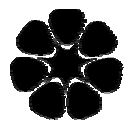


# ASSESSING THE ECOLOGICAL SUSTAINABILITY OF THE NORTHERN TERRITORY SPANISH MACKEREL FISHERY



A report prepared for Environment Australia as required for assessment under the Environment Protection and Biodiversity Conservation Act 1999.



**Northern Territory Government**

Department of Business, Industry & Resource Development

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## **Disclaimer**

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## **EXECUTIVE SUMMARY**

The Northern Territory Spanish mackerel fishery is an ecologically sustainable resource, managed under the *Northern Territory Fisheries Act 1988*.

Management of the fishery is guided by the Spanish Mackerel Fishery Management Advisory Committee, which includes representation from the commercial and recreational fishing sectors. The Committee drafted the Spanish Mackerel Fishery Management Plan in 1993 with public consultation and is currently reviewing the Plan to address such issues as Spanish mackerel byproduct in other managed fisheries and the introduction of sectoral catch shares in the dedicated fishery. The implementation of the revised Management Plan and a proposed Spanish mackerel Byproduct Action Plan for fisheries targeting species other than Spanish mackerel is scheduled for late 2002.

Logbook returns from commercial Spanish mackerel fishers and fishing tour operators (FTOs) are submitted to the Fisheries Division and provide the necessary details for stock assessments. Recreational and indigenous catch of Spanish mackerel is unknown at this time, however, the National Recreational and Indigenous Fishing Survey, currently underway, aims to provide catch and effort information. Management of FTOs is achieved through the same controls as recreational fishers as they are subject to the amateur fishing regulations. Biological information is collected by commercial fishers and Fisheries research officers.

Two public stock assessment workshops have been conducted for the Spanish mackerel fishery, in 1997 and 2000. A target annual yield of 450t of Spanish mackerel has been established for the fishery, based on a series of stock assessments since 1990. A notional catch limit of 90% of this target annual yield (by whole weight) has been defined as a major trigger point for the fishery. If the total fishery catch reaches this limit, a major review of the fishery and its management arrangements will take place to ensure overall catches are sustainable. Spanish mackerel stocks and management arrangements are reviewed annually through the production of the Spanish mackerel Status Report and the Annual Technical Report.

The Spanish mackerel fishery shows evidence of historical overfishing whilst the Taiwanese gillnet fleet targeted the species throughout the late 1970s to mid 1980s. Management of the fishery passed from the Commonwealth Government to the Northern Territory in 1988 and the number of licences was limited from 1990. Since this time, fishers targeting Spanish mackerel have significantly decreased from in excess of one hundred licences under the Pelagic fishery to 19 licences in the Spanish mackerel fishery. The surrender of two restricted licences for an unrestricted licence has provided the means for further reduction of commercial effort in the fishery. These effort controls are largely responsible for the stock recovery of Spanish mackerel we see to date.

The small numbers of commercial Spanish mackerel fishers, using species-specific gear and targeted fishing practices pose minimal impact on the ecosystem and environment as a whole. FTOs, recreational and indigenous fishers use similar gear and targeting methods.

The Spanish mackerel fishery and Spanish mackerel stocks are reviewed annually at the Northern Australian Fisheries Management Workshop, attended by fisheries managers, researchers and compliance officers from Western Australia, the Northern Territory, Queensland and the Commonwealth. Current management arrangements take into account controls in neighbouring jurisdictions, whilst complementary management arrangements between the States/Territory have been agreed, should research define shared stocks of Spanish mackerel. This forum is effective in addressing cross jurisdictional issues, particularly stock assessment and bycatch information.

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## 1 INTRODUCTION

### 1.1 Description of the Spanish mackerel fishery

Management of the Northern Territory Spanish mackerel fishery is achieved under the Northern Territory *Fisheries Act* and the Spanish Mackerel Fishery Management Plan.

Fishing tour operators (FTOs), recreational and indigenous fishers may catch Spanish mackerel in all NT waters and commercial fishers may harvest stocks seaward of the high water mark to the outer boundary of the Australian Fishing Zone.

The commercial Spanish mackerel fishery is managed by input controls including limited entry, a licence reduction scheme and gear restrictions. Licences have decreased from 28 to 19 since the introduction of a two for one licence reduction program in 1992, whereby two restricted Spanish mackerel licences are relinquished for the provision of one fully transferable licence. During 2001, 14 commercial fishers actively participated in the fishery.

Fishers may operate from a mother boat with up to two dories and use any number or combination of troll lines, floating handlines and rod and lines (see Appendix I). It is common for fishers to troll two to four lines behind a dory and up to eight lines from a mother boat. The majority of commercial fishers purchase bait for their fishing operations, however, a small number of operators (less than five) fish for bait under a restricted bait net entitlement (see Appendix I for the definition and use of a restricted bait net). Bait fish harvested under this entitlement may only be used for commercial fishing of Spanish mackerel.

Commercial fishers are required under the *Fisheries Act* to provide logbook returns to the Fisheries Division, listing catch, effort and market details, on a monthly basis.

Spanish mackerel byproduct limits have been imposed for a range of offshore and near-shore fisheries. The Timor Reef and Demersal fisheries have a nil byproduct of Spanish mackerel and the Commonwealth-managed Northern Prawn and Western Tuna fisheries may have a total of ten finfish in possession, including Spanish mackerel. Spanish mackerel byproduct arrangements for Northern Territory fisheries that target other species, have been canvassed through the review of the Spanish Mackerel Fishery Management Plan. The Barramundi and Shark fisheries have agreed to implement Spanish mackerel byproduct limits (see Principle 1.1.4).

The recreational fishery is managed through input and output controls. Recreational fishers are bound by amateur fishing regulations (Appendix II) and each fisher may have up to five Spanish mackerel in possession at any time. Recreational catch may not be sold, offered for sale or bartered.

FTOs, or fishing guides, are licensed by the Fisheries Division and managed under amateur fishing regulations. It is a provision of licence that FTOs record daily fishing activities on all species caught, including Spanish mackerel and submit this information as a logbook, monthly.

Indigenous fishers may take Spanish mackerel for traditional purposes and as a recreational pursuit utilising amateur gear.

## 1.2 History of the Fishery

Until the early 1970s, the holder of a General Fishing licence, issued under the NT Fisheries Ordinance, could land and sell any fish, including Spanish mackerel. Throughout the 1970s the taking of Spanish mackerel was restricted to Net and Line licensees.

With the passage of the *Fish and Fisheries Act and Regulations in 1980*, the Net and Line licence was superseded, with commercial mackerel fishers issued a Reef and Mackerel licence. In 1984, the licensing scheme was further refined, with Pelagic, Inshore Reef Fish or Offshore Reef Fish fishery endorsements allowing trolling as a permitted fishing method to take Spanish mackerel. Fishers were encouraged to operate under a Pelagic fishery endorsement when targeting Spanish mackerel.

A Taiwanese gillnet fleet commenced fishing for pelagic species, including Spanish mackerel, in 1974. Overall catches from the Australian Fishing Zone (AFZ) peaked at 10 000t pa processed weight, with shark, tuna and mackerel being the main species. The foreign fishing fleet was permitted to fish within 12 nautical miles of the NT coast until 1978, at which time they were excluded from waters adjacent to Arnhem Land and the Wessel Islands. Foreign fishing vessels were excluded from the Gulf of Carpentaria in the following year. Net lengths were restricted during 1986 in response to declining shark catch rates and concerns about the incidental capture of dolphins. These controls resulted in the conclusion of foreign fishing operations in northern Australian waters, late in that year.

The Commonwealth Government managed all fish species in northern Australian waters beyond three nautical miles of the coast, until the passage of the Offshore Constitutional Settlement in 1988. The Northern Territory Government assumed responsibility for the management of Spanish mackerel at this time for all waters adjacent to the NT coast to the outer boundary of the AFZ.

A ceiling on the number of licences in the Pelagic fishery was introduced in 1990. A public announcement on 1 April 1991 advised that the landing of Spanish mackerel by other than the holder of a Pelagic endorsement might not be recognised in any future allocation of fishing entitlements.

With the declaration of the Spanish mackerel fishery in 1991, only those licensees able to demonstrate a reliance on the fishery maintained access. Consequently, the number of licences was reduced to 28. A further licence reduction scheme was introduced in 1993, whereby new entrants to the Spanish mackerel fishery were required to either surrender two pre-existing licences or acquire a licence issued on the surrender of two licences.

A complete summary of the history of licensing and management arrangements is provided in Appendix III.

## 1.3 Management of the Spanish Mackerel Fishery

The Spanish mackerel fishery was declared under the Northern Territory *Fisheries Act* on the 1<sup>st</sup> July 1991 by notice in the NT Government Gazette, No. G28. The Spanish Mackerel Fishery Management Advisory Committee (SMACFMAC) was also established at this time.

SMACFMAC was formed to provide a consultative group to make recommendations on the future management of the Spanish mackerel fishery. A complete list of members is detailed under Item 2.3 of the Guidelines in this report.

Notable achievements of the Committee to date include formulating management arrangements which led to the initial Spanish Mackerel Fishery Management Plan and subsequent review, continuance of the licence reduction scheme and recommendations for the reduction of the incidental byproduct of Spanish mackerel in other commercial fisheries.

The Spanish Mackerel Fishery Management Plan was enacted on the 27 January 1993 (Appendix I). The Plan provided the means to reduce commercial fishing capacity and implement a possession limit for recreational fishers.

#### 1.4 Species Description

Narrow-barred Spanish mackerel (*Scomberomorus commerson*) inhabits tropical and subtropical waters of the Indo-Pacific, from Africa to Fiji. The species is found in Australian coastal waters of around 20°C or warmer, from Geographe Bay in Western Australia, throughout the northern coast and the eastern coast to the lower south coast of New South Wales.

Spanish mackerel school mostly with fish of similar size and of the same sex, over reefs to a depth of about 100 metres. Preliminary research from the FRDC-funded project: *Stock Structure of northern and Western Australian Spanish mackerel (98/159)*, indicate that there may be several semi-discrete stocks across the coast of the Northern Territory.

Spanish mackerel grow rapidly and to a large size with record fish exceeding two metres in length and purported to weigh up to 100 kg. Most fish in the commercial catch vary between 90 and 150cm fork length and average 10kg. Typically, most of the fish in the NT commercial catch are 4 to 6 years old.

Spanish mackerel reach reproductive maturity as early as two years of age and females, as small as 90 cm fork length, may have already spawned for two or more seasons before they are subject to commercial fishing. They are batch spawners (females' spawn every few nights during a spawning run) and spawning may be repeated over a protracted season in tropical waters.

An overview of the biology of Spanish mackerel is provided in the 1999 Fishery Assessment Report (Appendix IV).

## **2 ASSESSMENT OF THE MANAGEMENT REGIME AGAINST THE COMMONWEALTH (ENVIRONMENT AUSTRALIA) GUIDELINES**

The management regime must operate under Principles 1 and 2 and should be:

### **2.1 Documented, publicly available and transparent**

The Spanish Mackerel Fishery Management Plan (Appendix I) is available from the Department of Business, Industry and Resource Development (DBIRD) (formerly the Department of Primary Industry and Fisheries (DPIF)) and online at the Department's website [www.dbird.nt.gov.au](http://www.dbird.nt.gov.au).

Commercial fishers are briefed on the management arrangements and provided a copy of the Spanish Mackerel Fishery Management Plan prior to entering the fishery.

The Spanish mackerel fishery Status Report and the Annual Technical Report are published annually, providing updated catch trends and status of the Spanish mackerel fishery. These reports are available to the public online through the Department's website or in hard copy through the Fisheries Division.

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

Section 24 of the *Fisheries Act*, provides for the Minister to establish a fisheries management advisory committee to assist the Director in preparing proposed management plans. The Spanish mackerel fishery was declared a managed fishery in 1991 and the Spanish Mackerel Fishery Management Advisory Committee (SMACFMAC) was appointed at that time. SMACFMAC assisted Fisheries Division to produce the first draft of the Spanish Mackerel Fishery Management Plan that was released for public comment in September of that year.

The draft Management Plan was made available to all commercial Spanish mackerel fishers, the Northern Territory's recreational peak body- the Amateur Fishermen's Association of the Northern Territory (AFANT), interested community and environmental groups and the general public, through the former Department of Primary Industry and Fisheries, tackle shops and the NT Fishing Industry Council, now known as the Northern Territory Seafood Council. Public submissions were considered by SMACFMAC in 1992 and a draft Management Plan was approved by the Minister for Primary Industry and Fisheries in January 1993.

A review of the Spanish Mackerel Fishery Management Plan commenced in November 2000. The Fisheries Division, in recognising the legislative requirement, directed that SMACFMAC conduct a formal review of the existing Plan and make recommendations on future management arrangements, to ensure that the management regime continues to provide for the sustainable management of NT Spanish mackerel stocks.

A Discussion Paper (Appendix III) was distributed to all key stakeholder groups, including the general public and conservation groups, for comment. The Paper was also tabled for discussion at relevant Aboriginal Consultative Committee meetings. The release of the

Discussion Paper was announced through advertisements in all major regional newspapers and on the Department's website.

The public comment period for the Discussion Paper extended to five months, with four submissions received. The submissions were discussed at the June 2001 SMACFMAC meeting and will be considered in the drafting of the revised Spanish Mackerel Fishery Management Plan.

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

### **2.3.1 Management Committees**

Section 24 of the *Fisheries Act* allows the Minister to appoint members to an advisory committee. Through Ministerial appointment, membership of SMACFMAC includes the:

Director of Fisheries (Chair)

Police Fisheries Marine Enforcement Unit representative (Compliance)

Spanish Mackerel Aquatic Resource Manager (Management)

Principal Spanish Mackerel Research Officer (Research)

One recreational angler

Three commercial Spanish mackerel fishers, and the

Executive Officers of the Northern Territory Seafood Council and AFANT are afforded "observer" status.

Indigenous people are consulted and informed of relevant fisheries issues through Aboriginal Consultative Committees. Established Aboriginal Consultative Committees seek to gain broad knowledge from Aboriginal Traditional Owner's, Government and Industry representatives regarding shared stocks. This consultative process aims to allow greater participation of Aboriginal people in the fishing industry through management and stock allocation. All Aboriginal Consultative Committees have been advised of proposed changes in the Spanish Mackerel Fishery and were provided with the Discussion Paper on the review of the Spanish mackerel fishery management arrangements, for comment.

Members of the public, including community and environmental groups are also invited to provide their views to Fisheries Division through the Discussion Paper and other consultative processes.

Environmental groups and non-government organisations are advised and consulted on topical fisheries issues, including Spanish mackerel, through monthly advisory meetings with senior fisheries officers and the Director of Fisheries.

### **2.3.2 Stock Assessment Process**

A range of national and international expert fisheries researchers have contributed to stock assessments of the Northern Territory Spanish mackerel fishery (see Principle 1.1.2).

Peer review of the Spanish mackerel stock assessment process was provided through a seminar presented at the 1993 Australian Society for Fish Biology Conference (Buckworth and Hall 1993).

Public stock assessment workshops reviewing the Spanish mackerel fishery were conducted in July 1997 and August 2000. These workshops were led by nationally and internationally recognised stock assessment scientists. Technical analyses involved northern Australian researchers from a range of institutions including DBIRD (then DPIF), Queensland Department of Primary Industries, Fisheries Western Australia, Sydney University, CSIRO and the Bureau of Resource Sciences.

Members of the public, commercial Spanish mackerel fishers, industry, recreational representatives, fisheries managers, conservation and indigenous groups, attended the public sessions of the stock assessment workshops. Introductory and conclusion sessions were held to inform and gather input from stakeholders for stock assessment modeling undertaken by researchers during the remainder of the workshop.

Queensland, the Northern Territory and Western Australia have commenced collaborative research projects on Spanish mackerel that seek to address the limitations in information that is currently available for stock assessment and management. This information will provide an improved understanding of stock relationships throughout northern Australia. Such research projects include the FRDC funded study: *Stock Structure of northern and Western Australian Spanish mackerel (98/159)* and *Stock Assessment of Spanish mackerel (Scomberomorus commerson) in Western Australia (99/151)*.

#### **2.4 Strategic, containing objectives and performance criteria by which the effectiveness of the management arrangements are measured**

The *Fisheries Act* aims to "*conserve, enhance, protect, utilize, and manage the fish and aquatic life resources of the Territory to -*

- (a) promote, develop and maintain commercial and amateur fishing;*
- (b) provide for optimum yields from a fishery and maintain the quality of the yield;*
- (c) ensure that the fisheries of the Territory are not endangered or overexploited;*
- (ca) encourage tourist and scientific interest in fish and aquatic life; and/or*
- (d) ensure that the habitats of fish or aquatic life and the general environment is not detrimentally affected".*

These objectives are achieved by the Spanish Mackerel Fishery Management Plan, primarily through reducing commercial participation rates to extremely low levels and further effort reduction programs, monitoring of catches and regular review of management plans. Possession limits have been imposed for recreational anglers. The effectiveness of these management arrangements are assessed through the annual desktop review of the Spanish mackerel fishery.

The review of the Spanish Mackerel Fishery Management Plan, promotes

- The long term sustainability of the Spanish mackerel fishery and the ecological processes on which they rely;
- Equitable, quality fishing opportunities for all stakeholder groups; and
- Effective, efficient and consistent management that supports the sustainable use of individual Spanish mackerel stocks.

These objectives and performance indicators (defined in Table 1) will be incorporated in the revised Spanish Mackerel Fishery Management Plan.

The Northern Australian Fisheries Management Workshop is held annually and attended by members from the three northern States/Territory and Commonwealth governments. Strategic directions for research and management of all northern fisheries are discussed at this forum, including Spanish mackerel.

## **2.5 Capable of controlling the level of harvest in the fishery using input and/or output controls**

The level of harvest in the Spanish mackerel fishery is controlled through a combination of input and output controls.

The commercial fishery effort and subsequent level of harvest, is restricted to extremely low levels through limited entry into the fishery, a licence reduction scheme and gear restrictions.

The recreational fishery catch is limited by gear restrictions and possession limits, with each recreational fisher (including fishing tour operators and their clients) restricted to a possession limit of five Spanish mackerel.

The agreed 450t target annual yield of Spanish mackerel will limit the level of harvest in the Spanish mackerel fishery.

See Principle 1.1.7 for a complete overview.

The Spanish mackerel fishery management arrangements, together with byproduct limits of Spanish mackerel in other fisheries, are appropriate to the size and scale of the fishery and are sufficient to control the level of harvest in the fishery.

## **2.6 Contain the means of enforcing critical aspects of the management arrangements**

The Police, Fisheries and Marine Enforcement Unit (PFMEU) of the Police, Fire and Emergency Services, undertake compliance on all Northern Territory fisheries under the Northern Territory *Fisheries Act*.

The PFMEU enforce all aspects of fishing operations, particularly gear restrictions. Compliance is mainly undertaken wharveside, but the PFMEU have the ability to enforce at sea.

The Northern Territory has only three ports for unloading catch. This assists monitoring of all commercial fishers, as all vessels must dock in limited locations.

PFMEU regularly check the byproduct of the Spanish mackerel fishery and Spanish mackerel in other commercial fisheries, for compliance with byproduct possession limits.

Recreational fishers and fishing tour operators are subject to random inspections to ensure compliance with the possession limit.

It is considered that limited sites to launch or dock vessels, together with a dedicated fisheries enforcement unit are sufficient to enforce the critical aspects of the management arrangements.

## **2.7 Provide for the periodic review of the performance of the fishery management arrangements and the management strategies, objectives and criteria**

Management directions and the day-to-day management of the Spanish mackerel fishery are reviewed at meetings of SMACFMAC. Members may propose new, or amendments to, the objectives of the management of the fishery at these meetings, however, the objectives are generally discussed through the periodic review of the management plan. Such reviews are scheduled every 3-5 years.

The Fisheries Division undertakes an annual desktop review of the Spanish mackerel fishery, with the outcomes published in the annual Status Report. The Status Report (Appendix V) is a co-authored document, compiled by the Northern Territory fisheries managers, fishery researchers and compliance officers. Annual catch and effort data of all sectors are reviewed from fishery dependent data. Analysis of the current year's information together with all previous datasets is undertaken annually. The number of compliance issues dealt with throughout the year also provides information on the effectiveness of the management arrangements, together with the number of concerns raised by the general public.

Strategic management directions are reviewed annually by fisheries managers, researchers and compliance officers, at the Northern Australian Fisheries Managers Workshop.

## **2.8 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**

The Spanish mackerel fishery is a surface-based fishery. The fishing gear used is species specific, does not interact with the substrate and observations suggest that the fishery has little interaction with the wider marine ecosystem.

The fishery is assessed and monitored through logbook returns, observers and fishery dependent research. Commercial fishers are required by legislation to submit daily or monthly logbook returns on all targeted catch and byproduct. There is a comments section on the logbook for fishers to note any impacts on the fishery, ecosystem or any general environmental considerations (Appendix VI). Fishing tour operators are also required to submit daily logbooks on a monthly basis (Appendix VII).

The recreational sector is monitored and assessed through periodic surveys. The most recent survey, FISHCOUNT (Coleman, 1998), was a multi-faceted survey including an innovative diary system, conducted amongst residents and visitors from late 1994 through to early 1996. The "attitudinal" portion of the survey gave recreational fishers the opportunity to report any concerns on the wider marine ecosystem.

A National Recreational and Indigenous Fishing Survey currently underway aims to provide detailed information on the take of Spanish mackerel by the recreational and indigenous fishing sectors. The Northern Territory portion of this survey chose to incorporate a question on fisheries habitat or the environmental aspects of fishing. Participants were asked about any concerns in these areas. Initial outcomes of the survey will be available early 2003.

If any adverse impacts on the ecosystem are identified through logbook comments, observers or research, the Minister may make emergency amendments to a management plan under Section 26 of the *Fisheries Act*. Alternatively, if it is not considered an emergency, changes may be achieved through amendments to the Management Plan.

It is considered that comments on logbook returns, together with observer and research studies, provide an adequate reporting system, appropriate to the scale of the fishery, that is sufficient to monitor the impact of the Spanish mackerel fishery on the wider marine ecosystem.

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

There are no threat abatement plans or recovery plans implemented for species of relevance to the Northern Territory Spanish mackerel fishery. The Territory's fishing effort is restricted to very selective fishing gear that aims to minimize both interaction with the environment and limit bycatch.

If it became apparent that a threat abatement plan/recovery plan/bycatch action strategy was required in the Northern Territory, the Fisheries Regulations or the Spanish Mackerel Fishery Management Plan would be amended to facilitate the plan.

The review of the Spanish Mackerel Fishery Management Plan has proposed that a Spanish mackerel bycatch/byproduct action plan be developed for fisheries targeting species other than Spanish mackerel (Appendix III). It is envisaged that the Spanish mackerel bycatch/byproduct action plan will be implemented throughout the latter half of 2002.

### **3 ASSESSMENT OF THE MANAGEMENT REGIME AGAINST PRINCIPLES 1 AND 2**

#### **3.1 PRINCIPLE 1**

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

##### **Objective 1**

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

##### **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.**

Commercial Spanish mackerel fishers are required by legislation to submit monthly logbook returns on their fishing activities to Fisheries Division. Fishers have the option to record fishing information on either a daily basis or by each fishing session within a particular locality. Commercial fishers are required to record the location of fishing operations, information pertinent to Spanish mackerel catch, effort and all byproduct species. A complete overview of the information collected from commercial fishers is provided in Appendix VI.

Commercial fishers that harvest bait fish under a Restricted Bait Net Entitlement are also required to submit monthly logbooks, detailing bait fish catch information. Catch information collected under the Restricted Bait Net Entitlement is detailed in Appendix VI d.

Fishing tour operators are also required to submit daily reports on all catch, either retained or released, effort and catch location details (Appendix VII). These reports are submitted monthly.

Fisheries Division has collated catch and effort data from domestic fishers since the 1960s under the General Fishing Licence. Logbook information was also collected from the Taiwanese gillnet fleet by the Commonwealth management body, for the period 1974-1986. This information has been incorporated in stock assessment models.

Market returns are required to be submitted with catch and effort logbooks. These returns detail target and byproduct species catch and their sale destination (see Appendix VI for a sample market return). Data from market returns is compared to the information on catch logbook returns as it is entered into the Fisheries Division database. Thereby, the market data also serves to validate catch returns. Both catch and market returns are audited annually for the production of the Status Report.

Observers undertake regular monitoring onboard vessels, to validate catch returns and audit the manner in which commercial fishers complete returns. They may also sample fish for

biological research including genetic analyses, gonad staging, measuring length and removing otoliths for age determinations (Appendix VIII). Monitoring of catch is also undertaken wharveside by Fisheries research staff. Researchers charter commercial Spanish mackerel fishers to undertake research, that is, researchers have “hired” a Spanish mackerel fisher and bought all of the catch for biological analysis.

Commercial Spanish mackerel fishers are trained by fisheries researchers to collect a range of biological information on their catch. Fishers provide information such as the fork length of the fish, sex and the stage of gonad development. A minimum of ten percent, and at times up to twenty percent of commercial catch, is sampled annually by commercial fishers and fisheries observers.

Logbook information provided by commercial fishers and fishing tour operators, together with biological information gathered by commercial fishers and fisheries research observers, is reliable and appropriate to the size and scale of the fishery.

The small catch, value and participation level in the Spanish mackerel fishery relative to its geographic scale have generally precluded fishery independent sampling. *S. commerson* swim at high speed and aggregate over reef habitat, generally precluding extensive trawl or gillnet surveys to ascertain abundance. The large variety of scombroid fishes and turbid waters of northern Australia also mean that aerial survey for abundance is impractical, while the level of sampling to ensure appropriate precision in egg production survey methods is not considered to be feasible. Traditional mark and recapture studies are beyond the size and scale of the fishery.

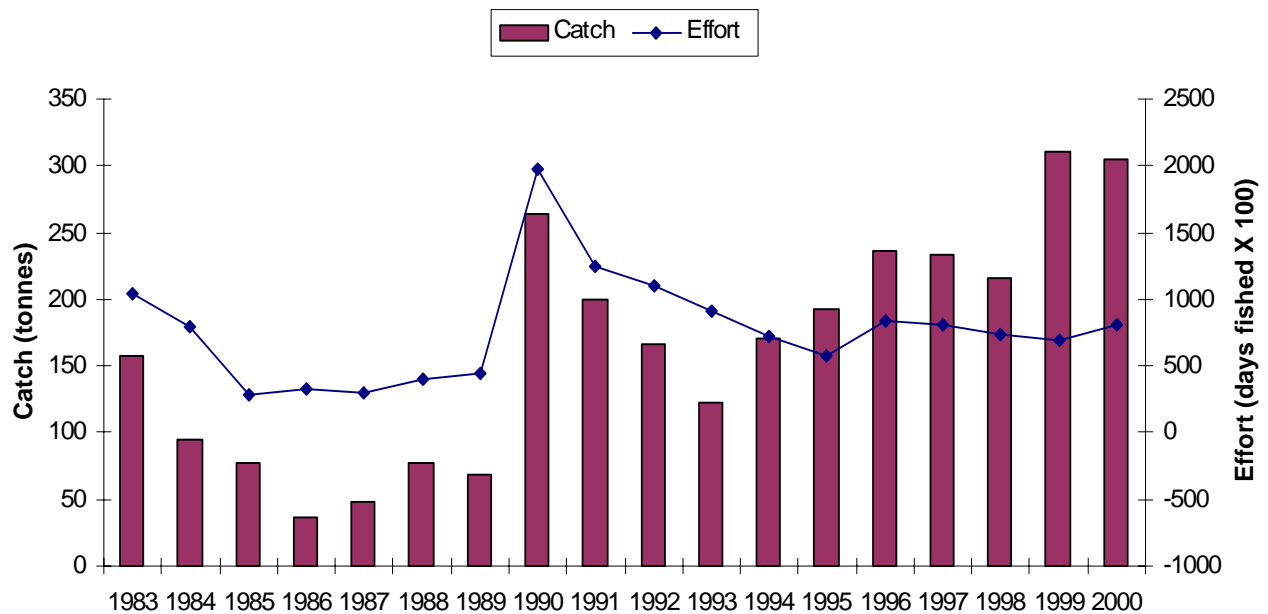
Information has been collected on the recreational catch of Spanish mackerel through FISHCOUNT (Coleman, 1998). This Territory-wide survey determined the estimated recreational landings of all mackerel species yet did not distinguish between the individual species of mackerel. Therefore, there is no accurate estimate at this time, of the recreational catch of Spanish mackerel.

Little information has been collected on the indigenous take of Spanish mackerel. The National Recreational and Indigenous Fishing Survey to be completed by early 2003, aims to provide catch and effort details on the recreational and indigenous take of Spanish mackerel. It is envisaged that further catch assessments will be undertaken on a periodic basis, for indigenous and recreational fishers.

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

Four major assessments of the status and dynamics of the Spanish mackerel fishery have been undertaken since the management of the fishery was passed to the Northern Territory Government. Annual desktop review and assessment of the fishery is undertaken through the production of the Annual Technical Report and the Status Report (Appendix V). Spanish Mackerel Fishery Assessment Reports (Appendix IV) are also published every 3-5 years.

Stocks of Spanish mackerel were assessed just prior to the declaration of the fishery in 1991. Taiwanese gillnet data, collected by the then Commonwealth Management Agency, was analysed in order to estimate the potential magnitude of the annual sustainable yield of the fishery. Data from domestic (NT) Spanish mackerel fishers was not included in this initial assessment as catch was minor (<270t) in comparison to foreign fishing vessel landings. Reported catches from the Taiwanese gillnet fleet in the late 1970s attained nearly 1000 tonnes of Spanish mackerel annually, with overall catches stabilizing between 400t and 500t of Spanish mackerel through the early 1980s (Stevens and Davenport, 1991). Anecdotal evidence also suggests that there may have been an under-reporting of catch from the Taiwanese gillnet fleet. Reductions in the catch per unit effort (CPUE) and mean size in this fishery during the early 1980s suggest that the species may have been overfished (Stevens and Davenport, 1991). These conclusions also corroborated those of earlier work on the status of the fishery (McPherson, 1985).



**Figure 1** Commercial catch and effort data for 1983-2000 of the Spanish mackerel fishery (by whole weight)

Long term reported landings of Spanish mackerel by foreign fishing fleets stabilised at around 400 to 500t pa. This value provides an estimate of the sustainable yield. The level of fishing effort was significantly reduced following the departure of the foreign fishing fleet in 1986. It is likely that Spanish mackerel stocks have been rebuilding since this time, which may increase the long term sustainable yield estimate for the fishery. However, with the lack of information necessary for alternative assessments, the magnitude of larger sustainable annual yields could not be ascertained, and the precautionary target of 450t annual yield for the fishery was adopted. Management arrangements, primarily maintaining commercial participation at low levels, offer an adequate level of protection by containing annual catches below the target annual yield. Subsequent years catches of Spanish mackerel have been a mere fraction of

the 450t level (until the late 1990s, the troll fishery catch was usually less than half this level), so there has been substantial opportunity for stock rebuilding.

It is anticipated that more rigorous assessment of the NT catch and effort data, supplemented by research information, will over time provide the basis for a more precise assessment. Subsequently, Fisheries Division has engaged in an annual review cycle of the fishery and further assessments will be conducted as more information becomes available (see Principle 1.1.1).

In 1992, Hall and Buckworth (Buckworth, 1993) undertook a stock assessment of the Northern Territory-managed Spanish mackerel fishery. Delay difference and age structured models, using catch and effort information from commercial fishers and input parameters describing growth and mortality rates derived from existing literature. Age at maturity and recruitment information was estimated from Fisheries observers and commercial fishers' monitoring data. This assessment assumed that the entire Northern Territory fishery harvested a single stock. The main conclusion from this work was that the catch and effort data were not informative about the impact of the fishery upon the stock. This provided the impetus to carry out analyses of otolith material collected during 1991-1994 (Buckworth, 1998a) to provide information on age structure.

Hall and Buckworth (unpublished) examined the catch and effort information and the preliminary results of the age structure study data in 1994 and again concluded that fishing showed no detectable impact on Spanish mackerel stocks. However, they emphasised the potential problems arising from the lack of an informative signal from the CPUE data, suggesting that, rather than indicating little impact on the fishery, it could arise from hyperstability. In this phenomenon, frequently observed in schooling species, catches and catch rates can remain stable if schools are successfully targeted, even though the size of the fish stock is diminishing (Hilborn and Walters, 1992).

Two public stock assessment workshops on Spanish mackerel were held in July 1997 and August 2000, hosted by the Northern Territory Fisheries Division. National and internationally recognised stock assessment scientists lead the reviews on Spanish mackerel stocks.

Equilibrium analyses of Spanish mackerel were undertaken during the 1997 workshop (Walters and Buckworth, 1997). Northern Territory commercial catch and effort data from 1983 to 1995 was analysed, including the age structure of the commercial catch for 1991-1994 (Buckworth, 1998a). The information on age and size composition of catches was compiled from length frequency sampling by commercial fishers and observer monitoring programs. The size at age values and ranges of natural mortality rates were derived from existing literature.

The age structure data proved to be more informative than the CPUE data. Nevertheless, the impact of the fishery on the stock, defined as harvest rates or fishing mortality rates, still remained uncertain. Further refinement of the available annual yield, derived from landings made by foreign fishing vessels, was not possible.

It was also noted that the low frequency of older fish in the age composition information could not be adequately explained by the CPUE information alone. Such patterns have arisen in other fisheries where fish migrate as they grow older and are then taken in other fisheries.

Given the accepted view at the time that Spanish mackerel undertook extensive migrations, it was suggested that these relatively low levels of older fish in the NT fishery could be due to their movement offshore and subsequent capture in international waters.

Initial results from the FRDC-funded project: *Stock Structure of the northern and Western Australian Spanish mackerel (98/159)*, indicate that *S. commerson* form a mosaic of small sub-stocks across the north of Australia and that it is unlikely that there are extensive movements (Buckworth *et al.*, in prep).

The 2000 Workshop (Buckworth *et al.*, in press) revisited much of the information previously analysed. Age structured models were used to analyse the catch and effort information from the NT fishery to 1999, as well as age composition information from 1991 to 1994 (Buckworth, 1998a) and information from the Taiwanese gillnet fishery.

The inclusion of the Taiwanese gillnet data proved to be particularly important. Even though the fishing mortality rate remained poorly defined, it became apparent that the age structure information, in particular the low frequency of older animals, probably reflected the heavy impact of the Taiwanese gillnet fleet. The low numbers of older fish may be attributed to removals from the population by over fishing by the Taiwanese gillnet fleet and subsequent reduction in recruitment. Such an interpretation suggests that the increasing CPUE ratio of the NT Spanish mackerel fishery is due to an increase in biomass.

Results of the 2000 workshop corroborated the 1997 workshop findings and suggested that the target annual yield of 450t of Spanish mackerel should remain until the fishing mortality rate was more accurately defined. It was also noted that the increasing CPUE may alternatively reflect behavioural changes, improved technical efficiency of operators, environmental trends, or some combination of all these factors.

Even though the 2000 workshop suggested that the impact of the fishery on Spanish mackerel stocks was poorly defined, the results indicate that the fish population is healthy, perhaps increasing. The 2000 analysis corroborates the conclusion that northern Australia's Spanish mackerel stocks were overfished by the Taiwanese gillnet fleet (Stevens and Davenport, 1991). At 300t, the present Spanish mackerel annual catch is around one third of the maximum reported Taiwanese gillnet catch (913 tonnes of Spanish mackerel in 1976) and the current CPUE figures are increasing.

New research techniques are being trialled to provide information on the present fishing mortality rate and stock size and structure, to assist stock assessment modeling of Spanish mackerel. Fisheries researchers are currently developing a new mark and recapture method to overcome problems with traditional tagging methods, which impose unacceptable levels of mortality in tagged mackerel.

An alternative method (to be trialled under a proposed Fisheries Research and Development Corporation project: *Genetic mark-recapture for real-time harvest rate monitoring. Pilot studies in northern Australia*) will assess the feasibility of *in situ* genetic sampling of Spanish mackerel and genetic auditing of the commercial catch. Marking the fish *in situ* enables monitoring of the catch for fishing mortality rates, is seeking to overcome the deficiency continually noted in assessments.

Fisheries researchers from Western Australia, Queensland and the Northern Territory meet annually through the North Australian Fisheries Management Workshop. Fisheries that straddle State/Territory boundaries, including Spanish mackerel, are reviewed at the workshop and new information pertaining to the species or fishery is discussed.

The current commercial harvest level of the Spanish mackerel fishery is substantially below the target annual yield, which suggests that current fishing levels are unlikely to impair the stocks' reproductive capacity. Removals by the fishery are likely to be substantially below any population fluctuations imposed by environmental variation and as such are also unlikely to have impact on biological diversity.

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

Spanish mackerel are distributed throughout tropical and subtropical waters of the Indo-Pacific, from Africa to Fiji. In Australian waters, they are found from Geographe Bay in Western Australia, throughout the northern coast and down the eastern coast to the lower southern coast of New South Wales.

The spatial relationships of Spanish mackerel from different locations in Australian waters are not well known. Genetic analyses indicate that Spanish mackerel from the northern Great Barrier Reef to New South Wales form a stock distinct from those of the Torres Strait and Gulf of Carpentaria.

The stock structure of Spanish mackerel throughout the Northern Territory and Western Australia is the subject of current studies on genetic examination, chemical analysis of otoliths and parasite studies. Collaborative research between Western Australia, the Northern Territory and Queensland through the FRDC-funded project *Stock Structure of northern and Western Australian Spanish mackerel (98/159)*, aims to identify the spatial distribution of Spanish mackerel stocks and the degree of mixing between stocks.

Early results of this work, together with the analysis of past Taiwanese gillnet data, suggests that there may be several functionally distinct Spanish mackerel sub-stocks across the top of Australia, forming a metapopulation. There may be very limited mixing of adult fish between the stock units but there is sufficient genetic interchange to ensure that they are genetically homogeneous. Fish sampled from Kupang, Indonesia, are quite distinct from northern Australian Spanish mackerel, suggesting limited movement of Spanish mackerel stocks between Australia and Indonesia. Outcomes of this research will be published upon completion of this project in 2003.

As an outcome of the Offshore Constitutional Settlement and the Memorandum of Understanding, the Northern Australian Fisheries Management Workshops (NAFMW) are held annually between Western Australia, Queensland, Northern Territory and the Commonwealth to reach agreement on management, research and compliance issues for northern Australia. Spanish mackerel has been identified as a species that may require complementary management between States/Northern Territory if the stocks are shown to be shared.

The FRDC project (98/159) will be reviewed upon completion by SMACFMAC. Complementary management arrangements between the States and Territory or management responses to cater for individual Spanish mackerel stocks, may be recommended by SMACFMAC to the Director of Fisheries.

There is a low risk of regional or localised depletion of Spanish mackerel stocks due to the low number of commercial and recreational fishers and fishing tour operators. The spatial catch and effort information of the Spanish mackerel commercial sector is reviewed annually through the production of the Status Report. If a localised depletion became evident through the annual review, management arrangements would be reviewed and recommendations of remedial management arrangements would be implemented under the Spanish Mackerel Fishery Management Plan.

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

Commercial Spanish mackerel fishers are required to submit daily or monthly logbooks of all catch, including byproduct (Appendix VI). Commercial fishers targeting species other than Spanish mackerel are also required to detail all byproduct, including Spanish mackerel. The harvest of Spanish mackerel from all commercial fisheries is included in stock assessments.

Byproduct limits for Spanish mackerel have been imposed for the Northern Territory Shark fishery. The "in possession" limit includes a base level of 300kg whole weight of Spanish mackerel as trunks and an additional 100kg as trunks for the fourth and every subsequent tonne of grey mackerel caught.

The Barramundi and Finfish Trawl fisheries also incidentally catch Spanish mackerel. Discussions are currently underway to determine an appropriate byproduct limit for these fisheries.

Commonwealth fishers are required to report byproduct through logbook returns and this data is made available for all NT Spanish mackerel assessments. The Northern Prawn fishery is currently restricted to an "in possession" limit of 10 fish of a range of species, including Spanish mackerel.

Fishing tour operators are licensed for the commercial activity of taking people on fishing tours. It is a requirement of their licence to submit daily returns of all catch including landings or fish released. This data, together with all commercial data is included in stock assessments of Spanish mackerel.

Comprehensive historical details on the recreational catch of Spanish mackerel and the majority of species of interest to recreational fishers in the NT is sparse.

A survey of the Northern Territory's recreational fishing sector was undertaken throughout 1995. This survey revealed that anglers landed 24 522 +/- 1796 mackerel throughout the survey period, with (13 400, 3 800, 3 500 and 3 000 mackerel from the Darwin Harbour,

Nhulunbuy, McArthur River and Cobourg Peninsula areas respectively) (Coleman, 1998). The survey did not distinguish between individual mackerel species. This means that the total recreational catch of Spanish mackerel is unknown at this time. However, estimates of the proportion of Spanish mackerel taken by recreational fishers, based on anecdotal evidence, is included in stock assessments to give an indicative total take of the species.

The National Recreational and Indigenous Fishing Survey (NRIFS) is currently underway. A descriptive brochure has been compiled for use throughout the survey to enable recreational and indigenous fishers to identify Spanish mackerel from other mackerel species. Information from this survey will be included in stock assessments and provide additional information to estimate landings of Spanish mackerel.

It is considered catch information, including byproduct species, from all sectors is appropriate to the size and scale of the fishery. Compliance of byproduct limits of Spanish mackerel in other fisheries is high, with no evidence of illegal take of Spanish mackerel.

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

In the absence of the details necessary for alternative assessments (see Principle 1.1.2), the approximate long term equilibrium catch of the Taiwanese gillnet fleet of 400 to 500 tonnes of Spanish mackerel per annum (calculated through stock assessments, as described under Principle 1.1.2) has been determined as the notional annual catch limit for the Spanish mackerel fishery.

The current overall catch of Spanish mackerel is 10% of the estimated total biomass of Northern Territory stocks (Buckworth and Hall, 1993). It has been predicted (from the analyses listed in Principle 1.1.2) that safe levels of fishing are between 20% and 30% of the fishable biomass for this species.

A mark and recapture method currently being trialled by researchers seeks to assist with estimating the fishing mortality rate and further refine the total biomass estimates for Spanish mackerel in Northern Territory waters. This information will provide an improved understanding of the potential productivity of the fished stock and a more precise potential harvest.

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

A notional catch limit for Spanish mackerel of 90% of the estimated sustainable yield (by whole weight) has been defined as the major reference/trigger point for the Spanish mackerel fishery.

The reference point has been determined, in consultation with stakeholders and the wider community, as a precautionary level at which a major review of the fishery will take place.

The 90% limit has been deemed precautionary as current catch levels are considerably lower than the reported landings made by the Taiwanese gillnet fleet fished for Spanish mackerel (1974 - 1986). The Taiwanese catch neared 1000t per annum of Spanish mackerel at this time, whereas current catch levels for the dedicated Spanish mackerel commercial fishery are around 300t. The recreational catch will be estimated through the information gained from the NRIFS, which should be available during the first half of 2002 (see Principle 1.1.7 for more information).

If 90% of the estimated sustainable yield (by whole weight) is reached, Fisheries Division will request SMACFMAC to review management arrangements so that the total take of Spanish mackerel will not exceed sustainable yield estimates. Management actions that may be considered by SMACFMAC are listed in Table 1.

The proposed introduction of sectoral catch shares has been generally agreed for inclusion in the revised Management Plan. That is, each sector (commercial and recreational) is allocated a share of the fishery. Individual sectors will trigger revised management arrangements for that sector if that sector's catch level changes by more than 20 percent (whole weight).

Any significant (20 percent) change (increase or decrease) in catch of a sectoral catch share or a 30% decline in the total catch of the fishery (by whole weight), will trigger a review of the fishery and the management arrangements. Catch levels are reviewed annually through the production of the Spanish mackerel Status Report and at the North Australian Fisheries Management Workshop.

**Table 1** Proposed management strategies for the Spanish mackerel fishery.

<b>Objective</b>	<b>Performance Indicator</b>	<b>Trigger Point</b>	<b>Management Action</b>
Ensure the sustainability of the Spanish mackerel stocks	Estimated catch by all sectors does not exceed the estimated sustainable yield of Spanish mackerel	Aggregate landings by all sectors reach 90% of the sustainable yield (by whole weight) and/or total fishery catch declines by 30% (by whole weight)	Management arrangements for the Spanish mackerel fishery will be reviewed by SMACFMAC. Management regime to be implemented to ensure that aggregate landings by all sectors do not exceed estimated sustainable yield
	Genetic studies indicate discrete Spanish mackerel stock(s)	Discrete Spanish mackerel stocks identified	SMACMFAC to review and make recommendations on appropriate management response to ensure the sustainability of discrete Spanish mackerel stocks
	Sustainable yield estimates are reviewed annually	Annual review	Continue existing research and review alternative yield estimate methodologies annually
Optimal utilisation of Spanish mackerel	Estimated catch share (as a percentage of total aggregate landings, by whole weight) for all sectors remains unchanged	Estimated catch share by a stakeholder group(s) (commercial or recreational) changes (increase or decrease) by more than 20% (by whole weight)	Undertake a desktop study to determine the circumstances leading to the increase/decline in catch share arrangements. SMACFMAC to make recommendations to the Director of Fisheries on appropriate management arrangements to address any changes in catch shares
Ensure the sustainability of byproduct taken in the Spanish mackerel fishery	Byproduct in the Spanish mackerel fishery increases significantly	Byproduct in the Spanish mackerel fishery increases to 10% of the total catch (whole weight)	SMACFMAC to make recommendations to the Director of Fisheries on appropriate management arrangements to

			address any changes and reduce byproduct levels
Minimise effects of fishing operations on endangered/threatened /protected species/communities	Endangered/threatened /protected species/communities are identified in NT waters	Impacts are observed by commercial fishers or fisheries observers	Threat abatement plan implemented

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

The management of the Spanish mackerel fishery is achieved by the Spanish Mackerel Fishery Management Plan (Appendix I). Limited entry, a licence transfer reduction scheme and gear restrictions were introduced through the enactment of the Plan in 1993 and limit the capacity of the commercial fishery. A possession limit for recreational fishers was implemented at this time.

Since the enactment of the Management Plan in 1993, new operators to the commercial fishery are required to either surrender two pre-existing Spanish mackerel licences for the issue of a fully transferable Spanish mackerel fishery licence or acquire a fully transferable licence. This has led, to a reduction of licences from 28 to 19 (March 2002). Of the 19 current licences, 9 are fully transferable (combined) and 10 have restrictions on their use, until they are combined with a similar licence.

The Northern Territory Spanish Mackerel Troll Line Association has recently recommended that the present licence reduction scheme be extended for another 5 years, at which time it should be removed from the management strategy. This is designed to encourage licensees to combine pre-existing licences in reducing capacity in the fishery.

Commercial Spanish mackerel fishers have gear restrictions under the Spanish Mackerel Fishery Management Plan. Licensees may only fish with a combination of troll lines, to which either (a) one hook, (b) one set of hooks attached to one piece of bait, or (c) one lure, to which hooks may be attached, or use a floating handline or a rod and line (see Appendix I). These gear restrictions seek to control the level of take in the commercial fishery and limit interaction with non-target species.

Other commercial fisheries that take Spanish mackerel as incidental and unavoidable byproduct have, or are in the process of implementing "in possession" limits of Spanish mackerel. The Northern Territory Shark fishery and the Commonwealth managed Northern Prawn and Western Tuna fisheries have possession limits in place, whilst the Barramundi fishery is currently negotiating acceptable byproduct levels. (See Principle 1.1.4).

The recreational sector and fishing tour operators (who must abide by recreational controls) have reduced catch capacity through the introduction of possession limits in 1993. Each recreational fisher may only have five Spanish mackerel in possession and is limited to amateur gear as defined in Appendix II. Indigenous fishers in the NT are also bound by recreational controls if they are fishing as recreational fishers.

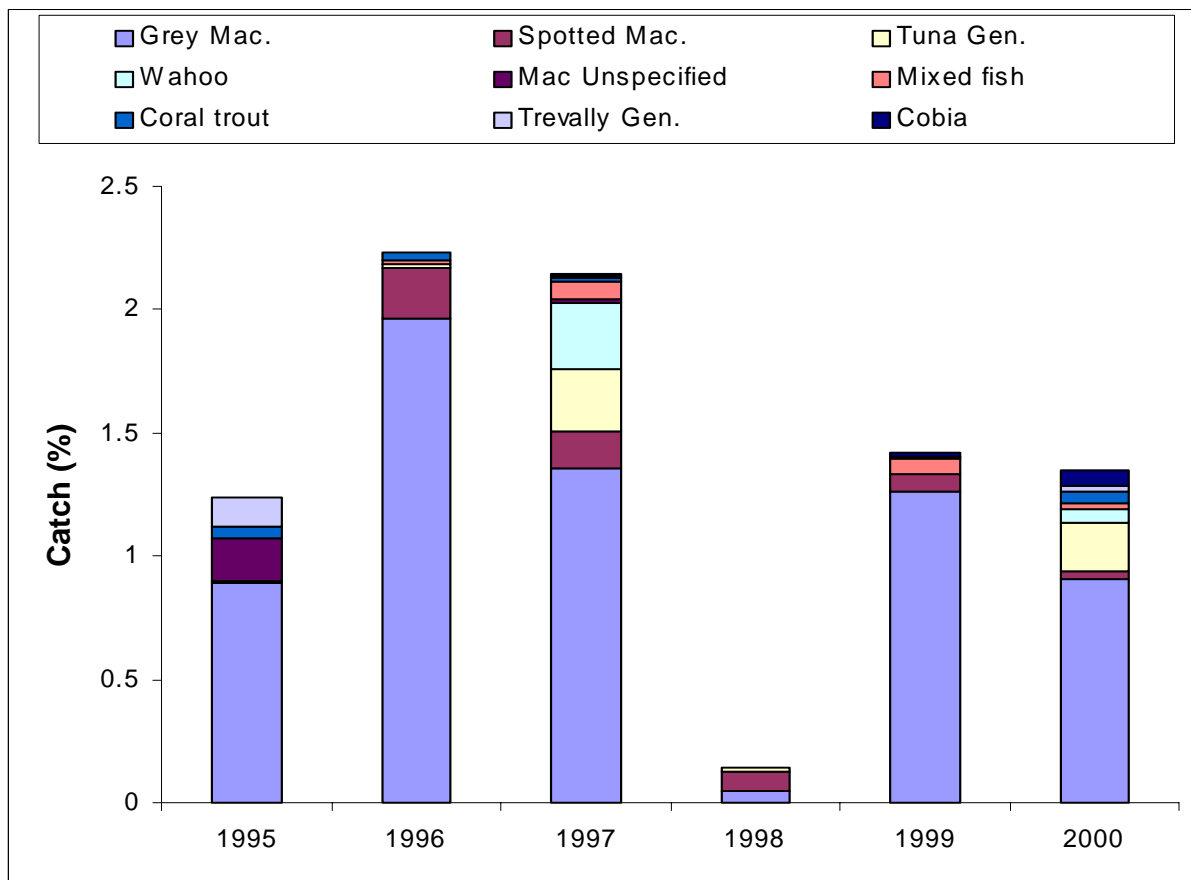
The Northern Territory Fisheries Division has requested that information on the recreational and indigenous catch of mackerel, collected through the NRIFS, distinguishes between Spanish mackerel and other types of mackerel. This data may then provide sufficient detail to estimate the recreational catch and will assist SMACFMAC in making recommendations about future management arrangements. Given the population growth, particularly around the Darwin region and the pressures that increased recreational effort place on the fishery, the recreational sector has agreed to consider a review of the possession limit for Spanish mackerel, should information from the NRIFS suggest that the recreational sector harvests a significant portion of the resource.

Revision of the Spanish Mackerel Fishery Management Plan through the Discussion Paper has canvassed the proposed implementation of catch shares for each stakeholder group (Appendix III). Sectoral catch shares would seek to limit the Spanish mackerel catch of each stakeholder group (commercial and recreational), through management arrangements specific to that fishing sector.

The total level of take in the Spanish mackerel fishery is primarily controlled by the imposition of a 90% limit of the estimated sustainable yield. That is, if the total catch of the fishery reaches 90% of the estimated sustainable yield, the fishery will be reviewed and revised management strategies discussed through SMACFMAC.

**1.1.8 Fishing is conducted in a manner that does not threaten stocks of by-product species. (Guidelines 1.1.1 to 1.1.7 should be applied to by-product species to an appropriate level).**

The selective nature of Spanish mackerel fishing gear and targeting practices restricts the take of byproduct and limits most byproduct to other pelagic species. The most common observed byproduct species are grey (or broad-barred) mackerel (*Scomberomorus semifasciatus*), long tail tuna (*Thunnus tonggol*), coral trout (*Plectropomus* spp.), cobia (*Rachycentron canadus*) and various trevallies (Family Carangidae). Byproduct currently comprises less than 2.5 percent (by whole weight) of the commercial Spanish mackerel fishery catch.



**Figure 2** Byproduct species as a percentage of the total commercial Spanish mackerel fishery catch by whole weight

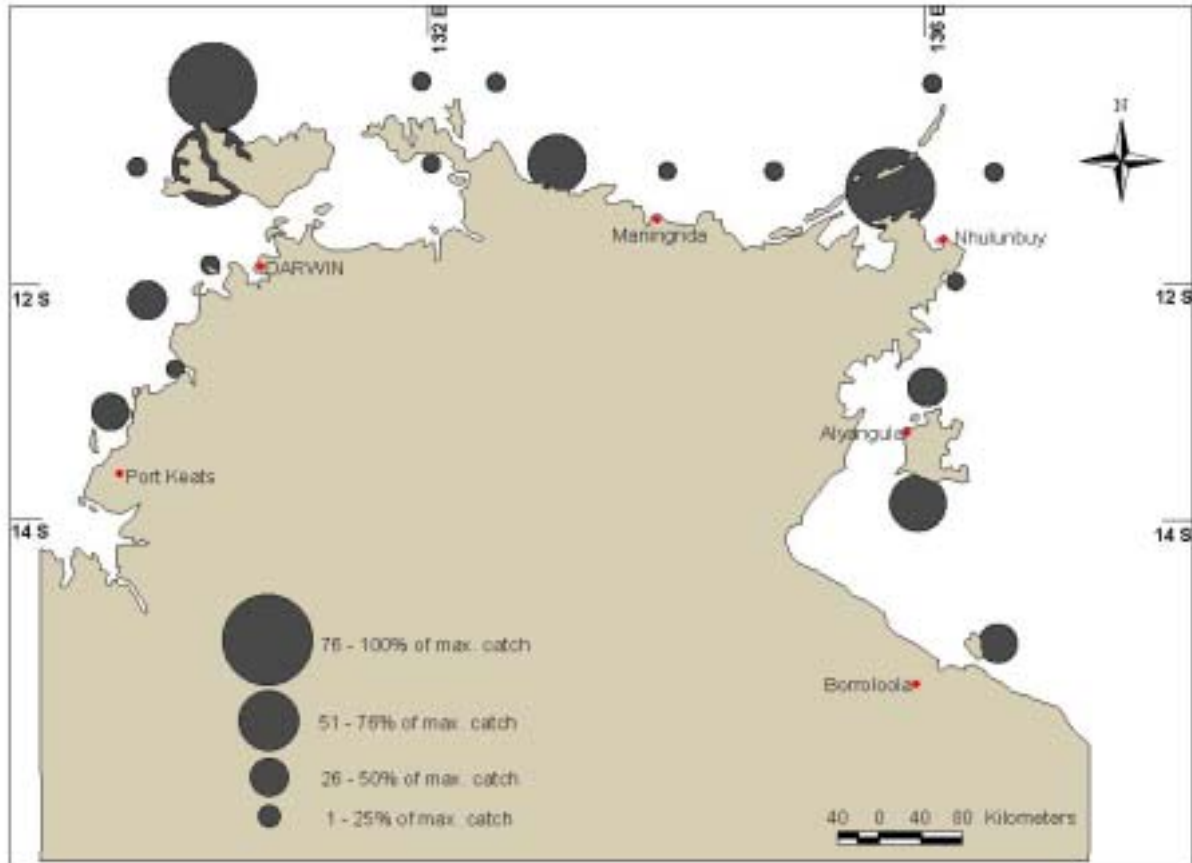
The Northern Territory Spanish Mackerel Troll Line Association has voluntarily instigated a nil byproduct limit of shark in the commercial Spanish mackerel fishery.

Fishing with floating lines and 10-12 size hooks or lures (which are favoured by both commercial or recreational fishers) minimizes the incidental capture of non-marketable or undersized fish and any sedentary species.

All commercial fishers are required to record byproduct on their monthly/daily logbooks. Market details are also required to be documented on returns. This serves to validate all catch data. Analysis of byproduct data from logbook returns, observers and research shows that byproduct is of such insignificant levels that commercial Spanish mackerel fishing is not considered a risk to the stocks of byproduct species.

Spanish mackerel researchers view commercial catch wharfside to undertake research activities and validate logbook data. This includes the examination of all byproduct species and byproduct of Spanish mackerel in other fisheries.

Spanish mackerel fishers fish along the entire Northern Territory coastline, comprising approximately 5,000 kilometers. Given the small number (14) of active commercial fishers, the fishing effort is dispersed around the entire coast.



**Figure 3** Distribution of the commercial Spanish mackerel fishery catch (after Buckworth and Clarke, 2001)

Byproduct is incidentally caught in all NT waters and this dispersed effort discounts any chance of localised depletions of byproduct species.

Byproduct is monitored through commercial fishing logbooks and assessed annually as part of the production of Status Reports and the Annual Technical Report. If there are any significant changes (10 percent increase, by whole weight) in byproduct levels, a review of the current management actions and discussion at SMACFMAC will ensue.

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

The management of the Spanish mackerel fishery has a high chance that Spanish mackerel catch levels are at ecologically viable stock levels and will be maintained with acceptable levels of probability, as detailed by Principle 1, Objective 1.

Spanish mackerel are abundant and dispersed as semi-discrete stocks around the entire NT coast.

An upper limit on the number of commercial participants and reducing level of capacity in the fishery aims to ensure the sustainability of the Spanish mackerel fishery and its byproduct species.

The proposed new management arrangements for the Spanish mackerel fishery seeks to address the expected growth by the recreational sector. A proposed catch allocation of Spanish mackerel to the recreational sector will provide for the fair and equitable management of all sectors, whilst ensuring that no individual sector significantly increases or decreases its catch of Spanish mackerel and that the total take of Spanish mackerel in the fishery will not exceed 450t.

The fishery is monitored continuously through logbooks and assessed annually through the production of the Annual Technical Report and the Status Report. Fishery dependent research is conducted to validate ongoing stock assessments and confirm that the levels of uncertainty throughout these assessments are acceptable.

The small number of commercial fishers, FTOs targeting Spanish mackerel and a well-represented recreational angling sector allows Fisheries Division to consult and communicate with all stakeholders in a timely manner and incorporate or adjust management controls to ensure the sustainability of the fishery.

The 450t limit of the total take of Spanish mackerel is considered to be a conservative approach of managing the resource, particularly given the recovery of the stocks following the departure of the foreign fishing fleet (see Principle 1.1.2). The estimated sustainable yield limit and all other management responses are appropriate given the size and scale of the fishery and uncertainties in stock assessment.

Byproduct comprises 2.5% (whole weight) of the total take of the commercial Spanish mackerel fishery and is considered to pose no threat to byproduct stocks. Given the size and scale of the Spanish mackerel fishery, it is not appropriate or possible to undertake research on byproduct species.

## **Objective 2**

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

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

Scenarios modeled in the 2000 assessment suggest that the NT Spanish mackerel stock is likely to remain stable or increase slowly under current levels of fishing (i.e. the fishery is

under-fished and is fished at such a level that it has or is nearly recovered from historical over-fishing).

The Spanish mackerel fishery is a sustainable fishery that is managed under the precautionary approach of Ecologically Sustainable Development (ESD). Available information and “best practice” modeling indicates that the impact of the Spanish mackerel fishery is within ecologically viable stock levels. Appropriate management arrangements are in place to ensure the ongoing sustainability of the fishery.

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

Stocks of Spanish mackerel are maintained at sustainable levels and will continue to recover from historic overfishing under the current management controls and possible future additional controls as discussed in Principle 1.1.6.

## 3.2 PRINCIPLE 2

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

### **Objective 1**

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

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

Bycatch in the Spanish mackerel fishery is negligible. The fishing gear and targeting practices limit the take of any species other than Spanish mackerel. Species that are incidentally caught are released alive. Spanish mackerel fishing practices (see Principle 1.1.7 and 1.1.8) involves fishing from dories, where troll lines are tended as soon as fish are caught. This allows fishers to release any unwanted species alive.

As incidental bycatch is negligible and poses no threat to bycatch species stocks, commercial fishers are not required to record bycatch under the compulsory logbook returns. Observers and fishery dependent research has established the negligible take of bycatch, which is monitored on every research-based fishing voyage, typically six times a year. Observation of released bycatch from commercial fishers and research officers has shown that almost all bycatch is released alive from Spanish mackerel fishing operations. This method of monitoring bycatch is reliable and appropriate to the size and scale of the fishery.

Bycatch species, although rarely taken, are comprised mainly of large sharks. When a shark is incidentally caught, generally predated on a hooked mackerel, it usually breaks free (as it cuts through the nylon line), or the fisher in the dory cuts the line and the shark is released (alive) to ensure the safety of the fishing operations.

Commercial fishers target Spanish mackerel between 90 and 150cm fork length. If the fisher inadvertently targets a school of smaller sized fish, the fisher will generally relocate to an area where larger sized fish can be caught. If the smaller fish are taken, they are retained for sale and not discarded. It is only the economics of the fishing activity that drives the fisher to target larger fish and although small numbers of smaller sized Spanish mackerel are still marketable, they are not preferred by seafood wholesalers/retailers. This is a rare occurrence as the fishing gear selectively targets fish in the 90 to 150cm fork length range.

Commercial fishers who choose to use the Restricted Bait Net Entitlement (less than five operators) mainly target garfish (*Hemiramphus far*) in oceanic waters. The seine net is deployed on schools of garfish and all fish captured are used as bait. There is no reported or observed bycatch from the use of the restricted bait net. This is validated by logbook returns from Restricted Bait Net Entitlement fishers and observation by research officers.

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

The vulnerability of bycatch species to targeted Spanish mackerel fishing is considered to be minimal. This is due to negligible levels of bycatch and very little association of bycatch species with schooling Spanish mackerel. The gear and targeting practices used in the Spanish mackerel fishery are highly selective to Spanish mackerel and pose no threat to bycatch stocks.

The annual review of the fishery through the production of the Annual Technical Report and Status Report assesses the levels of bycatch in the fishery.

Given the negligible level of bycatch, a risk assessment and risk analysis of bycatch species has not been undertaken. This is appropriate to the size and scale of the fishery.

**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.**

The hook, line and lure fishing gear used in the Spanish mackerel fishery limits capture and mortality of bycatch species. The fishing gear is operated mainly from dories, therefore fishers can immediately release bycatch alive.

**2.1.4 An indicator group of bycatch species is monitored.**

As previously discussed, bycatch is extremely low (estimated to be <1% of catch, by whole weight) in the Spanish mackerel fishery. As such, bycatch is monitored by commercial fishers and validated by observers and through fishery dependent research. An indicator group of bycatch species is therefore not appropriate, given the levels of bycatch.

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

Due to the specific targeting nature of the commercial operations (see Principle 2.1.1), decision rules based on perturbations in indicator species are not appropriate to the fishery.

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

The permitted fishing apparatus and operational nature of the Spanish mackerel fishery limits bycatch species and has hence, a very high chance of achieving the objective.

This is supported by commercial fishers' logbooks, observer cruise reports and fishery trials.

Given the size and scale of the Spanish mackerel fishery, it is not appropriate to undertake research on bycatch species.

## **Objective 2**

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

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

Commercial fishers' and fishing tour operators' logbooks, independent observers, technical and research officers have not indicated any interaction with endangered, threatened or protected species. Information gathered from these sources is considered reliable and appropriate to the size and scale of the fishery.

There are no threatened ecological communities identified in Northern Territory waters.

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

As there is no recorded interaction with endangered, threatened or protected species, there is no assessment of impacts of the fishery.

In the event of an observed impact with endangered, threatened or protected species, Fisheries Division will undertake an immediate review of the situation and may change any aspect of the operation by imposing additional Conditions of Licence and amending the Spanish Mackerel Fishery Management Plan to avoid any possible future interactions.

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

There are no recorded threatened ecological communities in Northern Territory waters. It is for this reason that no assessment of the impact of the fishery on threatened ecological communities has been undertaken.

Should a threatened marine ecological community be declared, changes to the Conditions of Licence for commercial and fishing tour operators and/or amendment to the Spanish Mackerel Fishery Management Plan will be imposed to minimise any possible impact of the fishery on the declared threatened community.

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

The nature of the fishing gear and targeted fishing practices of the Spanish mackerel fishery avoids interaction with endangered, threatened or protected species.

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

The Spanish mackerel fishery is a surface-based line fishery that does not impact on the substrate. The target species is most commonly found in clear oceanic waters.

However, Spanish mackerel fishers may interact with the substrate when anchoring. Fishers generally do not anchor on reefs or sub-surface structures, as they provide an unstable mooring due to wave action. Given the small size of mother boats (averaging 15 metres) and that dories tether to them, there is only the requirement of a small anchor to secure the vessel whilst not fishing. The small size of these anchors disturbs very little of the substrate and/or associated organisms.

There are only a small number of commercial operators (14) active in the fishery who, due to the seasonality of the fishery, fish on average less than 100 days per year. Commercial fishers that fish from motherboats tend to keep on the move, so that they may spend many of their fishing hours without anchoring at all.

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

Given there are no recorded interactions with endangered, threatened or protected species and there are no identified threatened ecological communities in Northern Territory waters, the Spanish mackerel fishery will achieve the objective.

Should there be any future interactions with these species or ecological communities, a review of the fishery would take place immediately and changes in the management of the fishery could be imposed through recommendations made by SMACFMAC to the Director of Fisheries.

**Objective 3**

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

**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.**

The Spanish mackerel fishery is a surface-based fishery of hand-hauled hook, line and lure method that has minimal impact on the ecosystem.

Due to the fishing gear utilised and the low levels of participation, it is not considered that this fishery would have a significant impact on the environment. However, observers and fishers do take note of any interaction with the ecosystem and would report such impacts to Fisheries Division. Should any change in the ecosystem or any of its components be identified, Fisheries Division would undertake a review of the fishery and its operations to determine any possible cause and identify any methods of rectification or future avoidance.

### **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.**

#### **1. Impacts on ecological communities**

- **Benthic communities**

Spanish mackerel commonly school in surface waters. As such, the Spanish mackerel fishery is focused on near-surface waters and subsequently, there is no interaction with benthic communities. The fishery may impact on the substrate and possible benthic communities during anchoring. Sand anchors are usually deployed on barren ground where its is considered that there would be minimal benthic interaction (see Principle 2.2.5).

- **Ecologically related, associated or dependent species**

There are several related species of Spanish mackerels (e.g. *S. semifasciatus*), tuna-like fishes (Family Scombridae) and trevallies (Family Carangidae), as well as many shark species that target the same bait fish, and each other, and occupy similar or adjacent habitats to *S. commerson*. It is considered that the removal of Spanish mackerel from the ecosystem will pose no measurable impact on any associated species.

- **Water column communities**

Spanish mackerel are a pelagic species that commonly school in surface waters, hence the species and the fishery has little impact on water column communities. Spanish mackerel are predatory and eat smaller (bait) fish, squid and prawns.

It is considered that there is a very low risk of any impact on ecological communities by the Spanish mackerel fishery. However, should there be any change from the impact of the fishery, management controls would be reviewed to eliminate any possible concerns and return the fishery to an ecologically sustainable state.

#### **2. Impacts on food chains**

- **Structure**

Spanish mackerel are predatory fish, near the top of the food chain. They feed on smaller (bait) fish of a range of species. In the complex web of predators and competitors it is highly unlikely that the current low level of Spanish mackerel catch will have any measurable effect

on bait fish or ecologically associated species identified under Principle 2.3.2 :1: *Ecologically related, associated or dependent species*.

No information has been collected nor any research undertaken on bait fish or their stocks in the NT.

- **Productivity/flows**

Spanish mackerel are subject to predation mainly by sharks and larger individual Spanish mackerel. Spanish mackerel are not the exclusive food source of sharks, therefore the take of Spanish mackerel by fishing methods is unlikely to impact on the food chain.

The harvest of bait under the restricted bait net entitlement is of such low quantities (averaging less than 250 kg annually for the commercial Spanish mackerel fishery), that it is considered not to be a risk to food chains or productivity.

It is considered that the Spanish mackerel fishery poses no risk to food chains and therefore no information has been collected on these issues.

### **3. Impacts on the physical environment**

- **Physical habitat**

The pelagic, near-surface nature of Spanish mackerel and its target fishery do not interact with any part of the physical habitat. The fish school near to the surface, which suits the hook, line and lure fishing method employed by Spanish mackerel fishers. There is therefore no risk to the physical habitat except from occasional anchorage. As mentioned in Principle 2.3.2 (point 1), fishers tend to anchor in areas that are devoid of reef or sub-surface structures as they inhibit the retrieval of anchors and provide a more stable anchoring platform.

- **Water quality**

The nature of the Spanish mackerel fishery imposes very little disturbance to water quality. Lines trolled near to the surface provide little disturbance to water movements and do not cause turbidity. Lines are hand hauled and they cannot be retrieved at speed.

The only possible impact to water quality is through poorly maintained vessels and the leaking of mechanical fluids and fuels. The *Marine Act* requires vessels to be maintained and not discharge any materials into the water. The Marine Branch of the Department of Infrastructure, Planning and the Environment is responsible for checking vessel maintenance and safety, by annual survey inspections. The Department inspects vessels wharveside and at sea for their compliance and sea worthiness.

The Spanish mackerel fishery poses no risk to the physical environment and subsequently, no data is collected on these components of the ecosystem. There has also not been any

reported incidents from fishery research observers, who undertake monitoring voyages about six times a year.

### **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.**

As there are no identified impacts of the Spanish mackerel fishery on the ecosystem, there are no relevant management actions in place. The nature of fishing operations, as well as the restriction of gear and vessels, limits the effects of fishing on the environment. Should it be deemed necessary to further restrict fishing practices to safeguard the environment, management controls may be altered through the amendment of the Spanish Mackerel Fishery Management Plan and Conditions of Licence.

If any substantial threats to the ecosystem are identified, analysis of the threats and proposed mitigation will take place immediately through the combined efforts of Fisheries Division and related environmental governing agencies.

If the threat warrants an urgent response, the Minister for Fisheries has the power under Section 26 of the *Fisheries Act* to impose emergency controls on the fishery.

Fisheries research observers undertake monitoring voyages about six times a year, whereby all aspects of fishing operations are recorded, including any impacts, or potential impacts on the ecosystem. No impacts have been observed to date.

### **2.3.4 There are decisions 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.**

As the Spanish mackerel fishery imposes no risk and has minimal interaction with all components of the ecosystem, there is currently no monitoring of any ecosystem indicators.

Should any aspect of the fishery change that may affect any component of the ecosystem or the environment as a whole, a monitoring program will be devised and incorporated into the Spanish mackerel research program. Monitoring would assess any changes, the level of change and any impact on target, byproduct or bycatch stocks or the environment. If any detrimental effects are identified, suitable methods of rehabilitation and avoidance would then be built into the Spanish Mackerel Fishery Management Plan and would become enforceable under the Plan.

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

The fishery has a very high chance of achieving the objective given that there is minimal impact of the fishery on the ecosystem generally.

Primarily, the restriction on fishing gear minimizes any interaction with bycatch or other ecological components or the environment as a whole. Management of the fishery is based on the precautionary approach by which the target fishery and all associated environmental components are maintained at sustainable levels.

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## 5 GLOSSARY

### **Aboriginal Consultative Committees**

Aboriginal elders representing various aboriginal communities of a given area, meet with senior Fisheries Division staff, representatives of the Northern Land Council and the NTSC and AFANT to discuss topical fisheries issues. Representatives from other government and non-government organisations may be invited to discuss specific issues.

### **Annual sustainable yield**

See "Target annual yield".

### **Annual Technical Report**

An annual report detailing all research and technical work undertaken by the Department of Business, Industry and Resource Development (formerly the Department of Primary Industry and Fisheries).

<http://www.nt.gov.au/dbird/dpif/pubcat>

### **Australian Fishing Zone (AFZ)**

Australia has proclaimed a 200-nautical-mile-wide zone around its mainland and territories coasts, within which it controls domestic and foreign access to fish resources.

### **Biomass**

Total weight of a stock or of a component of a stock (e.g. spawning biomass is the combined weight of mature animals).

### **Bycatch**

The part of a fisher's catch which is returned to the sea or that interacts with the fishing operation but is not landed.

### **Byproduct**

All species retained in a fishing operation that is not the target species.

### **Bycatch/byproduct limits for other commercial fisheries**

The amount of catch of managed species able to be taken in a fishery that has a differing target species. (e.g. the NT Shark fishery may take a base level of 300kg whole weight of Spanish mackerel as trunks and an additional 100kg as trunks for the fourth and every subsequent tonne of grey mackerel caught).

### **Catch per unit effort (CPUE)**

The number or weight of fish caught by a unit of fishing effort. (e.g. 80kg per hour fishing).

### **Current target catch**

The level of catch of all sectors in the current licensing year.

### **Fishery Assessment Report**

A research report identifying historical and current stock assessments and implications on the management arrangements of the fishery. Published by the Northern Territory Fisheries Division about every 3-5 years.

<http://www.nt.gov.au/dbird/dpif/pubcat>

**Fishing tour operator (FTO)**

A commercial enterprise that undertakes guided fishing voyages for paying clients. FTOs are licenced in the Northern Territory and are bound by the amateur fishing regulations. Recreational fishing possession limits apply to the guide and each client.

**Fork length**

The length of a fish measured as the distance between the tip of the snout and the most anterior point of the fork or 'V' of the tail.

**Maximum sustainable yield**

The maximum catch that can be removed from a stock over an indefinite period.

**Notional catch limit**

A predetermined percentage of the maximum sustainable yield (by whole weight) (i.e. 90% for the Spanish mackerel fishery). This limit is the point at which management arrangements for the fishery are reviewed, allowing sufficient time for implementation of new management controls before the maximum sustainable yield is reached.

**Offshore Constitutional Settlement (OCS)**

Arrangement commenced in 1982 whereby State and Commonwealth governments can introduce legislation on a fishery-by-fishery basis, passing responsibility for control to one or the other administration.

**Otoliths**

Calcareous deposits or bones found in chambers at the base of the skull in fish (and inner ear of other invertebrates). Sections of these bones frequently show rings or layers which may be used to determine age.

**Pelagic**

Inhabiting surface waters rather than the sea floor.

**Possession limit**

The maximum number of a managed fishery species allowed to be in possession of an individual at any place apart from their place of permanent residence, except for commercial fishermen of that fishery and indigenous fishers fishing on their own traditional lands. (e.g. individuals may have 5 Spanish mackerel in possession at any place apart from their place of permanent residence).

**Precautionary principle**

Where there are threats of serious irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

**Sectoral catch shares**

A predetermined catch limit for each stakeholder group: commercial and recreational. The total of the sectoral catch shares must not exceed the maximum sustainable yield.

**Status report**

An annual report published by the Northern Territory Fisheries Division detailing every aspect of a managed fishery, including historical and current information, stock assessments and management controls.

<http://www.nt.gov.au/dbird/dpif/fisheries/aqresman>

**Stock**

A group of individuals of a species occupying a well defined spatial range independent of other stocks of the same species. Random dispersal and directed migrations due to seasonal or reproductive activity can occur.

**Target annual yield**

A predetermined catch limit for all sectors of a managed fishery for any given licensing year (1 July - 30 June). This limit must meet all sustainability parameters.

**Trigger/reference point**

A predetermined point at which a given action will occur. (i.e. if this point is reached, the situation will be reviewed and new strategies may be set).

**Whole weight**

Total weight of a fish in kilograms, as a whole fish. (i.e. the fish in its natural state, not filleted or trunked).