

## North Coast Bioregion

### REGIONAL MANAGEMENT OVERVIEW

Commercial fisheries in this bioregion are focused on the tropical and deep-water snappers in offshore waters and on barramundi, threadfin salmon and shark in more coastal areas. Most of the State's smaller prawn trawl fisheries are also based in this region.

The Pilbara Fish Trawl Interim Managed Fishery continued as the provider of the majority of the State's demersal fishfish. Other important providers of demersal finfish operating in the area are the Northern Demersal Scalefish and the Pilbara Trap Managed Fisheries. All three fisheries operate under individually transferable effort (ITE) management arrangements, monitored by the Vessel Monitoring System.

There was further expansion of the VMS to include the Kimberley and Nickol Bay Prawn Managed Fisheries, with the Onslow Prawn Managed Fishery expected to come under VMS later in 2002. In these fisheries the VMS is used primarily for the management of closed waters (nursery areas).

A resource management agreement (the 'Barramundi Accord'), which was developed for the barramundi resources of the Kimberley, was given effect through a number of changes to management arrangements for the Kimberley Gillnet and Barramundi Managed Fishery and to recreational fishery controls. The management arrangements provided for under the Accord will allow for sustainable management of the stock and reduce conflict between user groups. These arrangements will be further developed over the next few years following the anticipated reviews of recreational and customary fishing in the Kimberley and Pilbara. The activities of netting operators on the Eighty Mile Beach and in the Pilbara will also come under further focus at that time.

The wetline fishery in the north coast bioregion operates in a number of areas:

- Mackerel fishing (primarily by trolling);
- Beach seining and near-shore gillnetting;
- Demersal line fishing (Pilbara line fishery).

Owing to concerns from both industry and Government about increased catches of mackerel and preliminary assessments that indicate that the species could be over-fished, an independent review committee has examined the fishery and reported to the Minister on future management options.

There is also a take of fish throughout the region by beach seining and near-shore gillnetting using hand-hauled nets, which is not currently subject to any dedicated management plan. Demersal finfish are also taken by line in the Pilbara by holders of fishing boat licences. The activities of the wetline fishery are expected to come under review in the near future to prepare the fishery for Integrated Fisheries Management.

### REGIONAL COMPLIANCE AND COMMUNITY EDUCATION OVERVIEW

Commercial fishery compliance inspections in the north coast bioregion are conducted by Fisheries Officers working out of offices located in Broome and Karratha. These officers undertake a variety of activities in the region, including sea-based inspections of licences, catch and fishing gear, and land-based inspections of catch, fish processing factories, retail outlets and catch consignment deliveries. As management arrangements require vessels to operate with a Vessel Monitoring System on board, officers also oversee the location of vessels and the time each vessel spends within the waters of specific fisheries.

The fisheries serviced include the Northern Demersal Scalefish, Broome, Kimberley, Onslow and Nickol Bay Prawn, Kimberley Gillnet and Barramundi, Pilbara Fish Trawl and Pilbara Trap Managed Fisheries. Officers utilise two 6.5–7 m patrol vessels located at Karratha and Broome to conduct inshore at-sea inspections, while a dedicated large patrol vessel (> 20 m) is deployed from other regions to carry out offshore work.

#### Activities during 2000/01

During 2000/01, Department of Fisheries Regional Services personnel undertook 2,515 hours of compliance work in commercial fisheries in the north coast bioregion (North Coast Commercial Compliance Table 1). A large proportion of these hours were spent responding to reports through the VMS of vessels operating outside the provisions of the Pilbara Trawl and Northern Demersal Scalefish Management Plans. The remainder of the services delivered were to a wide range of compliance activities across the remaining fisheries in the bioregion.

Between January and June 2001, Fisheries Officers recorded 13 field contacts with commercial fishing operations and 94 office contacts with commercial fishers. During the year, 4 infringement notices were issued, and a further 10 cases resulted in prosecution action against commercial fishers.

Overall, the main areas of concern within the bioregion relate to continued infringements detected through the VMS and inherent complexities within the management arrangements that lead to inadvertent breaches of the legislation.

Some concerns have also been expressed over continued conflict between commercial gillnet fishers and the recreational sector, especially in waters adjacent to Broome and the Eighty Mile Beach north of Port Hedland.

#### Initiatives in 2001/02

Funding of the compliance program for those commercial fisheries in the north coast bioregion not covered by cost recovery has proved a management issue as historically available funds have declined. Discussions have commenced with the commercial sector to assist in developing more efficient and cost-effective management strategies that in turn will lead to more effective compliance outcomes.

**NORTH COAST COMMERCIAL COMPLIANCE TABLE 1**

Summary of compliance and educative contacts and infringement types in commercial fisheries within the north coast bioregion during the 2000/01 financial year.

CONTACT WITH THE COMMERCIAL FISHING COMMUNITY	NUMBER
Hours delivered in bioregion	2,515
Fisher field contacts by Fisheries Officers (6 months)*	13
District Office contacts by Fisheries Officers (6 months)*	94
Fishwatch reports **	25
OFFENCES DETECTED	NUMBER
Infringement warnings	0
Infringement notices	4
Prosecutions	10

\* These figures represent regional activities conducted between 1 January and 30 June 2001, following the introduction of a new, more comprehensive system for collection of regional activity data. Since this represents an incomplete year of data, collected while Fisheries Officers were still undergoing training in the system, figures should be treated with caution.

\*\* This represents the total number of Fishwatch reports, both commercial and recreational, since the service provider reporting mechanism cannot currently differentiate between sectors.

**REGIONAL RESEARCH OVERVIEW OF WETLINE FISHING**

This assessment, which utilised the CAES database, indicates that around a quarter (22%) of the State's wetline catch during 2000/01 was reported from this bioregion, which includes waters off both the Kimberley and Pilbara coasts. The top ten species comprised Spanish mackerel (*Scomberomorus commerson*) 242 tonnes, threadfins (Polynemidae) 72 tonnes, goldband snapper (*Pristipomoides multidentis*) 28 tonnes, other mackerel 27 tonnes, unspecified shark 15 tonnes, grey mackerel (*Scomberomorus semifasciatus*) 14 tonnes, blacktip shark (*Carcharhinus* spp.) 8 tonnes, scarlet sea perch (*Lutjanus malabaricus*) 7 tonnes, nor-west snapper (Lethrinidae) 6 tonnes and red snapper (*Lutjanus erythropterus*) 6 tonnes. An interim management plan for the troll fishery for mackerel, details of which are reported on pp. 86–91, is currently in review. The majority of threadfin were taken by net fishers south of the Kimberley Gillnet and Barramundi Managed Fishery. Most other species are taken by line fishing off the Pilbara coast.

**ONSLow PRAWN MANAGED FISHERY**

**Management Summary**

The Onslow Prawn Managed Fishery targets western king prawns (*Penaeus latisulcatus*), brown tiger prawns (*Penaeus esculentus*), endeavour prawns (*Metapenaeus* spp.) and banana prawns (*Penaeus merguensis*). The opening and closing dates for the fishery vary from year to year and are based on advice from the Research Division. The 2002 fishing season commenced on 1 March and will end on 15 November, which generally aligns with season dates for the adjacent Exmouth Gulf Prawn Fishery. However, different areas within the fishery have different season dates which allows access to target species, usually tiger and banana prawns, at appropriate times.

Management controls for the Onslow Prawn Managed Fishery are based on limited entry, seasonal and area closures, gear controls and restrictions on boat size. The first steps to introducing bycatch reduction devices into the fishery were taken this year with vessels required to have half their gear fitted with BRDs. The management plan for the fishery was amended in September 2001 to remove the non-transferability provisions on C and D class licences. However, holders of these licences need to hold an Exmouth Gulf Prawn or Nickol Bay Prawn Managed Fishery Licence for the Onslow licence to be effective.

There was also an amendment to the management plan to implement the Vessel Monitoring System within the fishery. The VMS requirements will come into force on 1 October 2002.

**Governing Legislation/Fishing Authority**

Onslow Prawn Fishery Management Plan 1991  
Onslow Prawn Managed Fishery Licence

**Consultation Process**

Department–industry meetings

**Research Summary**

Research for managing this small fishery involves stock monitoring and assessment utilising the CAES monthly return data provided by industry, as well as information from interviews with boat skippers. Annual meetings are held with boat operators to consider the status of the stocks and recommend changes to fishing operations.

The following status report summarises the research findings for this fishery.

**ONSLow PRAWN MANAGED FISHERY STATUS REPORT**

Prepared by M. Kangas and E. Sporer

**FISHERY DESCRIPTION**

**Boundaries and access**

The boundaries of this fishery are 'all Western Australian waters of the Indian Ocean below high water mark lying west of 116°45' east longitude and east of a line commencing at the high water mark on the mainland due south of the

southernmost extremity of Locker Island drawn due north to the high water mark at that extremity; thence northwesterly to the high water mark at the southernmost extremity of Serrurier Island; thence northerly along the high water mark of that island on its western shore to its northernmost point; thence due north' (Onslow/Nickol Bay Prawn Figure 1).

The fishery is then divided into three fishing zones with associated nursery areas as follows: Area 1, incorporating Ashburton Nursery; Area 2, incorporating Coolgra Point Nursery; and Area 3, incorporating Fortescue Nursery.

During the 2001 season the areas were open during the following periods:

Area 1	2 April–15 November
Area 2	1 March–15 November
Area 3	1 March–15 November
Fortescue Nursery	1 May–15 November
Ashburton and Coolgra Point Nurseries	1 May–30 September

Different licence classes apply to this fishery allowing boats to trawl in specific zones. These classes are listed below (figures in brackets indicate 2001 endorsements):

Class A	Areas 1, 2 and 3 (4 boats)
Class B	Areas 2 and 3 (3 boats)
Class C	Area 2 (12 Exmouth Gulf boats)
Class D	Area 3 (12 Nickol Bay boats)

#### Main fishing method

Otter trawl.

#### RETAINED SPECIES

**Commercial production (season 2001):** 63 tonnes

#### Landings

The total landings of major penaeids for the 2001 season were 63 tonnes, including 15 tonnes of king prawns, 28 tonnes of tiger prawns, 7 tonnes of endeavour prawns and 13 tonnes of banana prawns (Onslow Prawn Figure 2). The Onslow fishery is a small fishery in which tiger and king prawns have been the dominant species caught over the long term with total landings ranging from approximately 60 to 130 tonnes. The season catch of 63 tonnes is at the lower end of the catch range for this fishery. Recorded landings of by-product species included 8 tonnes of coral prawns, 12 tonnes of bugs, 2 tonnes of squid and blue swimmer crabs and less than one tonne each of black tiger prawns, cuttlefish, shark and mixed finfish species.

#### Fishing effort

Not assessed.

#### Catch rate

Not assessed.

**Recreational component:** Nil

**Stock assessment complete:** Not assessed

The catches during 2001 continued to be below average for king prawns, middle of the range for tiger prawns and in the lower end of the range for endeavour prawns. Banana prawn catches were within the acceptable range in 2001, although

low compared to 2000 which was above average for the fishery. This decline in banana prawn catch occurred in spite of moderate rainfall; however, the rain was not associated with any cyclones, which increase water turbidity and reduce predation. Work continues on assessing the relationship between summer rainfall and banana prawn catches from Area 1, which includes the Ashburton River estuary, a nursery area for this species.

**Exploitation status:** Not assessed

**Breeding stock levels:** Not assessed

#### NON-RETAINED SPECIES

**Bycatch species impact:** Low

Bycatch from the fishery is typical of tropical trawl fisheries (i.e. up to about 6:1 relative to the target species), but the effort levels and spatial coverage are too low to impact bycatch species populations.

**Protected species interaction:** Low

The Onslow prawn fishery can at times catch turtles and sea snakes, but the overall low effort level and targeted coverage of the fishery suggest that such interaction would not be significant. Bycatch reduction devices (grids) will be used in the fishery in 2002/03.

#### ECOSYSTEM EFFECTS

**Food chain effects:** Low

Because of the limited spatial coverage of this fishery and its low levels of catch of the target species, it is unlikely to have any significant ecological consequences.

**Habitat effects:** Low

This fishery targets primarily king and tiger prawns in most years and, occasionally, schooling banana prawns in the infrequent high rainfall periods, as in 2000. Within the extensive licensed fishing zone, relatively few discrete areas offshore from nursery areas are fished (less than 5% of the overall fishery). Consistent effort occurs mostly between the Ashburton River and Onslow for banana and king prawns, and in the Mangrove Passage area for tiger prawns. Trawling occurs over a very small proportion (< 5%) of the king prawn habitat, as densities in most areas are too low for economically viable trawling. In contrast, fishing covers a high proportion (50%) of the discrete banana prawn habitats associated with river estuaries.

The fishery is restricted to clean sand and mud bottoms, where trawling has minimal physical impact.

#### SOCIAL EFFECTS

Estimated employment for the year 2001 was 12–15 skippers and crew, with up to 10 people involved in local processing.

#### ECONOMIC EFFECTS

**Estimated annual value (to fishers) for year 2001:** \$900,000

Ex-vessel prices for prawns vary depending on the type of product and the market forces operating at any one time. Generally, average prices received by vessels fishing along the northern coast in 2001 were as follows:

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King prawns	\$14.05/kg
Tiger prawns	\$16.16/kg
Endeavour prawns	\$10.49/kg
Banana prawns	\$11.55/kg
Coral prawns	\$2.12/kg

### FISHERY GOVERNANCE

**Acceptable catch range: 60–130 tonnes**

Under current effort levels and previous environmental conditions, the acceptable ranges of prawn catches, based on the catches of the 1990s, are as follows:

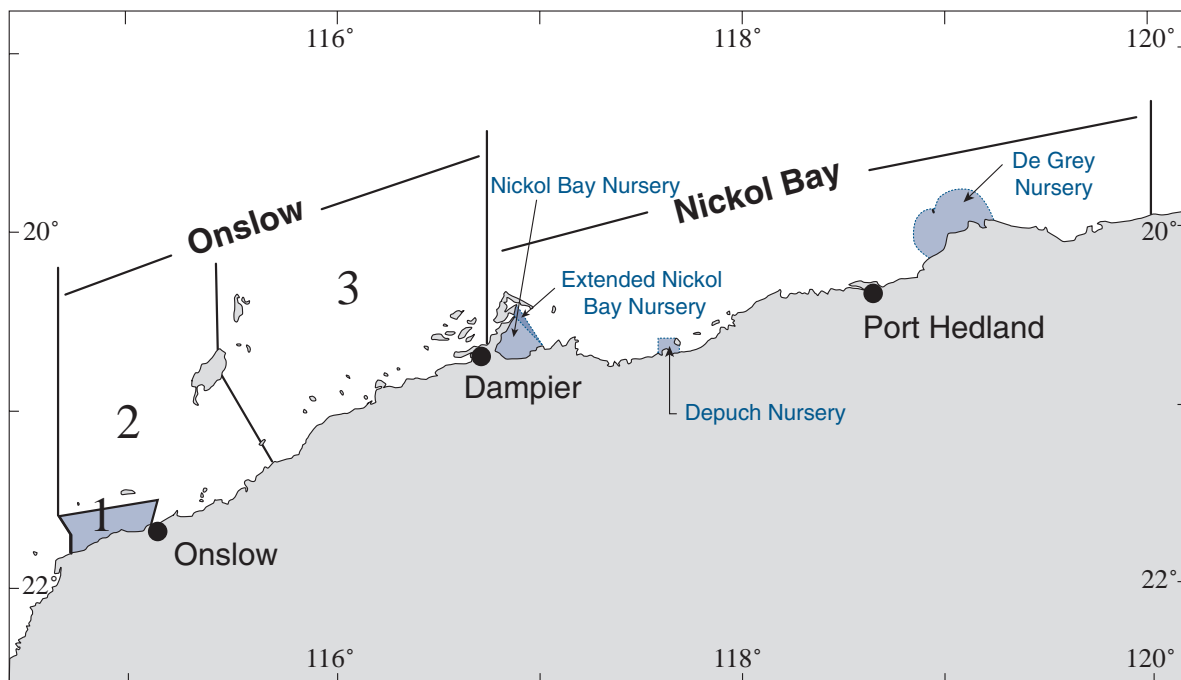
King prawns	10–55 tonnes
Tiger prawns	5–40 tonnes
Endeavour prawns	5–20 tonnes
Banana prawns	2–90 tonnes

Note the overall acceptable range for all species combined is different from the aggregate of the individual species ranges shown, as the environmental circumstances that benefit banana prawns generally result in decreased catches of the other species in the same year.

### EXTERNAL FACTORS

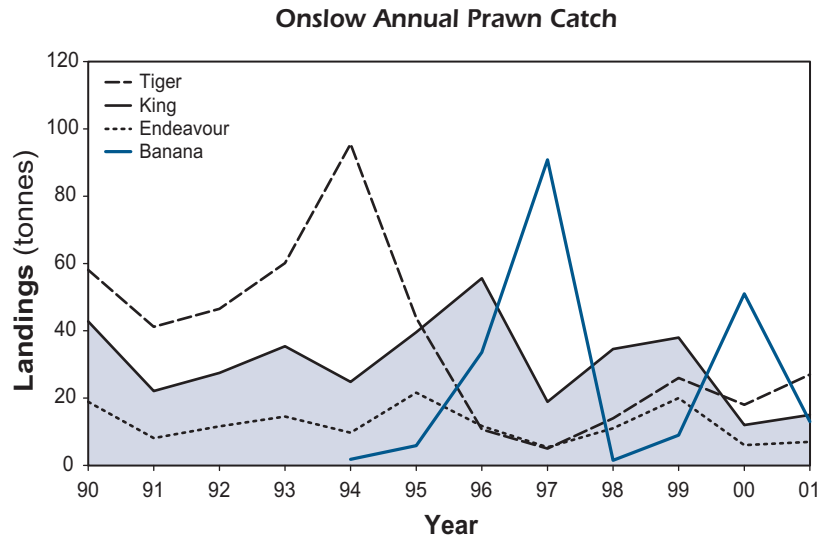
The catches taken are from a number of separate nursery areas and are highly variable from year to year. This is particularly the case for the rainfall-dependent banana prawn.

Catches of tiger prawns from this fishery are also quite variable. It is likely that severe cyclonic activity impacts negatively on tiger prawns in some years, and moreover, the effect varies depending on whether juvenile prawns are still in vulnerable, shallow nursery areas at the time. Severe cyclones can also impact directly on endeavour prawns. The king prawn catch has remained stable, indicating that environmental effects such as cyclonic activity (producing heavy rainfall) have little effect on the abundance of the king prawn stock. However, fishers report that there can be an indirect, short-term impact on the distribution of king prawns when heavy rainfall inland and subsequent river flooding appear to disperse the stock, affecting overall catches. At times, debris from flooding is reported to restrict fishing activities and hence landings for the year.



**ONSLOW/NICKOL BAY PRAWN FIGURE 1**

Boundaries of the Onslow and Nickol Bay Prawn Managed Fisheries.



**ONSLow PRAWN FIGURE 2**

Annual landings for the Onslow Prawn Managed Fishery, 1990–2001.

## NICKOL BAY PRAWN MANAGED FISHERY

### Management Summary

The Nickol Bay Prawn Managed Fishery (NBPMF) targets banana prawns (*Penaeus merguensis*), western king prawns (*Penaeus latissulcatus*), brown tiger prawns (*Penaeus esculentus*) and endeavour prawns (*Metapenaeus* spp.), with most prawn fishing activity using otter trawl gear and occurring in inshore areas.

Management controls for the Nickol Bay Prawn Managed Fishery are based on limited entry, seasonal and area closures, gear controls and restrictions on boat size. The first steps to introducing bycatch reduction devices into the fishery were taken this season with vessels required to have half their gear fitted with BRDs. In addition, the Vessel Monitoring System was implemented in the fishery in 2002.

There was also an amendment to the Pilbara Fish Trawl Interim Managed Fishery Management Plan which removed the linkages between that fishery and the NBPMF.

Different areas within the fishery have different season dates. The main fishing ground for the 2002 fishing season opened on 1 May and will close 15 November. Having a number of fishing areas with varying season dates allows access to target species, usually tiger and banana prawns, at appropriate times.

#### **Governing Legislation/Fishing Authority**

Nickol Bay Prawn Fishery Management Plan 1991  
Nickol Bay Prawn Managed Fishery Licence

#### **Consultation Process**

Department–industry meetings

### Research Summary

Research for the management of this small fishery involves stock monitoring and assessment utilising monthly return data provided by industry, information from boat skippers, and rainfall records. Stock assessment of the banana prawn stocks involves updating the catch–rainfall relationship.

Research outcomes are reviewed at annual industry meetings which consider the status of the stocks and recommend changes to fishing operations.

The following status report summarises the research findings for this fishery.

## NICKOL BAY PRAWN MANAGED FISHERY STATUS REPORT

*Prepared by M. Kangas and E. Sporer*

### FISHERY DESCRIPTION

#### **Boundaries and access**

The boundaries of this fishery are 'all the waters of the Indian Ocean and Nickol Bay between 116°45' east longitude and 120° east longitude on the landward side of the 200 m isobath' (Onslow/Nickol Bay Prawn Figure 1).

During the 2001 season the major fishing areas were open during the following periods:

Nickol Bay Nursery	1 May–1 August
Extended Nickol Bay Nursery	1 May–15 November
Depuch Nursery	1 May–1 August
De Grey Nursery	1 May–15 November
Onslow Area 3	1 March–11 November

There were 14 boats licensed to trawl for prawns in Nickol Bay during 2001.

**Main fishing method**

Otter trawl.

**RETAINED SPECIES**

**Commercial production (season 2001):** 22 tonnes

**Landings**

The total landings of major penaeids for the 2001 season were 22 tonnes, comprising 11 tonnes of banana prawns, 8 tonnes of king prawns, 2 tonnes of tiger prawns and 1 tonne of endeavour prawns (Nickol Bay Prawn Figure 2).

The catch forecast of banana prawns (80–190 tonnes), projected on the basis of rainfall over the period December to March, was not realised. Fishers noted a lack of water turbidity that may have contributed to high predation.

Recorded by-product species for 2001 were 13 tonnes of coral prawns, 4 tonnes of bugs, 3 tonnes of shark, and less than one tonne each of black tiger prawns, blue swimmer crab, squid, cuttlefish, scallops and mixed finfish species.

**Fishing effort**

During 2001, 289 days of fishing was recorded by boats licensed to fish in the Nickol Bay prawn fishery. This was approximately 60% down on the average number of fishing days recorded in the last four years, as the fleet left early to go to alternative fisheries in response to the very low abundance of banana prawns.

**Catch rate**

Not assessed.

**Recreational component:** Nil

**Stock assessment complete:** Not assessed

A broad relationship exists between the summer rainfall (December–March) and the catch of banana prawns in the following season (April–July). This relationship is assessed annually (Nickol Bay Prawn Figure 3). The catches in 2001 did not fit the relationship, with only 11 tonnes taken rather than the 80–190 tonnes forecast. A possible explanation is that although the rainfall recorded was moderate, it was not associated with any cyclone event that would increase water turbidity. The absence of turbidity may have increased predation rates.

**Exploitation status:** Not assessed

**Breeding stock levels:** Not assessed

**Projected catch next season (2002):**  
Banana prawns 1–40 tonnes

The catch projection for banana prawns, based on the 7 mm of rain during the 2001/02 summer period, is between 1 and 40 tonnes.

**NON-RETAINED SPECIES**

**Bycatch species impact:** Low

The Nickol Bay prawn fishery operates predominantly by specifically targeting schools of banana prawns. This results in relatively low effort and minimal bycatch compared with other trawl fisheries.

**Protected species interaction:** Low

The Nickol Bay prawn fishery can at times catch turtles and sea snakes, but the overall low effort level and targeted coverage of the fishery suggest that such interaction would not be significant. Bycatch reduction devices (grids) will be implemented in the fishery during 2002/03.

**ECOSYSTEM EFFECTS**

**Food chain effects:** Low

In view of the highly variable nature of banana prawn recruitment, positively related to cyclonic rainfall, any food chain impacts from fishing are likely to be minimal despite the relatively high annual exploitation rate.

**Habitat effects:** Low

The small fleet fishes on a limited number of discrete fishing grounds, making up less than 5% of the coastal habitat within the fishery. Habitat types on the trawl areas associated with banana and king prawns are mud and sand respectively, and not impacted significantly by trawl gear.

**SOCIAL EFFECTS**

Estimated employment for year 2001 was 40–50 skippers and crew, with up to 20 people involved in onshore processing in the region.

**ECONOMIC EFFECTS**

**Estimated annual value (to fishers) for year 2001:**  
\$300,000

Ex-vessel prices for prawns vary depending on the grade of the product and the market forces operating at any one time. Generally, average prices received by vessels fishing along the northern coast in 2001 were as follows:

Banana prawns	\$11.55/kg
King prawns	\$14.05/kg
Tiger prawns	\$16.16/kg
Endeavour prawns	\$10.49/kg
Coral prawns	\$2.12/kg

**FISHERY GOVERNANCE**

**Acceptable catch range:** 90–300 tonnes

Under current effort levels and previous environmental conditions, the acceptable ranges of prawn catches, based on the catches of the 1990s, are as follows:

Banana prawns	40–220 tonnes
King prawns	20–70 tonnes
Tiger prawns	2–40 tonnes
Endeavour prawns	1–10 tonnes

Note the overall acceptable range for all species combined is different from the aggregate of the individual species ranges shown, as the environmental circumstances that benefit banana prawns generally result in decreased catches of the other species in the same year. It should also be noted that the banana prawn catch has exceeded 400 tonnes following extreme cyclonic rainfall on three occasions over the past 30 years.

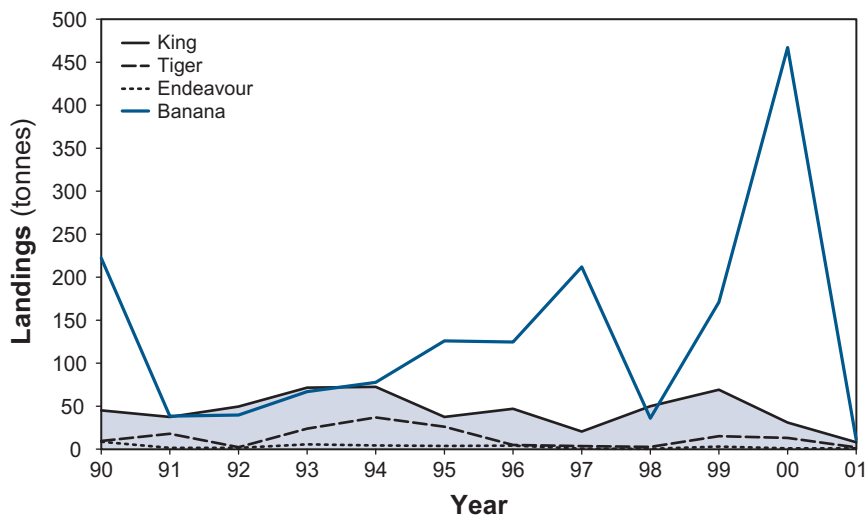
EXTERNAL FACTORS

Banana prawns usually dominate the catch from Nickol Bay. The catch of this species is positively correlated with rainfall in the months December to March. With only 7 mm of rainfall recorded for this period during 2001/02 and the low catches observed in 2001, very low landings (1–40 tonnes) of banana prawns are forecast for 2002. The king prawn catches were also below the acceptable range for this species in 2001 and may reflect lower recruitment levels due to less favourable environmental conditions. It is anticipated that the king prawn catches should return to the acceptable catch range in 2002 as low rainfall has again been experienced.

The majority of boats in the prawn fleet of Nickol Bay are also licensed to fish finfish stocks offshore in the Pilbara Fish Trawl Interim Managed Fishery (PFTIMF). Some are

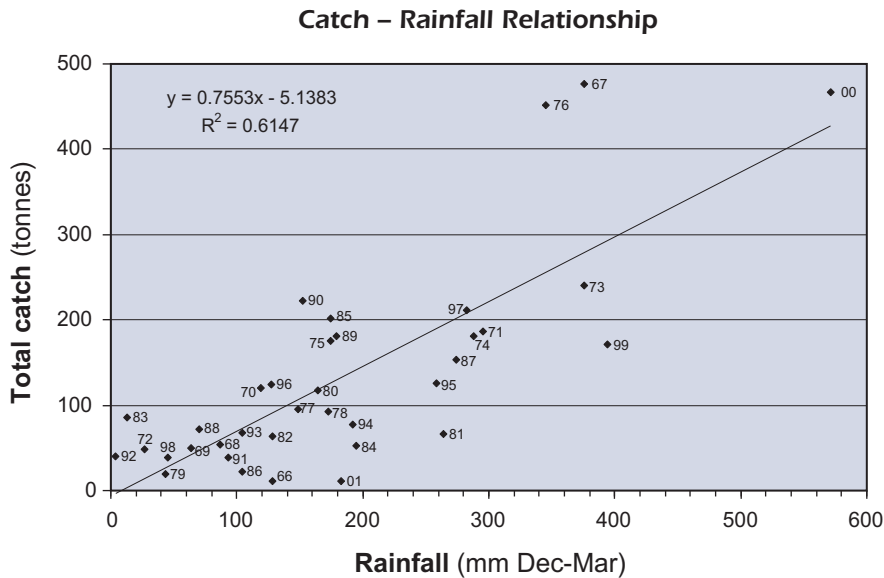
also licensed to fish for prawns in the Kimberley Prawn Managed Fishery. As such, the fishing effort in the Nickol Bay Prawn Managed Fishery is dependent on management measures in place elsewhere, and on the catch rates available in these other fisheries. Fishing for finfish has encouraged the construction of larger boats with greater fishing power than would otherwise have been supported by fishing prawns alone. In recent years, however, concern about over-exploitation in the PFTIMF has led to time quotas and other restrictions. The impact of these restrictions has forced some of these larger fishing vessels to return to the NBPMF and other fisheries for which they have licences. These vessels, however, are not economically viable in the NBPMF in low banana prawn years and leave the fishery early, leading to highly variable effort in the fishery.

Nickol Bay Annual Prawn Catch



NICKOL BAY PRAWN FIGURE 2

Annual landings for the Nickol Bay Prawn Managed Fishery, 1990–2001.



**NICKOL BAY PRAWN FIGURE 3**

Relationship between banana prawn landings and rainfall between December and March for the years 1966–2001.

## BROOME PRAWN MANAGED FISHERY

### Management Summary

The Broome Prawn Managed Fishery is a small fishery which operates from June to August in a designated trawl zone off Broome and generally coincides with the seasonal closures for the Northern and Kimberley prawn fisheries. The dominant species caught are western king prawns (*Penaeus latisulcatus*) and coral prawns (a combined category of small penaeid species). Licensees were required to install bycatch reduction devices in this fishery from the commencement of the 2002 fishing season.

#### Governing Legislation/Fishing Authority

Broome Prawn Fishery Management Plan 1999  
Broome Prawn Managed Fishery Licence

#### Consultation Process

Department–industry meeting

### Research Summary

Research data for managing this small seasonal fishery is provided by detailed research logbooks completed by all boats. This data is used for stock assessment and monitoring which is discussed with industry at annual review meetings. The relationship between catch and moon phase was investigated during 1997/98, which resulted in some modifications to the annual management arrangements to optimise fishing times.

The following status report summarises the research findings for this fishery.

### BROOME PRAWN MANAGED FISHERY STATUS REPORT

*Prepared by M. Kangas and E. Sporer*

#### FISHERY DESCRIPTION

##### Boundaries and access

The boundaries of this fishery are *'all waters of the Indian Ocean off the north-west coast of Western Australia east of 120° east longitude and west of 123°45' east longitude on the landward side of the 200 m isobath'*.

Within this schedule, the permitted fishing area is *'all Western Australian waters bounded by a line commencing at the intersection of 17°20' south latitude and 121°50' east longitude; thence east to the intersection of 17°50' south latitude and 121°55' east longitude; thence north-east to the intersection of 17°40' south latitude and 122° east longitude; thence north to the intersection of 17°30' south latitude and 122° east longitude; thence north-west to the intersection of 17°20' south latitude and 122°55' east longitude; thence west to the commencement point'*.

The permitted fishing area was opened for the 2001 fishing season on 1 June and closed on 31 July, allowing for a total of 60 nights fishing. Fishing actually ceased at 8.00 a.m. on 24 July after a total of 54 nights fishing.

Five Western Australian-based Northern Prawn Fishery (Gulf of Carpentaria) boats are licensed to operate in this fishery.

#### Main fishing method

Otter trawl.

#### RETAINED SPECIES

**Commercial production (season 2001):** 142 tonnes

#### Landings

The total landings for the 2001 season were 142 tonnes, including 62 tonnes of king prawns and 80 tonnes of coral prawns (Broome Prawn Figure 1) for 54 days fished. King prawn landings for 2001 were 38% lower than the five-year average (86 tonnes) whereas the catch of coral prawns was above average.

#### Fishing effort

Nominal effort recorded in the daily research logbooks for the fleet was 2,785 hours.

#### Catch rate

Average catch rates of 22.4 kg/hr for king prawns and 28.8 kg/hr for coral prawns were recorded. Although the catch rate for king prawns remained relatively stable for the duration of the fishery, declining from an average of 24 kg/hr in June to 20.2 kg/hr in July, it was low compared to previous seasons. This may be because the fishery commenced close to the full moon, when catch rates of king prawns are lowest, and only fished through one new moon period during the season. As this fishery is aligned to the mid-season closure of the Northern Prawn Fishery, the timing is not always optimal with respect to the recruitment of king prawns on to the trawl grounds. Additionally, the short duration of fishing does not always allow for the full exploitation of stocks during higher catch rate periods over the new moon.

**Recreational component:** Nil

**Stock assessment complete:** Yes

A Delury depletion analysis incorporating lunar effects was carried out on the 2001 logbook data to quantify the standing stock of king prawns in the Broome fishery. From this analysis, a standing stock of approximately 166 tonnes was estimated. This indicates that for the 2001 season approximately 38% of the stock was taken by fishing, utilising the 2,785 hours of fishing recorded in this fishery. The approach of using a depletion analysis has potential to examine variation in recruitment strength from year to year because the standing stock estimate for each year will reflect this. When sufficient years of data have been assembled, it will be possible to relate the proportion of the king prawn stock not fished at the end of each fishing season (a measure of residual spawning stock) and the recruitment of king prawns in the subsequent year.

The depletion method applied has provided a good insight into stock levels. It has the advantage of being a very direct assessment method, with the potential to carefully control exploitation rates. It is intended to continue its use as the primary assessment method for this fishery.

**Exploitation status:** Under-exploited

**Breeding stock levels:** Adequate

Depletion analysis indicated that approximately 60% of the king prawn stock was left when fishing ceased in the 2001 season. This stock would contribute to the spawning stock for 2002 and some females would have spawned prior to capture. These data indicate that the king prawn stock is being maintained well above the level of 20% of virgin biomass generally considered to be sufficient to sustain this type of prawn stock.

#### NON-RETAINED SPECIES

**Bycatch species impact:** Low

Owing to the very short duration of this fishery and the small number of boats involved, the impact on bycatch species is considered to be minimal.

**Protected species interaction:** Low

The fishery operates in relatively deep water, and this fact, combined with the short season, restricted small size trawl area and the small number of boats involved, means that interaction with protected species is minimal.

#### ECOSYSTEM EFFECTS

**Food chain effects:** Low

The short duration and limited spatial coverage of this fishery, and the small number of boats involved, indicate that food chain effects will be insignificant.

**Habitat effects:** Low

The fishery targets non-schooling king prawns with a secondary catch of coral prawns (common name due to colour, not habitat association) in relatively deep water. The fishery is permitted to operate only in a discrete area offshore, north-west of Roebuck Bay which is the nursery area for this king prawn stock. The defined trawling area was surveyed by Fisheries Research Division and industry divers prior to establishment of the management plan to ensure minimal impact on the adjacent pearl fishery habitat. The sea floor in the trawl area was mud or sand, which is unlikely to be adversely impacted by trawling.

#### SOCIAL EFFECTS

The estimated employment generated by the fishery for the year 2001 was 20 skippers and crew over the two-month season. The vessels operate for the remainder of the year in the prawn fisheries further north.

#### ECONOMIC EFFECTS

**Estimated annual value (to fishers) for year 2001:** \$1 million

Ex-vessel prices for prawns vary depending on the type of product and the market forces operating at any one time. Generally, prices received by boats for 2001 were as follows:

King prawns	\$14.05/kg
Coral prawns	\$2.12/kg

**FISHERY GOVERNANCE**

**Acceptable catch range: King prawns 35–170 tonnes**

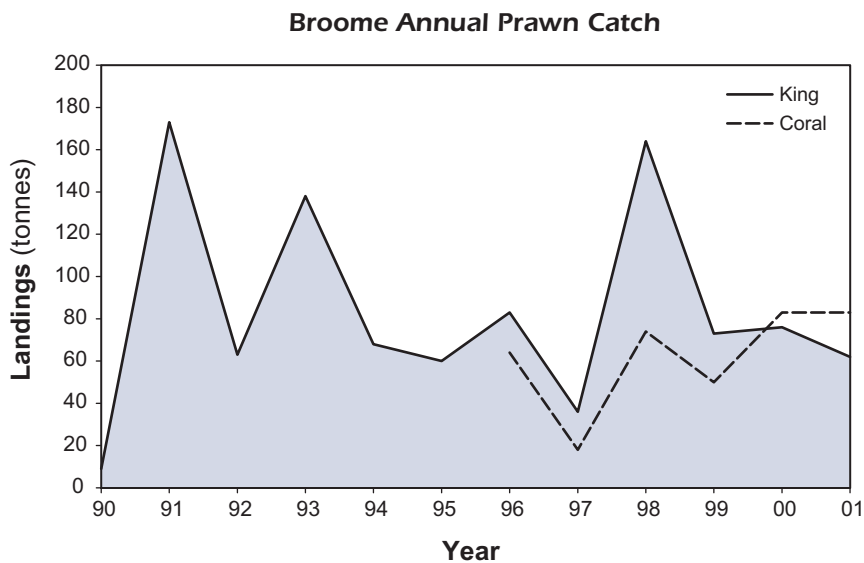
Under current effort levels and previous environmental conditions, the acceptable range for the king prawn catch, based on the catches of the 1990s, is 35–170 tonnes. The 62 tonnes of king prawns taken in 2001 are at the low end of the acceptable range due to low effort.

**EXTERNAL FACTORS**

Catches of king prawns in the Broome Prawn Managed Fishery have fluctuated between 36 and 173 tonnes since 1991. Before that time this fishing area was used on a casual basis by boats transiting to the Northern Prawn Fishery (NPF) in the Gulf of Carpentaria. The success of this fishery

depends on how the limited fishing season coincides with the king prawn recruitment and catchability, which is strongly influenced by the lunar period. Historically, the timing of this fishery has been set to coincide with the NPF mid-season closure rather than the appropriate lunar periods. Consequently, the timing of the fishing period has not always been optimal for maximising the catch from the king prawn stock as was seen in 2001 when a low exploitation rate occurred.

This fishery is valuable, despite its short season, because it allows up to nine weeks of fishing by five boats in a way that complements their fishing activity in the NPF, and in other fisheries in Western Australia.



**BROOME PRAWN FIGURE 1**

Annual landings for the Broome Prawn Managed Fishery, 1990–2001.

## KIMBERLEY PRAWN MANAGED FISHERY

### Management Summary

The Kimberley Prawn Managed Fishery, which targets banana prawns (*Penaeus merguensis*), operates off the north of the State between Koolan Island and Cape Londonderry and abuts the western boundary of the Commonwealth Northern Prawn Fishery. A significant number of vessels hold authorisations to operate in both fisheries, and opening and closing dates are aligned to prevent large shifts of fishing effort into the Kimberley fishery.

The management controls for the Kimberley Prawn Managed Fishery are based on limited entry, seasonal closures, gear controls and restrictions on boat replacements. The Vessel Monitoring System was introduced into the fishery during 2001. Bycatch reduction devices were also required to be installed by the licensees in this fishery from the second half of the 2002 season. A review of the management arrangements for this fishery, primarily to deal with the very high levels of effort, was commenced in 2002.

#### Governing Legislation/Fishing Authority

Kimberley Prawn Fishery Management Plan 1993  
Kimberley Prawn Fishery Managed Fishery Licence

#### Consultation Process

Department–industry meeting

### Research Summary

Research data for monitoring this fishery are provided by Western Australian fishers' monthly returns, and by research logbooks collected by the Australian Fisheries Management Authority for NPF boats licensed to operate in the Kimberley fishery.

Research assessments are provided to annual meetings of boat operators and provide the basis for recommending changes to management arrangements each year.

The following status report summarises the research findings for this fishery.

### KIMBERLEY PRAWN MANAGED FISHERY STATUS REPORT

Prepared by M. Kangas and E. Sporer

#### FISHERY DESCRIPTION

##### Boundaries and access

The boundaries of this fishery are 'all Western Australian waters of the Indian Ocean lying east of 123°45' east longitude and west of 126°58' east longitude'.

Seasonal dates for the Kimberley Prawn Managed Fishery are aligned with those of the adjacent Northern Prawn Fishery. Consequently, the 2001 season opened on 1 April and closed for the mid-season closure on 27 May. The fishery re-opened on 4 August and ran until the final season closure on 9 November.

Although a total of 133 boats had access to the Kimberley Prawn Managed Fishery under various licensing

arrangements, only 20 boats operated in the fishery during the 2001 season.

#### Main fishing method

Otter trawl.

#### RETAINED SPECIES

**Commercial production (season 2001): 303 tonnes**

#### Landings

The total landings for the 2001 season were 303 tonnes, comprising 238 tonnes of banana prawns, 47 tonnes of tiger prawns (*Penaeus esculentus*), and 18 tonnes of endeavour prawns (*Metapenaeus* spp.) (Kimberley Prawn Figure 1).

The banana prawn catch was within the projected catch range (200–350 tonnes) using the preliminary relationship between summer rainfall and catches. The tiger prawn catch was within the acceptable catch range for this species (15–60 tonnes), as was the endeavour prawn catch (7–80 tonnes).

Recorded by-products were 13 tonnes of squid, 3 tonnes of bugs and less than one tonne of scallops.

#### Fishing effort

During the 2001 season, 20 vessels operated in the fishery for a total of 1,159 fishing days.

#### Catch rate

Not assessed.

**Recreational component: Nil**

**Stock assessment complete: Not assessed**

Although there has been no formal stock assessment based on catches and fishing effort for the Kimberley prawn stocks, nevertheless the relationship recognised from other fisheries between rainfall and catches of banana prawns (the dominant species taken in this area) may provide a degree of forecasting.

Further investigations have shown a more promising relationship between early season rainfall (January and February) and the subsequent catch of banana prawns. Rainfall during the period January–February 2002 was 567 mm at Derby and 625 mm at Kalumburu, which indicates that banana prawn catches for 2002 should be in the range of 200–380 tonnes. Investigations on refining rainfall–catch relationships are continuing.

**Exploitation status: Not assessed**

**Breeding stock levels: Not assessed**

**Projected catch next season (2002):  
Banana prawns 200–380 tonnes**

The projected catch for 2002 based on the rainfall–catch relationship is 200–380 tonnes for banana prawns.

#### NON-RETAINED SPECIES

**Bycatch species impact: Low**

The majority of the catch in this fishery comprises banana prawns which form schools that are specifically targeted, meaning that bycatch is minimal. In the Kimberley, however, banana prawns may also be generally trawled when they are

dispersed due to local tidal conditions. Overall, the fishery is likely to have a low impact on bycatch species.

**Protected species interaction:** **Low**

Turtle exclusion devices are used by the NPF boats. Trials of bycatch reduction devices (on one side) will commence in the Kimberley Prawn Managed Fishery during 2002.

**ECOSYSTEM EFFECTS**

**Food chain effects:** **Low**

As the fishery targets banana prawns, which are highly variable in recruitment due to cyclonic rainfall, any food chain impacts from fishing are likely to be negligible.

**Habitat effects:** **Low**

The Kimberley prawn trawl fishery operates over a very limited sector, estimated to be less than 5% of the licensed area. Owing to the unusual nature of the environment, characterised by extreme (10 m) tidal ranges, heavy mud substrates and high turbidity, the fishing is judged to have minimal impact on the habitat.

**SOCIAL EFFECTS**

Estimated employment for the year 2001 was 80 skippers and crew.

**ECONOMIC EFFECTS**

**Estimated annual value (to fishers) for year 2001:**  
**\$3.7 million**

Ex-vessel prices for prawns vary depending on the type of product and the market forces operating at any one time. Generally, average prices received by boats fishing along the northern coast in 2001 were as follows:

Banana prawns	\$11.55/kg
Tiger prawns	\$16.16/kg
Endeavour prawns	\$10.49/kg

**FISHERY GOVERNANCE**

**Acceptable catch range:** **240–500 tonnes**

Under current effort levels and previous environmental conditions, the acceptable ranges of prawn catches, based on the catches of the 1990s, are as follows:

Banana prawns	200–450 tonnes
Tiger prawns	15–60 tonnes
Endeavour prawns	7–80 tonnes

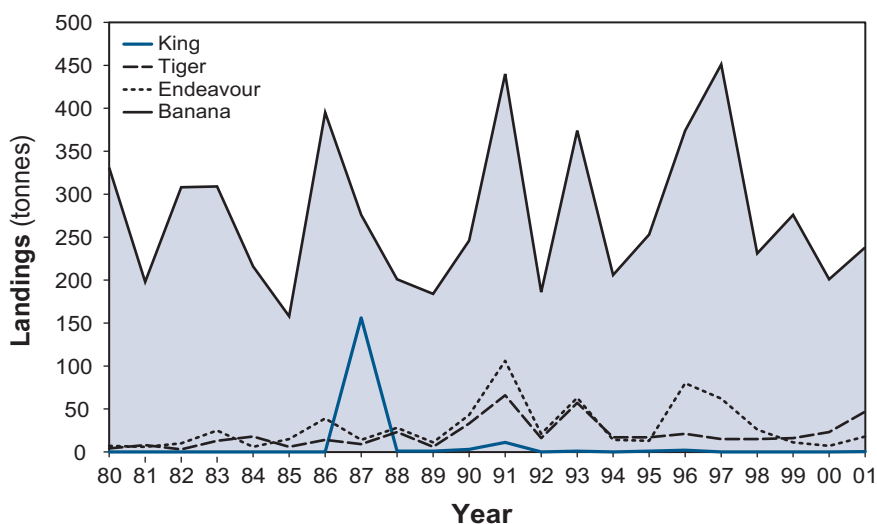
Note the overall acceptable range for all species combined is different from the aggregate of the individual species ranges shown, as the environmental circumstances that benefit banana prawns generally result in decreased catches of the other species in the same year.

**EXTERNAL FACTORS**

The relationship between summer rainfall and the catch of banana prawns is being investigated further. As banana prawns usually comprise the majority of the prawn catch from this fishery, this correlation will assist fishers and managers to make the best use of the fishery.

This fishery is used by relatively few stand-alone, Kimberley-only boats for the complete fishing season. Boats from Nickol Bay and elsewhere in Western Australia use it at certain times of the year to complement catches in their local fisheries. Boats fishing in the Northern Prawn Fishery in the Gulf of Carpentaria also use this fishery for periods each year, and in fact the Kimberley fishing season is set to mirror dates used in the NPF, to prevent the small Kimberley fishery from attracting too much fishing effort from its large neighbour. However, it must be noted that the level of latent effort in this fishery is high and this issue is currently being addressed by management.

**Kimberley Annual Prawn Catch**



**KIMBERLEY PRAWN FIGURE 1**

Annual landings for the Kimberley Prawn Managed Fishery, 1980–2001.

## KIMBERLEY GILLNET AND BARRAMUNDI MANAGED FISHERY

### Management Summary

The Kimberley Gillnet and Barramundi Managed Fishery (KGBMF) extends from the WA/NT border to the top of Eighty Mile Beach, south of Broome (latitude 19° S). It encompasses the taking of any fish by means of gillnet and the taking of barramundi by any means.

The species taken are predominantly barramundi (*Lates calcarifer*) and threadfin salmon (*Eleutheronema tetradactylum*). The main areas of the fishery are the river systems of the northern Kimberley, King Sound, Roebuck Bay and the top end of Eighty Mile Beach.

There are currently seven licences in the fishery, reduced from a historical level of 10 through a Voluntary Fisheries Adjustment Scheme in 1999. The licences are currently only transferable between family members, but it is proposed that they become fully transferable after 1 January 2003.

Following the development in 2000 of the 'Barramundi Accord', arrangements have now been put into place to achieve cohesive management of commercial and recreational fishing for barramundi. These arrangements include extensive areas closed to commercial fishing around major town sites and recreationally important fishing locations.

#### **Governing Legislation/Fishing Authority**

Kimberley Gillnet and Barramundi Fishery  
Management Plan 1989

Kimberley Gillnet and Barramundi Managed  
Fishery Licence

#### **Consultation Process**

Department–industry meeting

### Research Summary

The data used to assess the status of the series of barramundi stocks taken by this fishery are provided from the CAES database. The following status report is compiled annually and provided to industry and regional management.

## KIMBERLEY GILLNET AND BARRAMUNDI MANAGED FISHERY STATUS REPORT

Prepared by S. Ayvazian and G. Nowara

### FISHERY DESCRIPTION

#### **Boundaries and access**

The boundaries of this limited entry fishery are 'all Western Australian waters lying north of 19° south latitude and west of 129° east longitude and within three nautical miles seawards of the low water mark of the mainland of Western Australia and the waters of King Sound of 16° 21' 38" south latitude'. Access to the fishery was by seven vessels during 2000/01. (Note: The distribution of barramundi catches in Western Australia extends further south to the Ashburton River near Onslow. These catches are outside of the

boundaries of the managed fishery and are not included in this status report).

#### **Main fishing method**

Gillnet.

### RETAINED SPECIES

#### **Commercial production (season 2000/01):**

**All species 99.6 tonnes  
Barramundi 43.9 tonnes**

#### **Landings**

Each of five principal fishing areas is considered separately because of differing histories of development, effort application, recreational interest and unit stock considerations: Cambridge Gulf/Ord River, Kimberley coast (six river systems), King Sound/Fitzroy River, Broome coast, and Pilbara coast to the Ashburton River, the last of which is south of the prescribed restricted entry fishery (below latitude 19° S). Landings from the Pilbara coast are not included in the total catch figure. Total landings of barramundi for all four prescribed fishing areas within the fishery were 43.9 tonnes for 2000/01 (Kimberley Gillnet Figure 1). This catch of barramundi was approximately the same as in 1999/2000.

The 2000/01 landings of threadfin salmon, at 46.9 tonnes, were similar to those of barramundi (Kimberley Gillnet Figure 2). The catch for this species peaked between 1997/98 and 1999/2000 and has declined by approximately 50% since that time to the present catch. It is not known why the catches have fallen so dramatically. These two main species comprised 91% of the total catch. There were reported landings of 14 other species, including 3 tonnes of elasmobranchs (sharks and rays).

#### **Fishing effort**

The fishing effort in this gillnet fishery is calculated as the total annual number of fishing days by all boats multiplied by the average daily total of 100 m lengths of gillnet used per boat. During 2000/01, the total effort across the four prescribed fishing areas was 1,285 units. This total effort is slightly lower than last year (Kimberley Gillnet Figure 1).

#### **Catch rate**

The catch and effort for barramundi peaked in the late 1980s and since then total catch and effort have fallen, with an accompanying increase in catch per unit of effort. The current CPUE is up slightly from last year (Kimberley Gillnet Figure 1).

The catch and CPUE for threadfin peaked during 1998/99 and since that time has declined to the current low value (Kimberley Gillnet Figure 2), suggesting a switch in targeting from threadfin back to barramundi in the past two seasons.

#### **Recreational component:**

**Not assessed**

#### **Stock assessment completed:**

**Yes**

The last detailed stock assessment, utilising the 1999 commercial catch data and reported in the *State of the Fisheries Report 2000/2001*, indicated that the barramundi stocks in the Cambridge Gulf, Kimberley coast and King

Sound sectors were being harvested at sustainable levels, while in the Broome sector the breeding biomass was declining. Trends in catch and effort since that time indicate that the Broome sector experienced a peak catch and effort in 1999/2000 followed by a decline in 2000/01. The Cambridge Gulf sector had the highest catch for five years in 1999/2000, followed by a slight decline in 2000/01; however, the present fishing effort is at an historical low level. There has been a trend for increasing catch and fishing effort during the past three years in the Kimberley coast sector of the fishery. This is in contrast to the lower catches and effort recorded in the King Sound sector during the past three years.

Reported catches of threadfin salmon, the other target species, have declined in the past three years, which may be a function of declining abundance of threadfin or specific targeting of barramundi. This will be more closely monitored in future years.

**Exploitation status:** Fully exploited  
Barramundi on average are fully exploited.

**Breeding stock levels:** Adequate  
Assessment of the barramundi stocks indicates that breeding stocks in most areas are adequate.

#### NON-RETAINED SPECIES

**Bycatch species impact:** Low  
The fishery operates at a relatively low intensity over a wide area of the Kimberley, specifically targeting barramundi and threadfin salmon. The fishing gear, with large mesh sizes, does not generate a significant bycatch of species important to other sectors, but does take some sharks and rays. Because of the low effort levels, these impacts are unlikely to be significant to the stocks involved. Overall, this fishery is likely to have little effect on the Kimberley ecosystem as a whole.

**Protected species interaction:** Low  
The fishing gear used for this fishery does take some crocodiles. Because of the low effort levels, these impacts are unlikely to be significant.

#### ECOSYSTEM EFFECTS

**Food chain effects:** Not assessed

**Habitat effects:** Low  
The fishing gear has minimal impact on the habitat which is subject to extreme tidal currents and associated changes.

#### SOCIAL EFFECTS

The Kimberley Gillnet and Barramundi Managed Fishery involved an average of about 15 fishers in 2000/01. There was additional employment through local processors and distribution networks. The fishery provides local fresh fish for the tourist trade throughout the Kimberley region.

#### ECONOMIC EFFECTS

**Estimated annual value (to fishers) for year (2000/01):**  
All species \$605,000  
Barramundi \$368,000

#### FISHERY GOVERNANCE

**Acceptable catch range:** Barramundi 25–40 tonnes

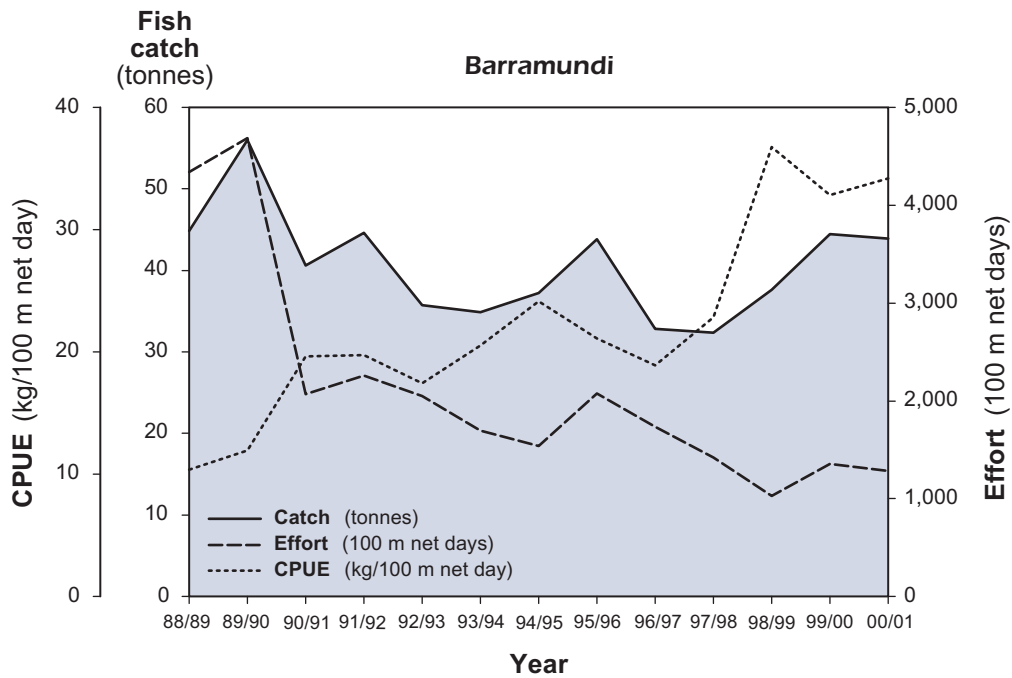
This projection is derived by double exponential, smoothed forecasting of the annual catches up to 1998/99 and the variation of observations around the predictions. The confidence intervals are set at 80%. The current catch is beginning to exceed the range set due to increasing abundance flowing from substantial decreases in effort over the past decade and is therefore not of concern.

#### EXTERNAL FACTORS

The barramundi stocks utilising the large, productive Kimberley river systems as nursery areas are expected to be reasonably resilient to fishing pressure. However, the smaller, isolated stocks along the Pilbara desert coastline are likely to suffer more variable recruitment. These stocks are subject to relatively uncontrolled fishing under general wetline licence arrangements, as well as from recreational fishers, and are likely to need specific management arrangements in the future.

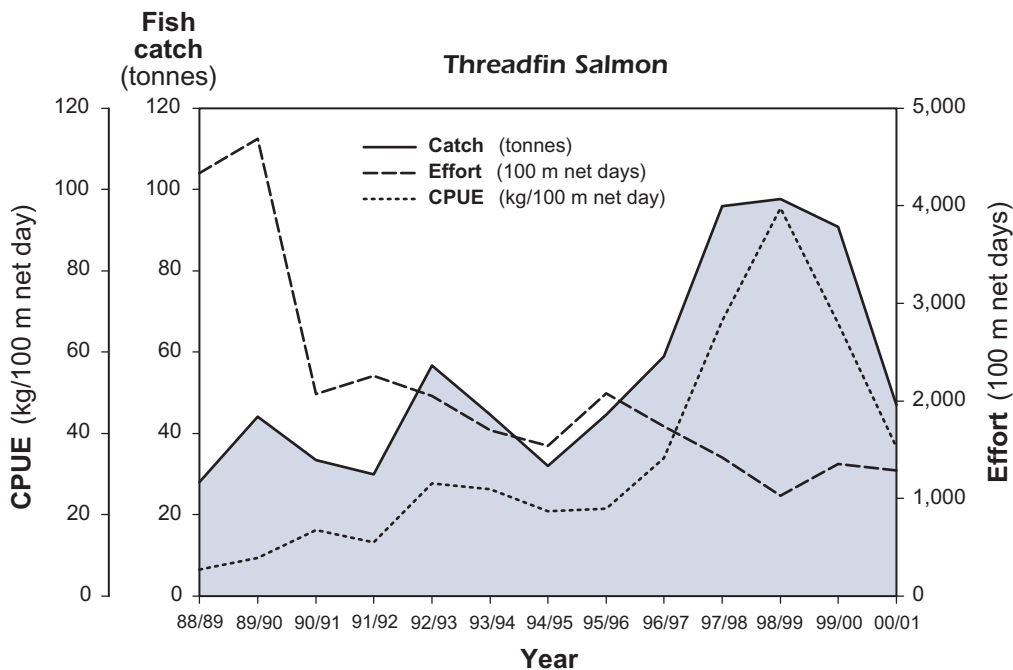
Resource sharing between commercial and recreational fishers on the Ord River has been an issue of debate. However, recent and anticipated levels of commercial fishing by existing operators are not considered to pose a threat to the viability of the resource. At current levels of commercial fishing it is unlikely that the abundance of barramundi is being significantly impacted across the Kimberley region.

Since 1995/96 the catch of threadfin salmon has been considerable, making it the major focus of this fishery in recent years (Kimberley Gillnet Figure 2). Murdoch University currently has a three year FRDC-funded project to study the biology of threadfin salmon in the Kimberley region.



**KIMBERLEY GILLNET FIGURE 1**

The annual catch, effort and catch per unit effort (CPUE, kg/100 m net day) for barramundi from the Kimberley Gillnet and Barramundi Managed Fishery over the period 1988/89 to 2000/01.



**KIMBERLEY GILLNET FIGURE 2**

The annual catch, effort and catch per unit effort (CPUE, kg/100 m net day) for threadfin salmon from the Kimberley Gillnet and Barramundi Managed Fishery over the period 1988/89 to 2000/01.

## NORTHERN DEMERSAL SCALEFISH MANAGED FISHERY

### Management Summary

The Northern Demersal Scalefish Managed Fishery (NDSMF) operates off the north-west coast of Western Australia in the waters east of 120° E longitude. The permitted means of operation within the fishery include handline, dropline and fish traps. Commercial catches are dominated by the tropical snapper (Lutjanidae), which include red emperor (*Lutjanus sebae*); the emperors or north-west snappers (Lethrinidae), which include goldband snapper (*Pristipomoides multidens* and related *Pristipomoides* species); and the cods or groppers (Serranidae).

The Northern Demersal Scalefish Fishery Management Plan 2000 commenced on 1 January 2001, superseding the Northern Demersal Scalefish Fishery Interim Management Plan 1997.

The fishery is managed by input controls, including individually transferable effort allocations, gear restrictions and area closures. The total effort allocation, based on a nominal total sustainable catch (TSC), is allocated on an annual basis. In 2001, the nominal TSC was 800 tonnes of demersal scalefish and the total effort allocation was 1,760 days.

A number of amendments were made to the management plan in 2001. These included an increase in the total number of units in Area 2 of the fishery and the insertion of a provision in the management plan which afforded natural justice to the sole remaining objector pending from the old interim management plan. The unit consumption monitoring mechanism was also altered to increase flexibility to the Area 2 licensees, and provisions were inserted that allow Area 2 licensees to pay their fees by instalments.

#### **Governing Legislation/Fishing Authority**

Northern Demersal Scalefish Fishery Management Plan 2000  
Northern Demersal Scalefish Managed Fishery Licence

#### **Consultation Process**

Northern Demersal Scalefish Management Advisory Committee

### Research Summary

Baseline research data on growth rates, age structure, reproductive biology and yield analyses, together with information gathered from the fishery, have been used to assess the status of the fish stocks that contribute to this fishery, principally red emperor and goldband snapper. This research work was undertaken in an FRDC-funded research project from 1997 to 2000. This information is now being incorporated into age-based stock assessment models to assess the long-term sustainable yield of the fishery, in particular the two key stocks. Ongoing monitoring of this fishery is being undertaken using both CAES data and VMS records.

The appropriateness of the present TSC is under review in order to provide a long-term sustainable catch level for Area 2 of the NDSMF.

The third largest component of the NDSMF catch is the cod group. Little information is currently available on the species composition and their relative abundance. A number of cod species which occur in the NDSMF are Indian Ocean endemics about which little is known. This gap in the knowledge of the NDSMF represents an area of future research work, as does an improved understanding of the catchability of the key species in the fishery that would facilitate improved stock assessments and management arrangements.

The future catch from the NDSMF may also involve the stocks from waters greater than 200 m depth. This area of the fishery is available as a research fishing zone, and fishers have the option to explore the deeper waters, though to date industry has had little success in this zone. The resources of this sub-region are therefore unlikely to be substantial, and given the low production potential of deeper-slope reef fish, the sustainable catch from this zone is likely to be quite low.

The following status report provides a synthesis of the current data from the fishery.

## NORTHERN DEMERSAL SCALEFISH FISHERY STATUS REPORT

*Prepared by S.J. Newman*

### FISHERY DESCRIPTION

#### **Boundaries and access**

The waters of the NDSMF are defined as all Western Australian waters off the north coast of Western Australia east of longitude 120° E. These waters extend out to the edge of the Australian Fishing Zone (200 nautical mile) limit under the Offshore Constitutional Settlement arrangements (Northern Demersal Scalefish Figure 1).

The fishery is further divided into two fishing zones, an inshore zone (Area 1) and an offshore zone (Area 2) (see Northern Demersal Scalefish Figure 1). The demersal scalefish resources of the deeper waters of the offshore zone (greater than 200 m depth) remain to be adequately investigated; these waters are shown on Northern Demersal Scalefish Figure 1 as a research fishing area. Fishing access to the research area can be facilitated through an agreed research framework.

The inshore waters in the vicinity of Broome are closed to commercial fishing. The closed area extends from Cape Bossut to Cape Coulomb, inside a line that approximates as closely as possible the 30 m bathymetric contour.

Access to the offshore zone (Area 2) of the NDSMF is currently limited to 11 licences under an individually transferable effort quota system. This allows the effort quota to be operated by a lesser number of vessels. For example, during 2001, 6 vessels (5 trap vessels and one line vessel) collectively held and operated the effort individually assigned to the 11 licences.

#### **Main fishing method**

Principally fish traps, and to a lesser extent line fishing methods such as handline and/or dropline.

## RETAINED SPECIES

**Commercial production (season 2001):** 504 tonnes

### Landings

The reported catch in the NDSMF rose steadily after the initial development period from 1990 to 1992, reaching a peak in catch levels in 1996 (Northern Demersal Scalefish Table 1 and Figure 2). However, since 1996 catch levels have decreased. In the four years since the implementation of management controls, the reported catch in the NDSMF has ranged between 470 and 580 tonnes, reflecting an annual average in this four-year period of approximately 523 tonnes. The catch of demersal scalefish in the NDSMF in 2001 increased from the low levels of the previous year as the result of an increase in the trap catch (Northern Demersal Scalefish Table 1, Northern Demersal Scalefish Figure 2). The trap and line fishery in the NDSMF principally targets red emperor and goldband snapper, with many species of snappers, emperors and cods comprising a large component of the landed by-product. A breakdown of the landed catch in the NDSMF in 2001 is provided in Northern Demersal Scalefish Table 2. The species composition of the landed catch is similar to that reported in 2000. There has been an increase in the landed catch of the key target species, with red emperor up from 89 tonnes to 95 tonnes and goldband snapper up from 185 tonnes to 204 tonnes. A number of operators within the NDSMF are also involved in other fishing activities in the region, such as trolling for Spanish mackerel (*Scomberomorus commerson*). The catches of pelagic fishes such as the mackerels are not included in the demersal scalefish catch. The catch of Spanish mackerel and other mackerels is reported on pp. 86–91.

### Fishing effort

The five fish trap vessels that fished in the NDSMF in 2001 reported using between 20 and 40 fish traps per day. The line vessel that fished in the NDSMF in 2001 reported using 5 lines per day. The effort allocated in 2001 was 152 fishing boat days per licence, or a total of 1,672 standard fishing days. A standard fishing day is defined as using up to 20 traps or 5 lines per day. The number of days fished reported in the statutory monthly returns was a total of 828 boat days, including 701 boat days for trap vessels and 127 days for line vessels. The number of standard fishing days (SFDs) reported using data from the VMS database was 1,064 SFDs (928 SFDs for trap vessels and 136 SFDs for line vessels), indicating that 608 SFDs remained unutilised in the fishery at the end of the 2001 fishing season. The number of days fished that is recorded in the VMS database is converted to standard fishing days and adjusted to take into account an allocation of travel days for travelling across sectors within the NDSMF.

The fish trap effort (in boat days fished) within the NDSMF has on average been decreasing since 1992. The fish trap effort in 2001 was marginally higher than that recorded in 2000 (Northern Demersal Scalefish Table 1). Since the introduction of management controls, fish trap effort has varied from 890 to 992 SFDs and a large proportion of the effort allocated to both line and trap vessels in the fishery has remained voluntarily unutilised in each fishing year. The line effort recorded in 2001 was down on that recorded in 2000 (Northern Demersal Scalefish Table 1).

### Catch rate

The introduction of management controls in 1998 resulted in an increase in catch per unit effort (CPUE) for trap vessels in the NDSMF. This increase in CPUE was related to increases in efficiency as fishers sought to maximise their catch return from each day fished in the fishery as the available fishing effort was limited. Since 1998, however, the CPUE for trap vessels has stabilised in the range 450–490 kg/day, which is similar to the range prior to the introduction of direct management. The CPUE for line vessels in recent years has been variable depending on the effort levels.

The trap CPUE averaged during 2001 was 480.3 kg per standard trap fishing day (20 traps x 24.02 kg/trap/day) compared to the forecast of 481.4 kg per standard trap fishing day (24.1 kg/trap/day) used in the effort allocation process. This CPUE was closer to the forecast than expected given the lower level of effort recorded in the fishery.

That is, artificially created effort anomalies were evident in 2001, following introduction of the VMS rules, as fishers chose to travel for as long as possible outside the boundary of the fishery to avoid the use of effort allocations in transit. Thus very little transit time is now logged as effort, whereas historically it was. The effect of this change in fishing fleet behaviour has been to inflate the current CPUE 5–10% above the 2000 level.

### Recreational component:

**Not assessed**

At present there is little recreational fishing effort directed towards the deeper-water fish species in Area 2, which are the key species targeted by commercial fishers in the NDSMF. Most of the recreational fishing effort targeting demersal finfish in the Kimberley region is thought to be concentrated in the Broome sector of Area 1, which is closed to commercial fishing. A creel survey of the Pilbara coast conducted recently included the West Kimberley (Broome) area, and these data are currently being analysed. The magnitude of this recreational fishing effort and the catch taken are expected to be small relative to the overall commercial catch.

### Stock assessment completed:

**Not assessed**

The introduction of formal management procedures has restricted the number of vessels permitted to fish in the waters of the NDSMF. A target TSC of 800 tonnes was initially adopted in order to constrain harvest rates. The control mechanism implemented to maintain a catch level of approximately 800 tonnes was a restriction on the number of trap or line days fished by each vessel exploiting the NDSMF resource. Trap and line effort units (fishing days) are allocated annually on the basis of historical catch rate trends and set to enable the target catch to be achieved within each year. The outcome from this effort determination process for the 2002 fishing season is noted in the 'Acceptable catch range' section below. However, it should be noted that the level of catch in the NDSMF over the past four years since effort controls were implemented appears to have stabilised in the range of 500–600 tonnes due to the decision by vessel operators to not fully utilise the allocated effort each year.

A summary of the key results arising from a major FRDC-funded research project completed in 2000 was given in the

*State of the Fisheries Report 2000/2001*. This project provided detailed biological information on the two key demersal finfish species in the NDSMF, red emperor and goldband snapper. The results indicated that the stocks of the two major target species were fully exploited and that a TAC of 800 tonnes, if achieved, would have the fishery operating above optimum levels if the catch of these species increased. This project has provided the foundation for detailed age-structured stock assessment models to be developed for the two key species. It should be noted that the assessment information now provided is different to that reported last year which was based on the preliminary outputs of the age-structured stock assessment models.

The current stock assessment analyses indicate that the maximum sustainable yield of the two target species can be obtained at current effort levels. It should be noted that higher levels of catch from the fishery may be possible if the fishers modify their targeting practices to increase their exploitation of a number of secondary (lower value) species which are faster-growing and more productive.

**Exploitation status:** Fully exploited

The two key species are fully exploited.

**Breeding stock levels:** Adequate

The length and age at maturity for goldband snapper and red emperor were reported in the *State of the Fisheries Report 2000/2001*. The spawning biomass of the key target species in the NDSMF has been estimated by the stock assessment model and assessed in relation to accepted international reference points for these types of species.

The assessment information now provided differs from previous reports because it is now based on the outputs of the age-structured stock assessment models. The stock assessment work indicates that the current level of breeding stock for goldband snapper is at approximately 41% of the estimated virgin level, while red emperor is at approximately 54% of the estimated virgin level. These levels are both above the recommended level of 30–40% of the virgin spawning biomass and therefore the current breeding stock and catch levels are considered adequate.

## NON-RETAINED SPECIES

**Bycatch species impact:** Low

As a result of the marketability of most species caught, there is a limited quantity of non-retained bycatch in this fishery. The most common bycatch species is the starry triggerfish, *Abalistes stellatus*, but the numbers taken are not considered to be significant.

**Protected species interaction:** Negligible

Trap fishing in deep water does not create any significant opportunities for the gear to interact with protected species.

## ECOSYSTEM EFFECTS

**Food chain effects:** Not assessed

**Habitat effects:** Low

As a result of the gear design, the fishery has little impact on the habitat overall, although there may be some interaction with coral habitats. 'Ghost fishing' by traps is unlikely to be

significant, as similar fish species have been observed on video to be able to exit traps if left undisturbed.

## SOCIAL EFFECTS

Six vessels fished in the 2001 fishing season with an average crew level of 3 people per vessel, indicating that 18 people were directly employed in the NDSMF.

## ECONOMIC EFFECTS

**Estimated annual value (to fishers) for year (2001):**  
**\$2.76 million**

The NDSMF principally targets the higher-value species such as the goldband snapper and red emperor. The fishery landed a total of 504 tonnes of demersal scalefish in 2001, for a catch value of over \$2.76 million. This estimate is based on the landed weight of each species recorded in the CAES system and the average price per kilogram of whole weight of each species as supplied by fish processors. This value is higher than that reported in 2000 owing to the increase in catch levels in the fishery. Further, the increase in value of the fishery is also a reflection of improved prices in the 2001-fishing season.

## FISHERY GOVERNANCE

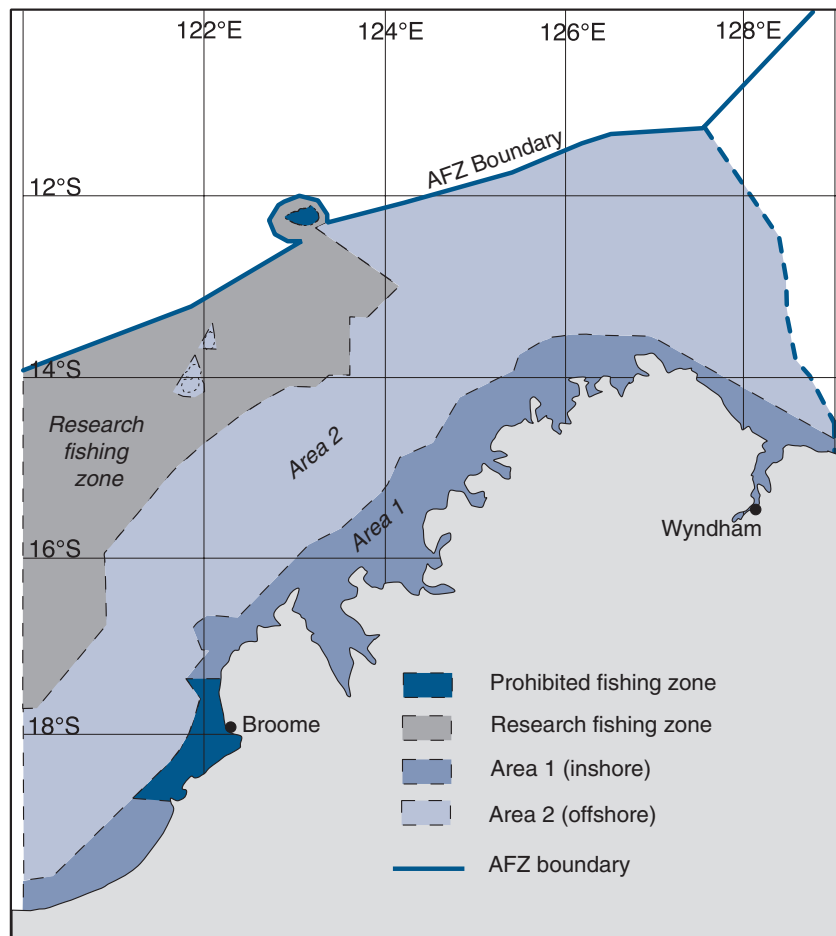
**Acceptable catch (or effort) range:** 600–1,000 tonnes

For the calendar year 2002, the total allowable effort was set at 1,760 fishing days distributed equally among the licences operating in the fishery. At this level of effort and at recent catch rates, the catch is expected to be in the range 600–1,000 tonnes.

However, the long-term sustainable catch level for Area 2 of the NDSMF is currently being assessed, which may result in refinement of the current TSC. In the four years since the introduction of management controls (1998–2001), the fleet has been unable to achieve the 800 tonne TSC. In each of these years a large amount of unutilised effort has remained at the end of the fishing year. Results from the recently completed FRDC-funded study assessing the key species in the NDSMF indicate that catch levels of the two key species should not exceed the present levels. The trigger points for management action are likely to be the TSC  $\pm$  20% after consultation with industry.

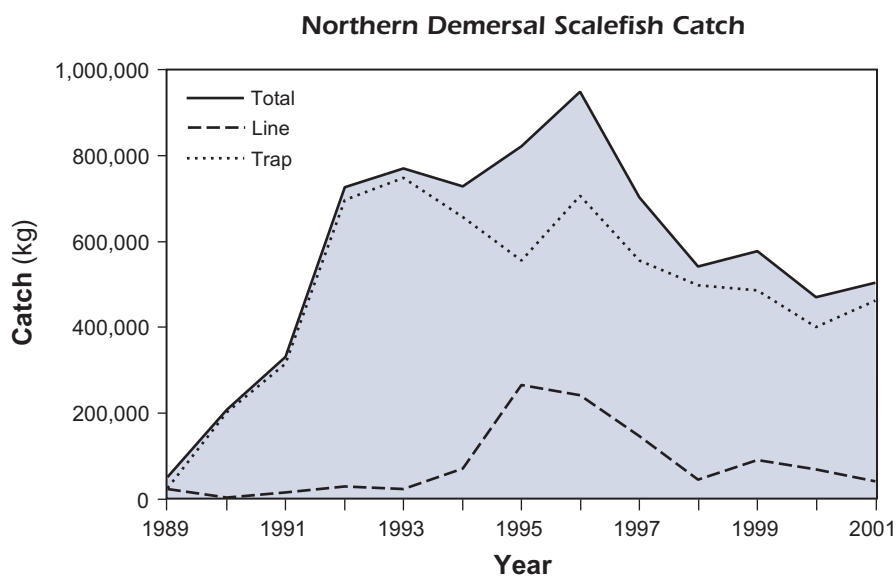
## EXTERNAL FACTORS

The impacts of environmental variation on the fishery are not large. There are no data to indicate either significant variation in recruitment amongst years or changes to catchability of the two key species amongst years.



**NORTHERN DEMERSAL SCALEFISH FIGURE 1**

Boundaries and access areas of the Northern Demersal Scalefish Managed Fishery.



**NORTHERN DEMERSAL SCALEFISH FIGURE 2**

Catches of demersal finfish in the NDSMF by line and trap, 1989–2001.

## COMMERCIAL FISHERIES NORTH COAST BIOREGION

### NORTHERN DEMERSAL SCALEFISH TABLE 1

Catches of demersal finfish by line and trap in the NDSMF, 1989–2001. Note that the NDSMF came under full management in 1998 and effort levels have been limited in each year since.

YEAR	TOTAL ALLOWABLE EFFORT	LINE		FISH TRAP		TOTAL CATCH (kg)
	(days)	CATCH (kg)	EFFORT* (block days)**	CATCH (kg)	EFFORT (block days)**	
1989		23,979	267	26,649	81	50,628
1990		4,638	91	202,783	395	207,421
1991		16,031	255	316,228	750	332,259
1992		29,607	433	695,954	1,776	725,561
1993		23,507	283	747,215	1,713	770,722
1994		71,763	453	656,937	1,349	728,700
1995		265,798	1,204	555,162	1,200	820,960
1996		242,590	1,319	706,063	1,412	948,653
1997		146,548	788	555,172	1,293	701,720
1998	1,684	44,863	78	497,154	916#	542,017
1999	1,716	91,045	228	485,918	992#	576,963
2000	1,562	68,543	155	401,487	890#	470,080
<b>2001</b>	<b>1,672</b>	<b>41,822</b>	<b>136</b>	<b>462,498</b>	<b>928#</b>	<b>504,320</b>

\* Line methods that have been selected for the calculation of effort include handline, dropline and longline only.

\*\* Block days are defined as the number of days on which fishing occurred in a particular block by a particular vessel (that is, block boat days).

# Trap fishing effort from 1998 onwards has been converted to standard trap fishing days for comparison with previous years.

### NORTHERN DEMERSAL SCALEFISH TABLE 2

Demersal finfish catch in tonnes and the percentage composition of each of the major species taken by trap and line fishers in the NDSMF in 2001.

SPECIES GROUP		LINE		FISH TRAP		TOTAL CATCH tonnes
		tonnes	%	tonnes	%	
Red emperor	<i>Lutjanus sebae</i>	1.3	0.3	93.7	18.6	95.0
Goldband snapper	<i>Pristipomoides multidens</i>	33.5	6.6	170.8	33.9	204.3
Cod species	Serranidae	2.0	0.4	81.8	16.2	83.8
Spangled emperor	<i>Lethrinus nebulosus</i>	--	--	34.4	6.8	34.4
Scarlet perch	<i>Lutjanus malabaricus</i>	2.3	0.4	36.0	7.1	38.3
Red snapper	<i>Lutjanus erythropterus</i>	0.5	0.1	2.2	0.4	2.7
Other species		2.3	0.5	43.7	8.7	45.9
<b>All demersal finfish</b>		<b>41.8</b>	<b>8.3</b>	<b>462.5</b>	<b>91.7</b>	<b>504.0</b>

## PILBARA DEMERSAL FINFISH FISHERIES

### Management Summary

The majority of demersal finfish produced from the North West Shelf are taken by fish trawling activities, with a lesser quantity taken by fish traps and line. Both the Pilbara Fish Trawl Interim Managed Fishery and the Pilbara Trap Managed Fishery operate under individually transferable effort regimes monitored by the satellite-based Vessel Monitoring System.

The Pilbara Fish Trawl Interim Managed Fishery commenced in 1998 when a number of fishing boats with conditions authorising fish trawling were brought under a management plan. The fishery is controlled through a combination of area closures, gear restrictions and total and area-specific effort limitations. Since coming into a formal management framework, effort has been reduced and redistributed to achieve the best yield from the fishery while keeping exploitation rates of key indicator species (red emperor, *Lutjanus sebae* and Rankin cod, *Epinephelus multinotatus*) at sustainable levels.

The ITE management arrangements introduced into the Pilbara Trap Managed Fishery in January 2000 dealt with the issue of latent effort in the fishery and proved effective at holding the fishery within its acceptable 300 tonne limit. However, the ability of the fishery to target red emperor may require species limits in the future.

Some demersal scalefish are also taken by 'wetline only' vessels which are not part of the two managed fisheries.

#### Governing Legislation/Fishing Authority

Pilbara Fish Trawl Interim Managed Fishery

Management Plan 1997

Pilbara Trap Management Plan 1992

Fishing Boat Licence (line fishing)

#### Consultation Process

Department–industry meetings

### Research Summary

Baseline research for managing these important fish stocks was conducted in two FRDC-funded projects from 1993 to 1999, providing a basis for long-term research monitoring of the stocks.

In addition, research surveys of both the deeper and the inshore areas adjacent to the existing trawl grounds have been completed under separate FRDC-funded projects. A further study into bycatch from the Pilbara trawl fishery, funded by the Natural Heritage Trust (NHT) and the Department of Fisheries, will be completed in 2002/03.

The following status report, which provides a synthesis of the data from the fishery, utilises the results of the earlier research together with ongoing catch and effort data provided through the research logbook system, CAES and VMS.

## PILBARA DEMERSAL FINFISH FISHERIES STATUS REPORT

Prepared by P. Stephenson and J. King

### FISHERY DESCRIPTION

#### Boundaries and access

The Pilbara Trap Managed Fishery (Pilbara Figure 1) lies north of latitude 21°44' S and between longitudes 114°9'36" E and 120° E on the landward side of a boundary approximating the 200 m isobath and seaward of a line generally following the 30 m isobath. This has been a managed fishery since 1992. In 2000, effort quota was introduced, with transferable trap units being allocated and their utilisation being monitored by VMS.

The boundaries of the Pilbara Fish Trawl Interim Managed Fishery (Pilbara Figure 1) are the waters lying north of latitude 21°35' S and between longitudes 114°9'36" E and 120° E on the landward side of a boundary approximating the 200 m isobath and seaward of a line generally following the 50 m isobath. The trawl fishery consists of two zones. Zone 1, in the west of the fishery, is currently not being trawled. In Zone 2, the interim management plan introduced in 1998 set down boundaries for six management sub-areas. There are 11 licence units with varying time allocations throughout Areas 1 to 6, with Areas 3 and 6 having zero time allocation. The allocated effort quota is transferable and monitored by VMS.

In addition, some wetline fishing occurs within the boundaries of the trawl and trap fisheries. Planning for consolidation of the general wetline catch in the Pilbara is continuing.

Pilbara Figure 1 is a general diagram showing areas where specific fishing activities are permitted within this fishery. The exact latitudes and longitudes delineating the sectors of the Pilbara fishery are listed in the Pilbara Trap Management Plan 1992 and the Pilbara Fish Trawl Interim Managed Fishery Management Plan 1997.

#### Main fishing method

Trawling is the dominant fishing method, with trapping and line fishing being relatively minor components.

### RETAINED SPECIES

#### Commercial production (season 2001):

**Trawl 2,221 tonnes**  
**Trap 266 tonnes**  
**Line 99 tonnes**

#### Landings

Catch of the major species for 2001 are shown in Pilbara Table 1. The catches by different fishing methods for the years 1985 to 2001 are shown in Pilbara Table 2 and illustrated in Pilbara Figure 2.

Demersal scalefish catch by trawl, trap and line was 2,221 tonnes, 266 tonnes, and 99 tonnes respectively.

The 2001 trawl fishery demersal scalefish catch had a similar species composition to that in 2000, though with decreased catches of blue spot emperor and Rankin cod and increased catches of red snapper and scarlet perch. The

major target species landed (2000 catch in brackets) were red snapper (*Lutjanus erythropterus*) 365 tonnes (252 tonnes), blue spot emperor (*Lethrinus hutchinsi*) 318 tonnes (401 tonnes), threadfin bream (Nemipteridae) 228 tonnes (187 tonnes), flagfish (*Lutjanus vitta*) 171 tonnes (166 tonnes), goldband snapper (*Pristipomoides multidentis*) 122 tonnes (75 tonnes), scarlet perch (*Lutjanus malabaricus*) 88 tonnes (65 tonnes), red emperor (*Lutjanus sebae*) 74 tonnes (68 tonnes), spangled emperor (*Lethrinus nebulosus*) 24 tonnes (27 tonnes) and Rankin cod (*Epinephelus multinotatus*) 19 tonnes (25 tonnes). Retained by-product totalled 150 tonnes, including shark 73 tonnes, bugs 7 tonnes and cuttlefish 67 tonnes.

The trap fishery catch increased slightly, from 257 tonnes in 2000 to 266 tonnes in 2001. Major species taken by the trap fishery in 2001 (2000 figures in brackets) were blue spot emperor 43 tonnes (39 tonnes), red snapper 35 tonnes (27 tonnes), red emperor 30 tonnes (40 tonnes), goldband snapper 26 tonnes (30 tonnes) and Rankin cod 21 tonnes (27 tonnes). There is no by-product in this fishery.

Demersal scalefish catches by line fishing were higher in 2001 at 99 tonnes (59 tonnes in 2000), mainly due to greatly increased catches of goldband snapper. The catches in 2001 (2000 figures in brackets) were mainly goldband snapper 38 tonnes (6 tonnes), spangled emperor 8 tonnes (18 tonnes), Rankin cod 4 tonnes (5 tonnes) and red emperor 4 tonnes (7 tonnes). In addition, the line vessels covered in this report recorded catches of 190 tonnes (187 tonnes) of sharks and rays (which includes the North Coast Shark Fishery catch) and 103 tonnes (130 tonnes) of mackerel in the Pilbara.

The Pilbara shark catch is reported in more detail in the North Coast Shark Fisheries Status Report (pp. 92–94), and the mackerel catch in the Spanish Mackerel Stock Status Report (pp. 87–91).

### Fishing effort

The fishing effort in the trap, line and trawl sectors of the commercial fishery is shown in Pilbara Table 3. The effort in days is from monthly catch and effort returns, however for the trawl fishery, the effort from 1991 to 2001 is also recorded as the net bottom time (hours) taken from skippers' logbook data.

In the trawl fleet there are the equivalent of seven full-time vessels. The number of hours allocated to the fleet in each area of the fishery (verified by a satellite monitoring system), the number of hours used, and the percentage of the allocation used in 1998 to 2001 are shown in Pilbara Table 4.

The management plan allows for some flexibility in the effort distribution between areas, which resulted in an effort over-run in 2001 of 8% in Area 2 and 3% in Area 4 (compared with 17% and 10% in 2000). There was no trawling in Area 3 or Area 6 in 2001.

Three trap boats were allocated 5,867 trap units in 2001 (days multiplied by number of traps) and the number of units used, calculated from VMS, was 5,380. This number of units used equates to 414 days fished with an average of 13.7 traps per day, an increase from the average of 11.6 traps used per day in 2000. The number of days allocated, the number of days used and the percentage of the allocation used in 2000 and 2001 are shown in Pilbara Table 5. The comparable

number of days reported in CAES returns in 2001 was 446 (compared with 518 days in 2000).

In 2001, line fishers reported operating for 401 days, compared with 500 days in 2000. This effort does not include trolling, which is reported in the Spanish Mackerel Stock Status Report (pp. 87–91), nor the dropline effort in the North Coast Shark Fishery (pp. 92–94). Plans for future management of line fishing in the Pilbara will be considered during the statewide 'wetline' fishing review.

### Catch rate

The catch rates (based on nominal effort) for red emperor have decreased in the recently developed Areas 4 and 5 of the trawl fishery, and have stabilised at a low level in Area 1. The red emperor catch rate has been stable in Area 2. Blue spot emperor catch rates have decreased in Areas 1, 2, and 5 of the trawl fishery. Rankin cod catch rates have been reduced to a very low level in Area 1, and have decreased in Areas 4 and 5 but appear to be stable in Area 2. Flagfish and threadfin bream catch rates are stable. There has probably been little efficiency increase on individual vessels in the last 12 months but the consolidation of the fleet has resulted in the effort allocation being used by the more efficient vessels. There is likely to be some efficiency increase in the future that will bias the observed catch rates upwards in future years.

Catch rate for the trap fishery (based on the reported number of days fished) was considerably higher in 2001 than 2000, apparently due to efficiency gain flowing from the consolidation of the fleet. The line catch rate in 2001 was more than twice that in 2000 due to the large goldband snapper catches.

**Recreational component:**

**Not assessed**

**Stock assessment completed:**

**Yes**

Red emperor and Rankin cod were used as indicators of long-lived species and blue spot emperor was used as an indicator of short-lived species.

The apparent local depletion of these indicator species in 2000 and 2001 led to a suggestion by the Department of Fisheries that effort reduction should occur in Areas 1 and 5 in 2002. After management consultation with industry, it was agreed to postpone any change in the total effort allocation and instead reduce the effort in Area 1 and increase effort in Areas 2 and 4.

*Trawl and trap fishery:* In 2001, the effort adjustment in the trawl fishery appears to have resulted in slow rebuilding of the spawning biomass of red emperor in Area 1 with continued increases in spawning biomass in Areas 2 and 4. In Area 1, Rankin cod and blue spot emperor catch rates continued to decline. In Area 5, the catch rates of red emperor, blue spot emperor and Rankin cod all continued to decrease, indicating that the fish stocks in this area are smaller than expected.

Anticipated increases in efficiency, especially as a result of the consolidation of the trap and trawl fleet, are likely to exacerbate the local over-exploitation of the indicator species.

*Line fishing:* The line catch was the highest recorded since 1997, mainly due to greatly increased goldband snapper catches.

The near-doubling of the goldband snapper catch between 2000 and 2001 in the trawl, trap and line sectors is cause for concern as this deeper-water species matures at a relatively large size and is long-lived, making it vulnerable to over-exploitation. Recent stable isotope ratio studies indicate there is little mixing of recruited goldband snapper between the Pilbara and Kimberley fisheries. However there may be exchange of eggs and larvae, which has management implications, as stock depletion in one fishery may reduce recruitment in adjacent fisheries.

**Exploitation status:** Fully exploited

**Breeding stock levels:** Adequate

Breeding stocks of the short-lived species (e.g. flagfish, threadfin bream) have been assessed as adequate in the fishing area overall. Catch rates of blue spot emperor continue to decline in Areas 1 and 5 of the trawl fishery, but it is likely that an adequate breeding stock exists outside the trawl fishery.

The spawning biomass of red emperor and Rankin cod was estimated to be satisfactory over the whole fishery, although there appears to be local depletion in Area 1 of the trawl fishery, in the portion of the trap fishery off Onslow, and possibly in Area 5 of the trawl fishery.

The increased focus on goldband snapper in 2001 by both the trawl and line vessels suggests the breeding stocks of these species are likely to be reduced and need to be monitored more closely in future.

To ensure breeding stock levels of red emperor and Rankin cod are maintained at satisfactory levels, overall effort reduction in the trap and trawl fishery should be considered in the future.

### NON-RETAINED SPECIES

**Bycatch species impact:** Low

Owing to the relatively large mesh size used by the fish trawl fishery, there is only a small bycatch of under-size and unmarketable scalefish. An NHT-funded project on bycatch in the trawl fishery will be completed in 2002/03. For the trap and line fisheries, bycatch is minimal.

**Protected species interaction:** Medium

The trawl fishery involves the occasional capture of dolphins which are apparently attracted to the trawl while it is operating. The significance of these accidental captures, relative to the population size and natural mortality of the North West Shelf dolphin population, will be assessed as part of the bycatch project. Sea snakes and turtles are occasionally captured in the fish trawl nets but are returned alive to the sea in most cases. The frequency of capture of these species will also be investigated during the bycatch project. There is no indication of interaction between protected species and the trap or line sectors.

### ECOSYSTEM EFFECTS

**Food chain effects:** Medium

The current fish trawl fishery operates with standard stern trawling gear (single net with extension sweeps) within an area previously trawled by a Taiwanese fleet. Historical research by CSIRO has suggested that the extensive

Taiwanese pair trawl fishery caused a significant decrease in the biomass of finfish on the North West Shelf, and a change in species composition towards smaller species. The current Australian trawl fishery, which developed when the fish stocks had somewhat recovered, uses a much larger mesh size and much lighter ground rope, and operates at lower exploitation rates. At the now permitted levels of trawl and trap exploitation, it is expected that the stocks will stabilise, albeit at a low level for some species in some areas. Overall, the effect of the fishery on the food chain of the North West Shelf is considered to have a moderate impact.

**Habitat effects:** Medium

Impacts to the habitat are restricted to those of the trawl fishery, which in turn is restricted to a relatively low proportion of the North West Shelf (Pilbara Figure 1). Area 3 and the waters inside 50 m are permanently closed to trawling, Zone 1 is currently closed to trawling, and Area 6 has had no trawl effort allocation since 2000. Effective impact is further lessened by the concentration of effort in the west of the fishery where the habitat is already most disturbed, with low effort in the east where habitat is least disturbed.

Within the area open to trawling, research has indicated that approximately 10% of the sessile benthic fauna (e.g. sponges) is detached per year, with higher rates in Area 1 where the effort is concentrated. It is not known whether this exceeds the rate of regrowth.

### SOCIAL EFFECTS

It is estimated that 20 fishers (using 11 licences) were employed during 2001 on Pilbara trawl fishing vessels, and 5 fishers (using 6 licences) in the trap fishery. The level of employment in line fishing is not assessed.

### ECONOMIC EFFECTS

**Estimated annual value (to fishers) for year (2001):**  
\$9 million

This estimate is based on the landed weight and price of each species as supplied by fish processors.

There has been little overall increase in prices in the last two years. The trawl demersal finfish catch is dominated by lower-valued species such as blue spot emperor and threadfin bream, and its value in 2001 was \$7.4 million, with a retained by-product valued at \$300,000. The trap and line catches are dominated by the valuable species such as red emperor and goldband snapper, and the demersal scalefish catch from these sectors was approximately \$1.1 million (trap) and \$500,000 (line). Important components of the line catch are shark and spanish mackerel, which have not been included in the value of the line fishery, but are recorded in the North Coast Shark Fisheries Status Report (pp. 92–94) and the Spanish Mackerel Stocks Status Report (pp. 87–91) respectively.

The catches from these fisheries dominate the Western Australian metropolitan markets and support the local fish processing sector. There is also an increasingly important export of scalefish to Europe and Asia.



## COMMERCIAL FISHERIES NORTH COAST BIOREGION

**PILBARA TABLE 2**

Summary of reported commercial catches (tonnes) of demersal scalefish by line, trap and trawl in the Pilbara fishery, as well as by-product from the fish trawl fishery.

YEAR	DEMERSAL SCALEFISH			Total	BY-PRODUCT* Trawl
	Line	Trap	Trawl		
1985	180	168	-	348	-
1986	65	113	-	178	-
1987	67	192	3	262	-
1988	136	243	3	382	-
1989	104	457	124	685	-
1990	157	407	421	985	4
1991	107	119	754	980	14
1992	63	148	1,413	1,624	21
1993	67	178	1,724	1,969	42
1994	79	207	2,506	2,792	102
1995	95	222	2,821	3,138	77
1996	136	302	3,201	3,639	102
1997	109	234	2,630	2,973	133
1998	78	250	2,512	2,840	119
1999	50	371	2,136	2,419	69
2000	59	257	1,995	2,314	80
<b>2001</b>	<b>99</b>	<b>266</b>	<b>2,221</b>	<b>2,592</b>	<b>150</b>

\* By-product consists of shark, cuttlefish, rays, bugs, and tropical lobster.

**PILBARA TABLE 3**

Summary of effort in the Pilbara fishery. The trap, line and trawl effort (days) is from monthly catch and effort returns. The trawl effort (hours) is nominal effort from operators' logbook data.

YEAR	LINE (days)	TRAP (days)	TRAWL (days)	TRAWL (hours)
1985	809	709	-	-
1986	655	548	19	-
1987	614	507	17	-
1988	985	804	32	-
1989	863	1,198	310	-
1990	1,332	1,321	698	-
1991	740	472	1,132	8,660
1992	514	681	983	10,030
1993	876	696	832	10,725
1994	732	545	1,484	22,087
1995	852	608	1,571	21,529
1996	814	513	1,550	25,246
1997	809	483	1,389	19,810
1998	692	503	1,291	20,555
1999	453	842	1,139	15,963
2000	500	518	957	14,084
<b>2001</b>	<b>401</b>	<b>446</b>	<b>1,162</b>	<b>15,330</b>

# COMMERCIAL FISHERIES NORTH COAST BIOREGION

**PILBARA TABLE 4**

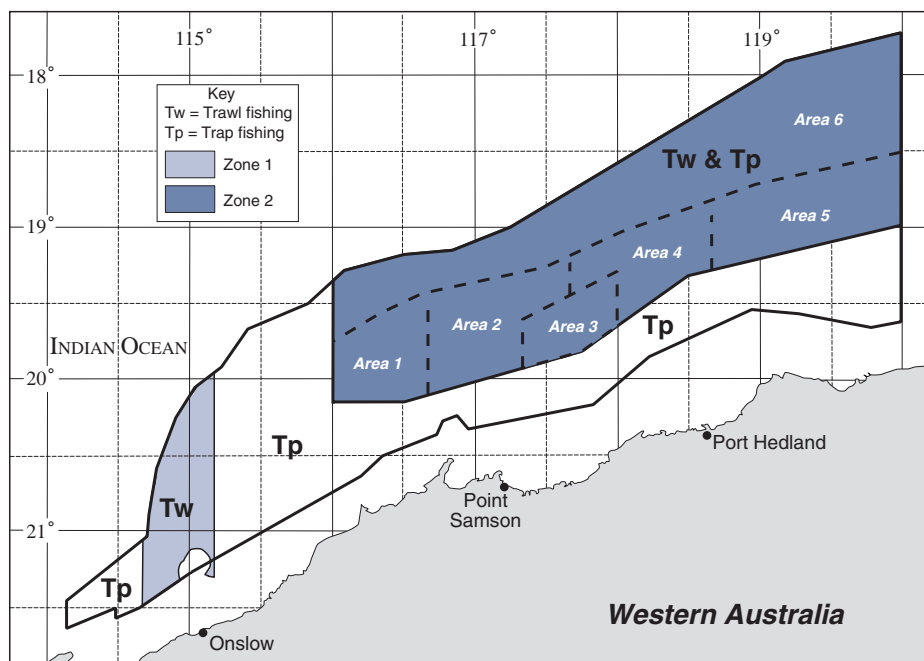
The number of hours allocated, the number of hours used and the percentage of the allocation used in each area of the Pilbara trawl fishery.

		AREA 1	AREA 2	AREA 3	AREA 4	AREA 5	TOTAL
1998	time allocation	17,136	3,360	0	3,360	5,712	29,568
TRAWL	time used	15,076	3,842	0	3,736	4,955	27,609
	% of time used	88%	114%	-	111%	87%	93%
1999	time allocation	11,481	3,360	0	3,057	5,198	23,096
TRAWL	time used	10,237	3,767	0	3,213	4,973	22,190
	% of time used	89%	112%	-	105%	96%	96%
2000	time allocation	11,481	3,360	0	3,057	5,198	23,096
TRAWL	time used	9,438	3,928	0	3,358	4,476	21,199
	% of time used	82%	117%	-	110%	86%	92%
<b>2001</b>	<b>time allocation</b>	<b>10,624</b>	<b>3,797</b>	<b>0</b>	<b>3,528</b>	<b>5,141</b>	<b>23,090</b>
<b>TRAWL</b>	<b>time used</b>	<b>10,428</b>	<b>4,091</b>	<b>0</b>	<b>3,644</b>	<b>4,819</b>	<b>23,000</b>
	<b>% of time used</b>	<b>98%</b>	<b>108%</b>	<b>-</b>	<b>103%</b>	<b>94%</b>	<b>100%</b>

**PILBARA TABLE 5**

The number of days allocated, the number of days used and the percentage of the allocation used in the Pilbara trap fishery.

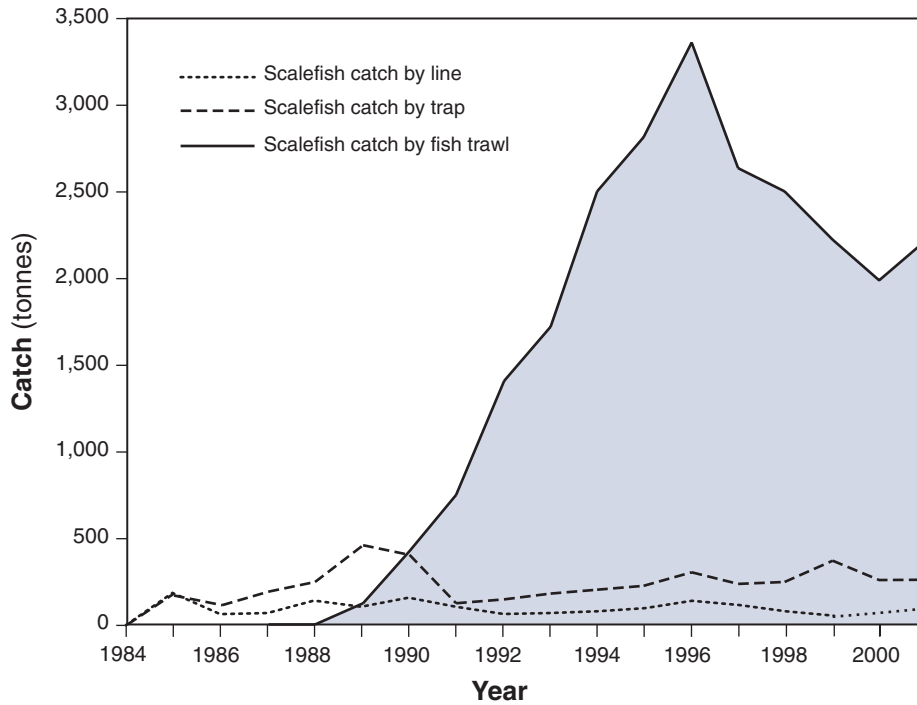
2000	time allocation	524
TRAP	time used	507
	% of time used	97%
<b>2001</b>	<b>time allocation</b>	<b>420</b>
<b>TRAP</b>	<b>time used</b>	<b>414</b>
	<b>% of time used</b>	<b>99%</b>



**PILBARA FIGURE 1**

Demersal scalefish fisheries of the Pilbara region of Western Australia. Areas 1 to 6 refer to the management regions in Zone 2 of the trawl fishery. Zone 1 has been closed to trawling since 1998.

**Pilbara Demersal Scalefish Catch by Gear Type**



**PILBARA FIGURE 2**

Catches of demersal scalefish (tonnes) in the Pilbara fishery by trap, line and trawl.

## MACKEREL FISHERY

### Management Summary

Fishing for Spanish mackerel, under the general wetline access available to all Western Australian licensed commercial fishing boats, was reported by 72 boats during 2001. Although most of these catches were made opportunistically by boats operating within other fisheries, there were about 10 boats which specifically targeted mackerel. Owing to concerns over increased catches and evidence to suggest that the species may be in danger of over-fishing, an interim management plan (IMP) was examined by a Mackerel Independent Advisory Panel, which has made recommendations to the Executive Director on criteria for access to and management arrangements for the mackerel fishery. It is expected that management arrangements will be put in place during 2002/03.

Currently, the capture of Spanish mackerel by commercial and recreational fishers is subject to a minimum legal size of 900 mm total length.

#### **Governing Legislation/Fishing Authority**

Fish Resources Management Regulations 1995  
Fishing Boat Licence

### Research Summary

The narrow-barred Spanish mackerel, *Scomberomorus commerson*, is the main target species in the Western Australian mackerel fishery and has been the focus of two recent research projects. Results from these studies, which include a joint WA/NT/Qld FRDC-funded project to determine the stock structure of Spanish mackerel in northern Australia and a stock assessment of Spanish mackerel in Western Australia, should be available by the end of 2002. The stock assessment project involves the gathering of biological information and analysis of catch and effort data for the commercial fishery. With the aid of fisheries models these data will be used to determine the status of mackerel stocks in Western Australian waters and provide a basis for management arrangements to control the future catches from the fishery.

The following status report summarises the research findings for this fishery, based primarily on data for Spanish mackerel.

## SPANISH MACKEREL STOCK STATUS REPORT

Prepared by M. Mackie

### FISHERY DESCRIPTION

#### Boundaries and access

Spanish mackerel are widespread throughout the Indo-West Pacific. In Western Australia, they are fished commercially from Geraldton north to the Northern Territory border. Most of the commercial catch is taken from May through to October, with minor catches made during summer in the Pilbara and Kimberley regions when weather conditions permit. Fishers have also reported mackerel as far south as Albany on rare occasions.

Spanish mackerel are usually captured at or near the surface in coastal areas around reefs, headlands and shoals. Anecdotal evidence suggests that many also spend time dispersed in deeper offshore waters, particularly during summer when the coastal fishery is generally not viable. It is also likely that Spanish mackerel migrate along the coast, although preliminary results from the stock structure project indicate that these movements are not extensive.

Based on methods used in the fishery and likely boundaries of the interim management plan, the mackerel fishery is reported in four sectors,

**Kimberley sector:** The use of dories (5–6.5 m dinghies) is restricted to this sector, which extends east of longitude 121° E (previously 120° E) to the Northern Territory border. Dories troll two to three lines and work to a mother boat that is about 20 m in length. Fishing gear used in this sector is relatively heavy (8–10 mm rope with a 200+ kg mono line and wire trace), crew numbers vary between three and five, and fishing trips generally last between one and three weeks. Mackerel captured in this sector are usually filleted, boxed and frozen for distribution throughout Australia.

**Pilbara sector:** This sector extends from longitude 114° E to 121° E and north of 23° S. Vessels used in this area are between 9 and 15 m in length (no dories), with one to two crew using 180 kg mono line and wire trace. In recent years the main catches from this sector have come from the Port Hedland area. Fishing trips usually last less than a week, and the product is trunked, brined, and sold locally or sent fresh to Perth markets.

**Gascoyne sector:** This sector extends from 27° S to 23° S. Vessels used in this area are between 7 and 15 m in length and are crewed by one to two persons for trips lasting one to five days. Gear used is rod and reel with 20–30 kg line and wire trace. Fish caught by Carnarvon- and Quobba-based fishers are usually kept whole in brine for export, while fish landed at other ports are usually trunked and sold locally or sent fresh to Perth markets.

**West coast sector:** This sector extends south of 27° S. Fishing gear and methods are the same as those used in the Gascoyne sector, with most catches obtained from the Geraldton and Abrolhos areas. Few commercial mackerel catches are made south of Geraldton. Note that for analyses of catch rates the Gascoyne and west coast sectors are combined.

#### Main fishing method

Trolling.

### RETAINED SPECIES

Commercial production (season 2001):

Spanish mackerel 389.9 tonnes  
Other mackerel 56.0 tonnes

#### Landings

Spanish mackerel (*Scomberomorus commerson*) is the main target species and may comprise more than 90% of the catch. Grey or broad-barred mackerel (*Scomberomorus semifasciatus*) is the dominant by-product, particularly in the Gascoyne and west coast sectors where it is sometimes captured in large numbers. However, because fishing methods need to be modified in order to catch this species in quantity, it is essentially a separate fishery. Other by-products of Spanish mackerel fishing include school mackerel (*Scomberomorus queenslandicus*), spotted mackerel (*S. munroi*) and shark mackerel (*Grammatocygnus bicarinatus*), wahoo (*Acanthocybium solandri*), cobia (*Rachycentron canadum*), tunas, smaller sharks and the occasional reef fish such as spangled emperor and coral trout. Quantities of mullet, whiting and similar species are also netted by some fishers for use as bait in their mackerel fishing operations.

The reported catch of 389.9 tonnes of Spanish mackerel in 2001 comprised 179.3 tonnes from the Kimberley sector, 107 tonnes from the Pilbara sector, 70.5 tonnes from the Gascoyne sector and 33 tonnes from the west coast sector (Spanish Mackerel Figure 1 and Table 1). Historic trends in catches were described in the *State of the Fisheries Report 2000/2001*. Discussion with fishers indicates that the relatively low 2000 catch in the Kimberley region was mainly due to environmental effects on the seasonal abundance of mackerel. Reported catches in the west coast sector are usually minor, although a historic high of 33 tonnes was recorded in 2001. This significant increase was apparently due to an increase in mackerel availability in this sector following an unusually high recruitment year in 1999/2000 (as noted during the stock assessment project).

Annual catches of other species of mackerel, including grey, school, spotted and shark mackerel, are shown in Spanish Mackerel Table 1. Grey mackerel are sometimes captured in large numbers but are usually present in the fishery for only one or two months each year. This species, which makes up approximately 80% of the 'other mackerel' catch, is preferred over Spanish mackerel on the export market and is now caught in significant numbers in the Gascoyne sector. The large catches of other mackerel from 1988 to 1992 indicate that grey mackerel are also present in large numbers at times within the west coast sector. It has also become more targeted in the Pilbara sector although at present little is known about the distribution and abundance of this species in the north of the State. Annual fluctuations in the catch of other mackerel are thus mainly due to variability in the capture of grey mackerel, with catches of school and shark mackerel species making up approximately 7% each of this category. Catches of other mackerel in the Kimberley and Pilbara show significant year-to-year variability and, in contrast to catches of Spanish mackerel, were lower in 2001 than in 2000. This was also the case in the Gascoyne sector, whereas in the west coast sector catches of other mackerel increased substantially, from 4 tonnes in 2000 to 11.5 tonnes in 2001.

### Fishing effort

The commercial fishing effort recorded in the CAES database for the 2001 season, by sector, was as follows:

Kimberley sector	9 boats	573 days
Pilbara sector	17 boats	475 days
Gascoyne sector	32 boats	1,200 days
West coast sector	29 boats	835 days

The annual number of boats recording catches of Spanish mackerel has varied substantially since 1980, from 4 to 20 boats in the Kimberley sector, 17 to 53 boats in the Pilbara sector, 13 to 56 boats in the Gascoyne sector, and 10 to 39 boats in the west coast sector. Note some of these boats may fish in more than one sector.

The unit of effort recorded here is CAES fishing days, i.e. the total number of days fished for any month during which Spanish mackerel were landed. This data does not therefore provide a true indication of the effectiveness of fishing effort, as it contains considerable latent effort. Initiation of a fishery-specific logbook once the fishery becomes more structured under the IMP will provide more reliable data on real mackerel fishing effort.

Monthly patterns of fishing effort are similar to those for catches; 83% of the annual fishing effort by all vessels within the Kimberley sector for the period 1990–2001 (data pooled) occurred between June and October, with a peak of 21% in August. In the Pilbara sector for the same period, 65% of the fishing effort occurred from July to August (peak of 21% in August); in the Gascoyne sector 85% of effort occurred from May to August (peak of 31% in July), and in the west coast sector 71% of effort occurred from March to June (peak of 21% in May). These data highlight the strong seasonality of mackerel catches, with the decreased peak in the Pilbara sector reflecting a more prolonged mackerel fishing season than in other sectors. The data also show that peak catches occur earlier in the south than in the north of the State.

### Catch rate

Analysis of catch rates (kg whole fish per day) is complicated because many fishers who catch Spanish mackerel do not normally target them. The effort these fishers expend in catching mackerel is thus likely to be confounded with effort spent catching other species. In order to properly evaluate trends in catch rates, the analyses are therefore based on data for vessels known to target mackerel. In addition, these data have been standardised to allow for changes in fisher experience, for the introduction of dories, GPS and faster vessels, and for change in catchability of mackerel with the use of lighter lines. The data provided here and in Spanish Mackerel Figure 2 may therefore differ from data provided in previous years. Because of restricted boat numbers, the data for the Gascoyne and west coast sectors have also been pooled.

There is little data for reliably assessing catch rates in the Kimberley sector until 1985. Since this time catch rates have varied between 124 kg/day and 196 kg/day (average 152 kg/day), and generally exhibit a slight rising trend with 169 kg/day captured in 2001. Prior to 1990 catch rates in the Pilbara sector fluctuated significantly, reaching a low in 1988 of 43 kg/day. Since 1990 catch rates in this sector have continued to rise, particularly after 1996, with 217 kg/day

recorded in 2001 (Spanish Mackerel Figure 2). Catch rates in the combined west coast/Gascoyne sector are lower than in the northern sectors and exhibit more of a cyclic pattern, with the highest catch rate recorded in 1979 (126 kg/day) and the lowest in 1992 (20 kg/day). In 2001 the catch rate was 85 kg/day.

**Recreational component:** West coast 40% (approx.)  
Gascoyne 40% (approx.)  
Pilbara 20% (approx.)

Recreational survey data are available for the west coast in 1996/97 (Sumner and Williamson 1999), the Gascoyne in 1998/99 (Sumner et al. 2002) and the Pilbara in 1999/2000 (Williamson et al. in prep.). Data for the Broome area obtained during the Pilbara survey also provide an estimate of recreational catches for that part of the Kimberley sector. In the west coast sector during 1996/97 12.9 tonnes of Spanish mackerel (45% of the total recreational/commercial catch) and 0.4 tonnes of other mackerel (12% of the total catch) were taken, whilst in the Gascoyne region during 1998/99 51 tonnes of Spanish mackerel (45% of the total catch) and 8.1 tonnes of other mackerel (25% of the total catch) were captured. Recreational catches in the Pilbara sector during 1999/2000 comprised 20.5 tonnes of Spanish mackerel and 10.2 tonnes of other mackerel (16% and 37% of the total catch respectively), whereas in the Kimberley sector during the same survey 2.7 tonnes of Spanish mackerel and 0.4 tonnes of other mackerel were captured (2% of the total catch for each of the mackerel categories). Note that these recreational catch data are spatially comparable with commercial catch data presented in this report and include data for mackerel that were taken by sharks before being landed. The data do not include fish that were caught and released (up to 50% of captures), although mortality of these fish may be high because mackerel do not recover well from capture.

Reported catches of Spanish mackerel by recreational charter vessels have been relatively minor since 1990, ranging between 0.8 and 3.1 tonnes per year (mean = 1.8 tonnes), with 0.9 tonnes recorded during 2001. Most (80–100%) of the charter catch was taken in the Gascoyne and Pilbara sectors.

**Stock assessment completed:** Yes

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

Biomass dynamics modelling was only appropriate for the southern region (combined west coast and Gascoyne sectors) as there was insufficient contrast in the catch and effort data for the other sectors. The estimated carrying capacity (*K*) for Spanish mackerel in the southern region is estimated to be 1,115 tonnes (95% CI = 757–2,116 tonnes) whilst the estimated biomass in 2001 was 913 tonnes (95%

CI = 580.5–1,417 tonnes). The combined recreational and commercial catch for the southern region during 2001 was approximately 20% of the 2001 biomass estimate. Yield-per-recruit analyses indicate that the appropriate fishing mortality for this species ( $F_{0.2}$  at maximum YPR) is approximately 0.2 in the Pilbara and Gascoyne sectors, and 0.3 in the Kimberley sector, suggesting the need for conservative management in the Pilbara and Gascoyne sectors. Current fishing mortality is likely to be similar to or slightly above these target levels. The information available to date therefore indicates that stocks of Spanish mackerel in Western Australia are healthy, although a cautious approach is needed. Insufficient data is available for assessment of stocks of other mackerel species.

**Exploitation status:** **Fully exploited**

The above analyses indicate that at current catch levels the Spanish mackerel fishery is fully exploited and further increases in effort would not be appropriate. Anecdotal evidence from expert mackerel fishers suggests that grey mackerel stocks are currently under-exploited in the Gascoyne sector, although they are increasingly being targeted for the export market. The abundance of this species in the Pilbara and Kimberley sectors is unknown but it is probably under-exploited in these areas also. The status of other mackerel species has not been assessed.

**Breeding stock levels:** **Adequate**

Spanish mackerel rapidly attain sexual maturity: size and age at 50% maturity was 898 mm and 706 mm total length for females and males respectively (< 2 years of age). With the current minimum legal size of 900 mm total length and the focus by the fishery on 1- to 3-year-old fish (59–79% of fish in the catches are in these age groups), the breeding stock is essentially the same as the exploited stock. Based on the preliminary results of the stock assessment project, the current rates of exploitation around the Western Australian coastline appear to be allowing sufficient survival of the breeding stock to maintain recruitment levels.

**NON-RETAINED SPECIES**

**Bycatch species impact:** **Low**

Fishing for Spanish mackerel uses specialised troll lines to target the schooling fish and involves limited discarding. Species occasionally caught and generally discarded include sailfish, billfish, pike, barracuda, shark, mackerel tuna, queenfish and trevally.

**Protected species interaction:** **Not assessed**

**ECOSYSTEM EFFECTS**

**Food chain effects:** **Not assessed**

**Habitat effects:** **Negligible**

The fishing methods used in this fishery have minimal impact on the habitat.

**SOCIAL EFFECTS**

Approximately 72 people were employed catching Spanish mackerel during the 2001 mackerel fishing season. This estimate is based on those boats recording significant catches of Spanish mackerel (> 500 kg in the Gascoyne, > 1000 kg in the Pilbara and Kimberley). The average number of crew on each boat (2 per boat in the Gascoyne and Pilbara, 4 per

boat in the Kimberley) was then pooled to determine overall employment. This estimate does not consider employment of fishers in the west coast sector or of fishers catching minor amounts of mackerel in other sectors, as they are considered employees of other fisheries. For many of the fishers included as employees of the mackerel fishery, the duration of employment is only about six months each year.

**ECONOMIC EFFECTS**

**Estimated annual value (to fishers) for year (2001):**  
**Spanish mackerel \$2.2 million**  
**Other mackerel \$300,000**

Overall ex-vessel prices for Spanish mackerel (\$5–6/kg) and other mackerel (\$4–6.50/kg) were obtained from fish processors and represent an average price per kilogram of whole weight. Actual prices paid to fishers for their product may reach over \$10/kg for fillets and trunks, particularly during summer when few mackerel are captured.

**FISHERY GOVERNANCE**

**Acceptable catch range:** **249–358 tonnes**

Acceptable catch ranges for the individual sectors are Kimberley 110–165 tonnes, Pilbara 80–110 tonnes, Gascoyne 50–70 tonnes and west coast 9–13 tonnes. These acceptable catch ranges are based on historic catch trends and may be changed when the interim management plan is introduced or when the processes controlling recruitment variability in Spanish mackerel are better understood.

Reported catches during 2001 in the west coast sector were well above the acceptable catch range for this region. However, as these catches appear due to high recruitment rather than significant increases in fishing effort, they are not considered a threat to the ongoing sustainability of the resource. Catches within the other sectors were either within (Pilbara) or slightly above (Kimberley and Gascoyne) the respective acceptable catch ranges. Catches outside the acceptable catch range in the Gascoyne and Kimberley sectors are not of immediate concern given the variability of catch and effort, which are yet to be controlled under a management framework.

**EXTERNAL FACTORS**

Spanish mackerel and associated species are important commercial and recreational species, and implementation of the interim management plan will provide timely regulation of the commercial fishery that is needed for the long-term conservation of these fish. This is agreed in principle by industry, although there is considerable debate about the type of management that is needed. As a consequence there have been delays to implementation of the IMP and it is unlikely to be operational during the 2002 season. Ongoing cooperation between Department of Fisheries research staff and mackerel fishers will be essential under the IMP to ensure information needed to monitor the status of the fishery is obtained.

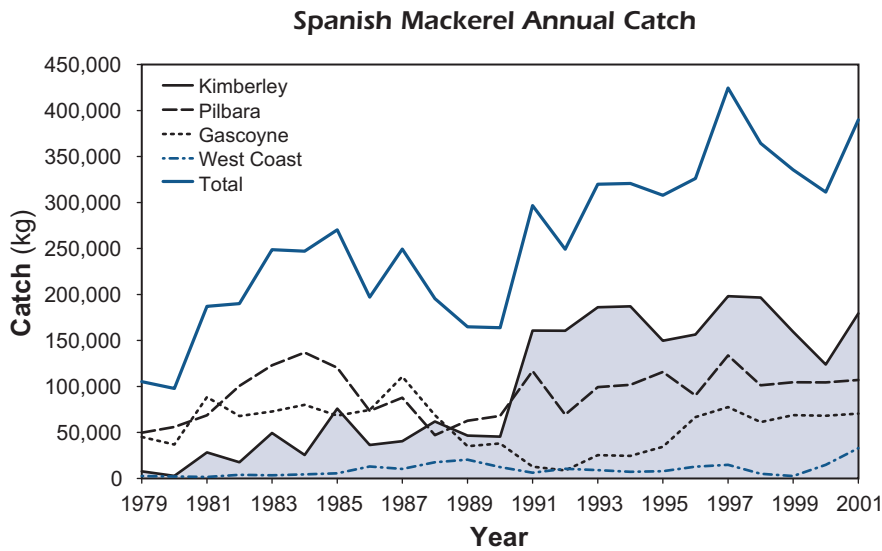
The recreational fishery for Spanish mackerel also requires assessment as this is a growing sector which takes a significant proportion of the mackerel catch. Such an assessment will need to examine the usefulness of current minimum size limits and bag limits, since research fishing and tagging experience suggests that the survival of released fish is low.

**SPANISH MACKEREL TABLE 1**

Catches of Spanish and other mackerel within each sector. The main species included under 'other mackerel' are grey mackerel (*Scomberomorus semifasciatus*), school mackerel (*S. queenslandicus*), spotted mackerel (*S. munroi*) and shark mackerel (*Grammatocygnus bicarinatus*). WC = west coast sector.

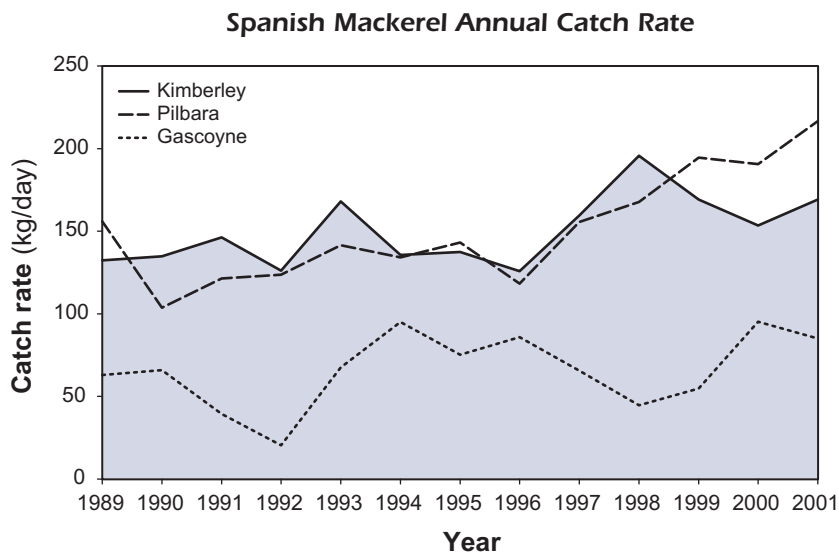
YEAR	SPANISH MACKEREL (tonnes)					OTHER MACKEREL (tonnes)				
	Kimberley*	Pilbara	Gascoyne	WC	Total	Kimberley	Pilbara	Gascoyne	WC	Total
1980	2.8	56.0	36.9	2.2	97.9	0.0	8.6	2.1	0.0	10.8
1981	28.3	68.7	88.5	1.7	187.2	1.9	0.4	0.1	0.1	2.5
1982	17.6	100.7	67.8	4.0	190.1	3.3	3.6	11.8	1.2	19.9
1983	49.5	123.0	72.8	3.5	248.7	0.0	2.2	0.9	0.6	3.6
1984	25.5	136.9	80.1	4.5	247.0	0.4	1.2	0.2	0.0	1.8
1985	75.9	120.4	68.3	5.7	270.3	11.7	5.7	2.0	0.1	19.4
1986	36.4	73.5	72.3	12.9	195.1	16.7	11.4	8.9	2.2	39.2
1987	40.6	87.8	110.6	10.3	249.3	12.2	2.3	8.6	0.7	23.9
1988	62.0	47.1	68.8	17.6	195.5	56.6	16.2	3.3	13.3	89.3
1989	46.6	62.7	35.1	20.4	164.8	13.4	35.8	18.2	37.1	104.5
1990	45.4	68.0	38.1	12.3	163.8	24.8	97.3	23.6	20.9	166.4
1991	160.7	116.8	12.8	6.3	296.7	50.5	44.3	12.1	8.9	115.8
1992	160.6	69.3	8.7	10.6	249.2	37.0	30.5	5.2	6.8	79.5
1993	186.1	99.3	25.4	9.1	319.9	28.0	36.4	8.1	2.4	75.0
1994	187.1	101.8	24.6	7.2	320.7	67.9	9.7	6.5	3.8	87.9
1995	149.7	115.8	34.5	7.9	307.9	27.6	15.6	9.7	2.8	55.8
1996	156.4	90.3	66.7	12.8	326.2	34.1	31.0	25.9	2.9	93.8
1997	198.2	133.2	77.6	14.9	423.9	64.7	31.8	20.6	3.5	120.6
1998	196.7	101.2	61.2	5.2	364.3	25.8	16.2	21.2	2.6	65.7
1999	159.5	104.7	68.8	2.6	335.6	26.9	7.9	32.7	5.2	72.7
2000	123.8	104.5	68.1	14.9	311.3	14.3	27.1	29.2	4.0	74.6
<b>2001</b>	<b>179.3</b>	<b>107.0</b>	<b>70.5</b>	<b>33.0</b>	<b>389.9</b>	<b>13.7</b>	<b>13.0</b>	<b>17.7</b>	<b>11.5</b>	<b>56.0</b>

\* Catches by Taiwanese gillnet fishers of approximately 5–90 tonnes per year (mean approx. 50 tonnes) between 1980 and 1986 (Stevens and Davenport 1987) are not included in these estimates. These gillnet catches include data east to longitude 131° E and therefore are not directly comparable with Kimberley catches.



**SPANISH MACKEREL FIGURE 1**

Annual catch of Spanish mackerel in Western Australia.



**SPANISH MACKEREL FIGURE 2**

Estimated catch per unit effort (kg/day) for vessels specialising in catching Spanish mackerel. Effort data was based on only those vessels known to target the species.

## NORTH COAST SHARK FISHERIES

### Management Summary

*Joint Authority Northern Shark Fishery (JANSF):* The taking of shark between 123°45' E (Koolan Island) and the WA/NT border (and to the limit of the Australian Fishing Zone) is controlled by a joint authority arrangement between the Commonwealth and the State of Western Australia under State law. In this arrangement the State is given control of the JANSF on behalf of the Joint Authority.

The Offshore Constitutional Settlement arrangement set down in February 1995 specifies that the use of pelagic gillnets, demersal gillnets and demersal longlines to commercially take sharks and rays (Class Chondrichthyes) and bony fish (Class Osteichthyes) are to be managed by the Joint Authority in the JANSF. The Department is currently reviewing the JANSF with the view to updating the management arrangements.

*WA North Coast Shark Fishery (WANCSF):* The Western Australian-controlled sector of the northern shark fishery is managed by orders under section 43 of the *Fish Resources Management Act 1994*. The orders were first gazetted in May 1993 and cover the taking of shark in all waters off the north coast, from longitude 114°06' E (North West Cape) to 123°45' E with shark longlines and shark droplines using powered hauling gear. Those permitted to fish in the WANCSF with shark gear do so under a fishing boat licence condition and are permitted to use longlines and droplines with metal traces.

The State's shark fisheries are currently undergoing the ecological sustainability assessment process. An initial risk assessment workshop was held in April 2002 and a draft report will be available for comment from Environment Australia in early 2003.

In January 2002 the WA Demersal Gillnet and Demersal Longline Fisheries Management Advisory Committee, which formerly advised only on the management of the southern shark fisheries, was restructured to include a representative of the northern fisheries, and renamed the WA Demersal Net and Hook Fisheries Management Advisory Committee.

There is a lack of knowledge regarding the dynamics of the large number of target shark species in these fisheries, largely as a result of low fishing activity. The paucity of knowledge on northern shark species is not a problem unique to Western Australia, and to address this concern the Department of Fisheries is part of a collaborative shark research project involving a number of agencies across northern Australia, including CSIRO and the Northern Territory and Queensland fisheries agencies.

**Governing Legislation/Fishing Authority**  
Fisheries Notice no. 476 (Section 43 order)  
Fisheries Notice no. 602 (Section 43 order)  
Fisheries Notice no. 601 (Section 43 order)  
Condition 127 on a Fishing Boat Licence

### Consultation Process

WA Demersal Net and Hook Fisheries Management  
Advisory Committee  
Department–industry meeting

### Research Summary

Research to monitor the status of northern shark stocks has been undertaken as an extension of the south and west coast shark research project. A three-year research project funded by the FRDC began in July 2000 and will provide an improved understanding of these fisheries and of northern shark stocks generally. An EA/FRDC-funded research project examining the sustainability of Australia's tropical sharks and rays, which began in 1999, will also help to improve our understanding of the impacts of various fishing sectors which exploit elasmobranchs across the northern half of Australia. This project involves researchers from CSIRO, the Department of Fisheries' shark research section, the Northern Territory Department of Business, Industry and Resource Development and the Queensland Department of Primary Industries. Phase 2 of this project, which aims to fill some of the information gaps identified during Phase 1, began in July 2002 and is scheduled for completion in June 2005.

The following status report has been prepared based on CAES data from industry and a knowledge of tropical shark stocks from preliminary research data and the scientific literature.

## NORTH COAST SHARK FISHERIES STATUS REPORT

*Prepared by R. McAuley and R. Lenanton*

### FISHERY DESCRIPTION

#### Boundaries and access

Western Australia manages fishing for shark by longline or dropline from longitude 114°06' E to 123°45' E (the WANCSF). Longline and gillnet fishing for shark from longitude 123°45' E to the WA/NT border is managed by Joint Authority between Western Australia and the Commonwealth (the JANSF). Gillnet fishing is not permitted west of longitude 123°45' E or within 12 nautical miles of the coast east of longitude 123°45' E. A total of 13 fishers have licensed access to one or more of these zones.

Owing to the small number of operators in the JANSF, confidentiality arrangements do not permit the publication of catch and effort data from this fishery on their own. Therefore, as the principal methods and some target species are common to the JANSF and WANCSF, these data have been combined and the two regions are considered as a single northern shark fishery for assessment purposes.

#### Main fishing methods

Primarily shark dropline and shark longline. During 2000/01, two vessels reported using gillnets in the JANSF.

### RETAINED SPECIES

**Commercial production (season 2000/01): 272 tonnes**

**Landings**

This total shark catch of 272 tonnes included 79 tonnes of sandbar sharks. In 2000/01, the northern shark fisheries also retained 10 tonnes of finfish species. For a more detailed breakdown of catch species composition, see North Coast Shark Table 1. Annual catches since 1994/95 are shown in North Coast Shark Figure 1.

In addition to the catch by the two dedicated fisheries, sharks are also caught by other user groups. During 2000/01, vessels licensed in other managed fisheries operating in the area between North West Cape and the WA/NT border reported catches of shark and ray totalling 83 tonnes. A further 'wetline' catch of 19 tonnes of shark and ray was taken by vessels without access to managed fisheries.

**Fishing effort**

Effort has not been reported in previous years, as the accuracy of CAES data from the northern shark fisheries was uncertain. Since August 2000, Department of Fisheries research staff have been working closely with the full-time operators in the northern shark fisheries and the standard of catch and effort reporting is now considered to be good. The standardised effort measure used (hook hours) is the number of longline hooks multiplied by the number of fishing hours.

In 2000/01, the total fishing effort was 1,210,606 hook hours expended by 9 vessels, which represents an increase of 12.9% over the previous year (North Coast Shark Figure 2). The majority of effort was concentrated in the region between North West Cape and Broome. Given the continued high value of shark fins and the introduction of additional full-time vessels, effort in this fishery is likely to rise further in coming years.

**Catch rate**

The catch rate data (North Coast Shark Figure 2) indicate that there is no overall trend in abundance in the tropical shark stocks over the period since 1994/95.

**Recreational component:** **Not assessed**

**Stock assessment completed:** **Not assessed**

A preliminary stock assessment of the fisheries' main target species, the sandbar shark, *Carcharhinus plumbeus*, should be completed next year.

**Exploitation status:** **Not assessed**

**Breeding stock levels:** **Not assessed**

**NON-RETAINED SPECIES**

**Bycatch species impact:** **Low**

The fisheries have some scalefish catch which is generally retained for sale. There is some discarded bycatch of unsaleable species of sharks, stingrays and scalefish which preliminary ESD assessment has rated as a low to negligible risk to those stocks.

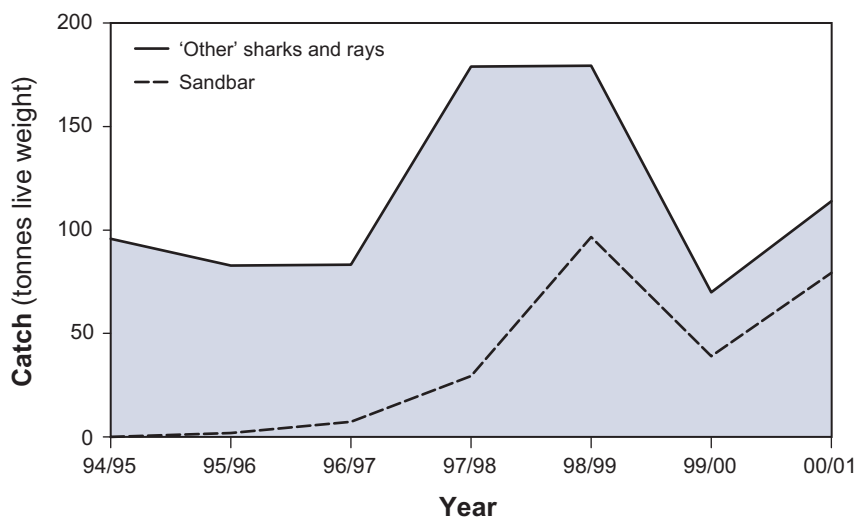
**Protected species interaction:** **Low**

The longline and dropline methods used in the northern shark fisheries have been rated as having a generally low risk of interacting with protected species. Given the current low level of pelagic gillnet effort in the fisheries (see 'Main fishing methods'), the risk of interaction with protected species such as dolphins by this method is also considered to be low.

**ECOSYSTEM EFFECTS**

**Food chain effects:** **Not assessed**

**North Coast Shark Annual Catch**



**NORTH COAST SHARK FIGURE 1**

Annual landings for the north coast shark fisheries (WANCSF and JANSF) for the period 1994/95 to 2000/01.

**Habitat effects:**

**Negligible**

The principal types of fishing gear (dropline and longline) are set so that they are only in intermittent contact with the seabed, and their physical impact on the seabed is minimal.

**SOCIAL EFFECTS**

Estimated employment in the northern shark fleet during 2000/01 was approximately 25 fishers.

**ECONOMIC EFFECTS**

**Estimated annual value (to fishers) for year (2000/01):**  
**\$900,000**

The combined value of the catch from the two managed sectors was approximately \$900,000 (including the estimated value of shark fins). During the 2000/01 season, shark fins maintained their value of between \$25 and \$120/kg, depending on fin size and species. As fishers do not specify the value of fins on their catch returns, fin weight was calculated at an average of 3% of sharks' whole weight and value was conservatively estimated using a price of \$60/kg (the high value reflecting the generally larger sharks caught in this fishery). Categories of shark which do not have saleable fins were excluded from fin valuation.

**FISHERY GOVERNANCE**

**Acceptable catch range:**

**Not assessed**

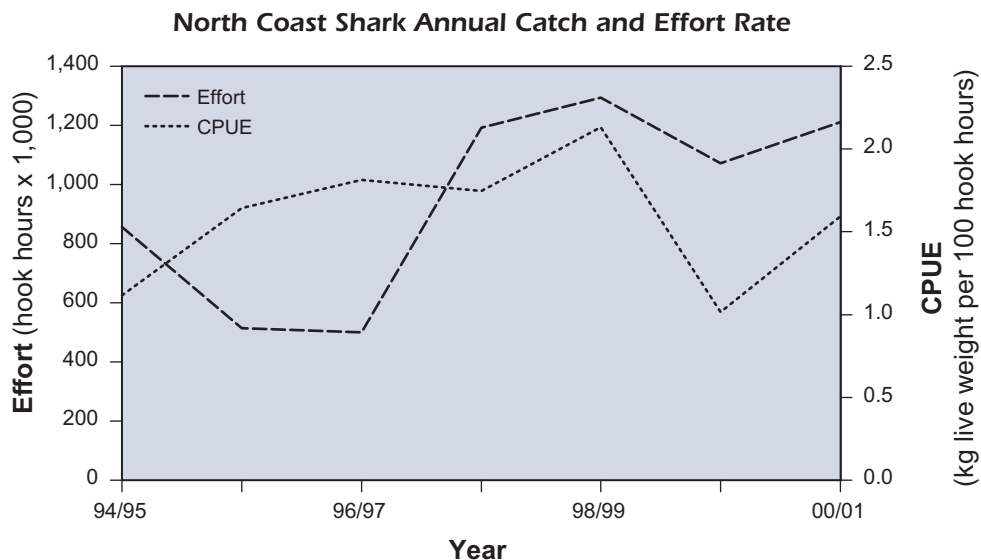
**EXTERNAL FACTORS**

A significant quantity of sharks are caught in the State's northern bioregion as by-product by vessels licensed to fish for other target species. This factor, in addition to the multi-species nature of the tropical shark fisheries, will make formal stock assessment difficult, particularly for the minor species in the catch.

**NORTH COAST SHARK TABLE 1**

Catch species composition for the north coast shark fisheries (WANCSF and JANSF), 2000/01.

SPECIES		CATCH (tonnes)
<b>Elasmobranchs</b>		
Sandbar (thickskin) shark	<i>Carcharhinus plumbeus</i>	79
Blacktip shark	<i>Carcharhinus</i> spp.	47
Tiger shark	<i>Galeocerdo cuvier</i>	34
Pigeye shark	<i>Carcharhinus amboinensis</i>	29
Hammerhead shark	Sphyrnidae	23
Lemon shark	<i>Negaprion acutidens</i>	15
Bronze whaler shark	<i>Carcharhinus obscurus</i>	9
Grey reef shark	<i>Carcharhinus amblyrhynchos</i>	7
Skates and rays		4
Shovelnose rays		3
Other sharks		22
<b>Scalefish</b>		
Red emperor	<i>Lutjanus sebae</i>	3
Rankin cod	<i>Epinephelus multinotatus</i>	2
Mackerel (unspecified)		1
Other scalefish		4



**NORTH COAST SHARK FIGURE 2**

Annual catch and effort rates for the north coast shark fisheries (WANCSF and JANSF) for the period 1994/95 to 2000/01.