established under section 303DB of the Act by including in the list the following specimens:

- Specimens that are or are derived from fish or invertebrates, other than specimens that belong to species listed under Part 13 of the Act, taken in the Western Australian Mackerel Fishery, as defined in the *Western Australia Mackerel Fishery Interim Management Plan 2004*, made under the *Western Australian Fish Resources Management Act 1994*.
- with a notation that inclusion of the specimens in the list is subject to the following restrictions or conditions:
- The specimen, or the fish or invertebrate from which it is derived, was taken lawfully;
- The specimen is included on the list until 17 November 2009.

Dated this 11th Day of November 2004

[signed]

Ian Cresswell

Delegate of the Minister for the Environment and Heritage

The Hon Kim Chance MLC
Minister for Agriculture, Forestry and Fisheries
11th Floor, Dumas House
2 Havelock Street
West Perth WA 6005

Dear Minister

I am writing to you as Delegate of the Minister for the Environment and Heritage in relation to the assessment of the Western Australian Mackerel Fishery under the *Environment Protection and Biodiversity Conservation Act 1999* (the Act). In June 2004 the Department of Fisheries Western Australia (DFWA) submitted the document *Final Application to the Australian Government Department of Environment and Heritage on the WA Mackerel Fishery* for assessment under the Act.

The submission has been assessed for the purposes of the protected species provisions of Part 13 and the wildlife trade provisions of Part 13A of the EPBC Act.

I am pleased to advise that assessment of the fishery is now complete. The assessment report will be available on the Department of the Environment and Heritage (DEH) website at: <http://www.deh.gov.au/coasts/fisheries/assessment/index.html>.

I am satisfied that the management arrangements for the fishery require that all reasonable steps are taken to ensure that protected species are not injured or killed and the level of interactions with such species in the fishery is not likely to adversely affect the conservation status of protected species or the survival and recovery of listed threatened species. Hence, the management arrangements for the Western Australian Mackerel Fishery meet the requirements of Part 13 of the Act and I propose to accredit the management plan accordingly. Accreditation will ensure that individual fishers operating in accordance with the management arrangements are not required to seek permits in relation to interactions with protected species in Commonwealth waters.

I am satisfied that for the purposes of the wildlife trade provisions in part 13A of the EPBC Act, the management arrangements provide the basis for the fishery to be managed in an ecologically sustainable way. I therefore propose to amend the list of exempt native specimens, to include specimens that are or are derived from fish taken in the Western Australian Mackerel Fishery, excluding specimens that are listed under Part 13 of the EPBC Act, for a period of five years. Such listing will serve to exempt the fishery from the export controls of the EPBC Act, providing the fishery continues not to involve the export of specimens listed on the Convention on the International Trade in Endangered Species.

The management arrangements for the fishery generally comply with the Australian Government's *Guidelines for the Ecologically Sustainable Management of Fisheries*. The fishery is well managed under a comprehensive, adaptable, precautionary and ecologically based regime capable of controlling, monitoring and enforcing the level of take from the fishery.

The combination of management arrangements, data gathering, proposed research and monitoring and nature of the fishery allows confidence that the fishery managers will maintain low bycatch levels, minimise interaction with protected species and manage impacts on the wider ecosystem.

While there are some environmental risks associated with this fishery, I believe that the DFWA is addressing them adequately. Officers from our two departments have discussed key areas requiring ongoing attention. I understand that they have agreed to a number of recommended actions, focusing on ensuring the continuation of good management practices, to be implemented before the next Australian Government review of the fishery.

These recommendations, attached to the letter, have been an important factor in my decision to exempt the fishery and I look forward to receiving your confirmation that they will be implemented.

I would like to thank you for the constructive way in which your officials have approached this assessment and I look forward to reviewing the remainder of the Western Australia managed fisheries.

Yours sincerely

[*signed*]

Ian Cresswell

Delegate of the Minister for the Environment and Heritage

11 November 2004

Recommendations to the Department of Fisheries Western Australia on the ecologically sustainable management of the Western Australian Mackerel Fishery

The Western Australian Mackerel Fishery is a well-managed fishery with a range of significant management measures to promote the ecologically sustainable harvesting of species from the fishery. These measures include:

- A range input and output controls for the target species;
- A range of reviewable management objectives and performance measures and indicators contained within the ESD report for the fishery;
- Highly targeted fishing methods with negligible interactions with non-target species and the surrounding marine ecosystem.

The following recommendations have been made to further strengthen the effectiveness of the management arrangements for the fishery and minimise environmental risks in the medium to longer term. DFWA should action these recommendations before the next review in 2009.

Recommendation 1

DFWA to advise DEH of any material change to the fishery's legislated management plan and/or arrangements that could affect the criteria on which EPBC decisions are based, within three months of that change being made.

Recommendation 2

DFWA, in its annual State of the Fisheries Report, to report on the performance of the fishery against performance measures that relate to the sustainability of the fishery.

Recommendation 3

The ESD Report, including all performance measures, responses and information requirements to be incorporated into the management regime and decision making process.

Recommendation 4

DFWA, within 2 years, to incorporate into the management regime fishery specific objectives, performance indicators and performance measures for byproduct species or species groups and for bycatch. DFWA, within 1 year, to also incorporate into the management regime objectives to minimise interactions with protected/listed species and to minimise impacts on the marine environment.

Recommendation 5

DFWA to ensure, where appropriate, that any relevant charter boat, conservation and recreational interests in the fishery are considered through consultative mechanisms.

Recommendation 6

DFWA to develop a compliance strategy for the WAMF. The strategy will provide for periodic review and explicitly address the effectiveness of the input regime, the proposed ITQ regime and those controls applying to the recreational sector.

Recommendation 7

DFWA to review monitoring and research needs and priorities to meet the stock assessment and management information requirements for the WAMF. DFWA to also develop a monitoring and research strategy to address priority needs, including stock assessment research needs for Spanish and Grey mackerels.

Recommendation 8

Within 18 months, DFWA to develop a process to improve estimates of recreational take, particularly in the West Coast and factor these into stock assessments and management controls to ensure overall catch levels are sustainable.

Recommendation 9

DFWA to review the effectiveness of measures to control recreational catch of Spanish mackerel, particularly in the West Coast to ensure that these measures are appropriate and adequately constrain recreational effort. Should the review indicate that existing measures are not appropriate, DFWA will initiate new measures within 12 months of that finding.

Recommendation 10

DFWA to develop and implement, within 18 months, a robust system to validate fishery dependent data on catch and effort for all target and byproduct species.

Recommendation 11

DFWA to implement a system to improve the identification and recording of elasmobranch species taken as byproduct in the WAMF.

Recommendation 12

DFWA will provide a mechanism by which fishers are able to record interactions with those non-retained species that are at risk from the fishery.

Recommendation 13

DFWA to provide a mechanism, which allows fishers to record interactions with protected/listed species. DFWA to implement an education program to ensure that industry has the capacity to make these reports at an appropriate level of accuracy.