

## South Coast Bioregion

### Regional Management Overview

Management arrangements in the South Coast Purse Seine Managed Fishery continue to be dominated by the after-effects of the 1998/99 mortality event, believed to be caused by a Herpesvirus. At this stage the stocks in the western zones of the fishery have not rebuilt sufficiently to allow for commercial exploitation. Quotas for 2000/2001 in the Albany and Bremer Bay areas remained at zero (although there are small research quotas to allow for research sampling). The quota in the Esperance area was originally set at 1,060 tonnes, but later raised on a pro rata basis to 1,300 tonnes when the season was extended to 30 June.

The review of the South Coast Estuarine Fishery was completed in 2000 and Ministerial approval of the outcomes was received. A Voluntary Fisheries Adjustment Scheme was established to facilitate a voluntary reduction in the number of participants ahead of the implementation of the approved outcomes. A VFAS was also established to remove herring G-trap entitlements and five entitlements were removed.

Some changes have been made to the management arrangements for the Esperance Rock Lobster Managed Fishery. In addition, following successful negotiations with Environment Australia, a new 'Controlled Specimens Declaration' was granted under the *Wildlife Protection (Regulation of Imports and Exports) Act 1982* for spiny, giant and snow crabs.

The abalone fishery is one of the major fisheries of the area, taking predominantly greenlip and brownlip abalone on the south coast, while Roe's abalone is taken mostly on the west coast. The Joint Authority Southern Demersal Gillnet and Demersal Longline Managed Fishery is another important fishery of the region. This fishery, and its west coast counterpart, have been engaged in a strict process of effort reduction and exploitation rate control to rebuild the biomass of the major shark stocks. The first five-year program of effort reduction will be completed in 2001 and a new program will have to be developed for 2002 onwards.

There was a significant catch in the south coast scallop fishery during 2000/2001 (reported under Minor Scallop Fisheries in the west coast bioregion, p. 17), following an unusually high level of recruitment to the fishery. A high level of variation in recruitment is normal for scallop fisheries and it is likely that this fishery will return to more normal catch levels in future years.

The 'wetline' fishery in the south coast bioregion is composed primarily of inshore gillnetting and beach-seining sectors.

### Regional Compliance and Community Education Overview

On the south coast, the major compliance issues relate to abalone. The commercial abalone fishery continues to require a high level of compliance activity, with reports of

breaches in 2000/2001 of management rules relating to annual quota management, non-completion of catch and disposal records, and the unlicensed take and sale of abalone.

Poaching activity by unlicensed operators running illegal commercial operations continues to be a significant issue within this fishery. These operations extend to the illegal take and shipment of abalone to overseas and interstate markets. The Serious Offences Unit was again used this year to target this particular problem. Two major prosecutions of unlicensed commercial-level operators are currently under way, and high-level investigations into other suspected offenders are continuing. The media attention given to the high fines and penalties imposed for these offences ensures that the general public is aware of the activities of fish thieves, and serves as a deterrent to other thieves.

The development of a uniform national approach to compliance monitoring of the abalone industry by fisheries agencies around Australia will also assist in addressing this problem. A National Docketing System is now in place for all other abalone-producing states, and Western Australia is continuing to develop a similar audit and monitoring system.

In addition to the cases of unlicensed operation reported above, three prosecutions were initiated for commercial abalone offences during 2000/2001, and one other matter is currently under consideration.

Funding of the compliance program for the commercial abalone fishery remains a major management issue and resulted in 'response only' field compliance being provided for the last six weeks of the quota season. The abalone fishery is in the high-risk category for non-compliance, and the resourcing of the compliance program needs to be resolved.

Compliance monitoring activities undertaken in the Joint Authority Southern Demersal Gillnet and Demersal Longline Managed Fishery include monitoring the use of time/gear units and net lengths. Some commercial/recreational/general community conflict continues in certain areas of the fishery. Community and industry liaison by Fisheries Officers has assisted each sector to develop a better understanding of the other sectors' concerns and needs.

Compliance within the South Coast Estuarine Fishery continues to be generally good. Some complaints were received regarding fishers continuing to operate nets beyond the daytime set net closure times. These instances sometimes occur because of breakdowns or larger than expected fish catches. Fisheries Officers monitor licences, gear restrictions, closed-water areas, fish size limits and setting and retrieval limits in this fishery.

There is a high level of compliance activities in the seasonal Western Australian salmon fishery. Inspections for this shore-based fishery include beach inspections for block nets, checking commercial licences, and monitoring of penning time periods and compliance with designated fishing zone boundaries.



# Commercial Fisheries

Recreational/commercial conflict in relation to beach-based activities continues to be an issue for this fishery, particularly with respect to designated fishing zones. Fisheries Officers continue to conduct a public education program during the salmon season.

Compliance activities in the Australian herring fishery concentrate on the period of time each day for which nets may be set. There were no major compliance problems and no significant conflicts reported for this beach-based fishery for 2000/2001.

In the South Coast Purse Seine Managed Fishery, the closures and associated regional effects required more time to be spent on liaison with fishers, processors and the general community, rather than specific monitoring and enforcement work.

Fisheries Officers undertake compliance monitoring and inspections in a number of minor commercial fisheries in this bioregion. No major compliance issues have been encountered in these fisheries during 2000/2001.

A total of 8 infringement/warning notices were issued and 4 prosecutions were initiated during 2000/2001 for commercial fisheries offences (excluding abalone) in the south coast bioregion.

## Regional Research Overview

In addition to the research projects and activities noted in the research summary for each individual fishery, there has been a major focus during 2000/2001 on assessing the general wetline catch in each bioregion. This assessment, undertaken utilising the CAES database, indicates that only 6% of the wetline catch was reported from the south coast bioregion during 1999/2000. The top ten species include redfish (28 tonnes), pink snapper (17 tonnes), samsonfish (14 tonnes), squid (12 tonnes), Australian herring (10 tonnes), hapuku (7 tonnes), queen snapper (6 tonnes) and deepsea trevalla (4 tonnes).

## South Coast Rock Lobster Fisheries

### MANAGEMENT SUMMARY

*Esperance Rock Lobster Managed Fishery:* The Esperance Rock Lobster Managed Fishery has 11 vessels which operate between longitudes 120° and 125° E, catching the southern rock lobster, *Jasus edwardsii*, and a small quantity of various deep-sea crab species. A maximum pot entitlement of 10 pots per metre applies to any boat and there is a restriction of 90 pots on the overall pot entitlement on any licence. Favourable rock lobster habitat supports a small but significant and relatively secure rock lobster fishery.

There were significant changes in the management arrangements for the Esperance Rock Lobster Managed Fishery, with the removal of the requirement for mandatory pot reductions on transfer and the introduction of a process to allow the Executive Director to vary the season dates. Following successful negotiations with

Environment Australia, a new 'Controlled Specimens Declaration' was granted under the *Wildlife Protection (Regulation of Imports and Exports) Act 1982* for spiny, giant and snow crabs.

### *Other south coast rock lobster fishing endorsements:*

In addition to the Esperance fishery, southern rock lobster and deep-sea crabs are also taken by vessels authorised to fish for lobsters on the south coast outside the Esperance managed fishery zone. These vessels operate in two zones, catching predominantly southern rock lobster, although catches of western rock lobster, *Panulirus cygnus*, are also taken in the western part of the fishery, particularly in the area adjacent to the Windy Harbour/Augusta Rock Lobster Managed Fishery.

Effort in the areas adjacent to the Esperance fishery is controlled by a limitation on the number of licences issued and constraints on the number of rock lobster pots that a boat may carry. However, the fluctuating nature of recruitment into the fishery and scarcity of favourable rock lobster habitat mean that this fishery tends to be exploited on an opportunistic basis in accordance with variations in available stock. The fishery does not lend itself to full-time specialist rock lobster fishing; instead, rock lobster fishing operations in these areas are generally part of more diversified fishing activities with the level of operation and catch varying from year to year.

Deep-sea crab stocks are thinly spread over the fishing grounds but exploitation rates are increasing. This is likely to result in catches that fluctuate widely from season to season, as fishable stocks are rapidly fished down in times of abundance, and then rebound following periods where the scarcity of legal-size specimens makes it less economic to target them.

### *Windy Harbour/Augusta Rock Lobster Managed Fishery:*

There are only two licensees in this fishery and the public disclosure of total catch data would breach the confidentiality requirements of the *Fish Resources Management Act 1994* by allowing the catch of an individual fisherman to be identified. Accordingly, this catch data is included in the published total catch data of the West Coast Rock Lobster Managed Fishery. Both western and southern rock lobsters, together with small quantities of deep-sea crabs, are taken from this fishery. The fishery is located where the southern limits of the main population of western rock lobster and the western limits of the range of southern rock lobster meet.

### *Governing Legislation/Fishing Authority*

#### **Esperance**

Esperance Rock Lobster Management Plan 1987  
Esperance Rock Lobster Managed Fishery Licence

#### **Other south coast endorsements**

Fish Resources Management Regulations 1995  
Regulation Licence granted under Regulations 125 and 126

**Windy Harbour/Augusta**

Windy Harbour/Augusta Rock Lobster Management Plan 1987  
 Windy Harbour/Augusta Rock Lobster Managed Fishery Licence

**Consultation Process**

Agency–industry meetings

**RESEARCH SUMMARY**

Research in this sector involves assessing the current status of the stocks in the area based on commercial catch returns and information from south coast rock lobster fishermen. This information is reflected in the following status report.

**South Coast Rock Lobster Fisheries Status Report**

*Prepared by R. Melville-Smith*

**FISHERY DESCRIPTION**

**Boundaries and access**

The boundaries of the Esperance Rock Lobster Managed Fishery (ERLMF) are between longitudes 120° E (near Hopetoun) and 125° E (near Point Culver) seawards to the 200 nautical mile Australian Fishing Zone outer limit. In 1999/2000, 11 vessels were licensed to fish in the area.

Boundaries for the neighbouring southern rock lobster fishery zones are defined as:

*Great Australian Bight (GAB) zone:* being the Australian Fishing Zone adjacent to the south coast of Western Australia, from longitude 125° E to longitude 129° E to the 200 m depth contour.

*Albany zone:* being the waters of the Australian Fishing Zone adjacent to the south coast of Western Australia, from longitude 116° E to longitude 120° E to the 200 m depth contour.

In 1999/2000, 31 vessels were endorsed to fish in the GAB and Albany zones. Endorsements have been frozen since October 1994 and fishermen without ongoing catch history have been asked to show cause why their related rock lobster pot entitlements should not be cancelled. While the agency’s intention is to reduce the number of pot entitlements as the opportunity arises, it is recognised that the Albany/GAB zones will never be a significant rock lobster fishery and will be best managed as an adjunct to fishers’ other diverse operations.

**Main fishing method**

Rock lobster pots.

**RETAINED SPECIES**

**Commercial production (season 1999/2000):**  
**69 tonnes**

**Landings**

A catch of 38 tonnes of southern rock lobsters was taken in the ERLMF in 1999/2000, a decrease of 5% on the

catch taken in the 1998/99 season (40 tonnes). The combined catch for the GAB and Albany southern rock lobster fishery zones in 1999/2000 was 31 tonnes, a decrease of 14% on the 1998/99 figure (36 tonnes). Catches in the Albany zone increased from 6 to 8 tonnes, but in the GAB zone of the fishery catches decreased from 29 to 23 tonnes. As a by-product of the rock lobster fishery, 3 tonnes of giant crabs and 14 tonnes of champagne crabs were landed in the Albany zone and 2 tonnes of giant crabs in the ERLMF.

**Fishing effort**

The ERLMF experienced a 20% decrease in nominal fishing effort levels, from 52,600 pot lifts in 1998/99 to 42,000 pot lifts in 1999/2000. Total effort for the Albany and GAB zones in the 1999/2000 season was 90,500 pot lifts, a decrease of 1,200 pot lifts (1%) on the previous season’s 91,700 pot lifts. Fishing effort increased in the Albany zone, from 21,600 pot lifts in 1998/99 to 33,700 pot lifts in 1999/2000, and decreased in the GAB zone, from 70,000 pot lifts in 1998/99 to 56,800 pot lifts in 1999/2000. Effort figures are confounded in the Albany zone, because an unknown amount of the effort recorded there may have targeted deep-water crabs rather than lobsters.

**Catch rate**

The catch per unit of fishing effort for the 1999/2000 season in the ERLMF increased by 18%, from 0.76 kg/pot lift in 1998/99 to 0.90 kg/pot lift in 1999/2000. The combined catch per unit of fishing effort for the GAB and Albany zones in the 1999/2000 season was 0.34 kg/pot lift, a 13% decrease from the 0.39 kg/pot lift for the 1998/99 season. Catch rates decreased from the 1998/99 value in the Albany sector by 21%, from 0.29 to 0.23 kg/pot lift, and in the GAB by 2%, from 0.42 to 0.41 kg/pot lift.

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

**Stock assessment completed:** **Yes**

Indications from production modelling of the Western Australian portion of the southern rock lobster resource, and from a postal survey in which commercial fishers were asked to quantify the amount of available ground colonised by lobsters, suggest that the western and eastern zones are not suited to southern lobster colonisation. The survey of fishers showed that the western and eastern zones only have about 10% of the amount of ground available for lobster colonisation compared with what can be found in the optimal fishing areas inside the ERLMF. The Esperance area has a long history of sustained exploitation (South Coast Rock Lobster Figure 1) and model results, though inconclusive, would suggest that the virgin biomass for this part of the fishery was substantial (of the order of 400–1,000 tonnes). Model outputs show that the ERLMF fishery is sustainable at current annual catch levels of around 40 tonnes, but not at the 60 tonne levels that were experienced in the early to late 1990s. The fact that the current effort in this fishery remains similar to that during the period of 60 tonne catches means that if latent effort is utilised in the future, localised depletion will be likely to result.



# Commercial Fisheries

Stock assessments for the GAB and Albany zones show that sustainable yields in both zones are small, and at the fishing levels of recent years, both areas have been rapidly depleted. Should the rates of exploitation that have been experienced in recent times persist in the future, they will probably lead to lobster fishing in the GAB and Albany zones becoming uneconomic. Unsustainable fishing pressure in the neighbouring zones should not affect the ERLMF, as recruitment to the south coast fishery overall is not considered to be dependent on egg production from Western Australian waters.

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

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

The stock of southern rock lobster in Western Australian waters is at the western edge of its distribution. Puerulus settlement to this region is probably derived from the bulk of the stock in South Australian, Tasmanian and Victorian waters and, as such, the broodstock in Western Australian waters probably makes an insignificant contribution to the southern rock lobster larval pool. Available evidence would suggest that recruitment may be sporadic and driven by large-scale environmental factors rather than localised breeding stock levels.

For the secondary retained species, i.e. deep-sea crab species, there are management measures (legal minimum sizes, return of females carrying eggs) in place to protect the broodstock. Therefore, while the standing stock of these slow-growing and long-lived species may have been depleted by fishing several years ago, their broodstock has remained at acceptable levels.

## NON-RETAINED SPECIES

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

The gear used in this fishery generates minimal bycatch and the design of the pots is such that they do not 'ghost fish' if lost.

**Protected species interaction:** **Negligible**

Rock lobster pots and ropes have minimal capacity to interact with protected species in this fishing area.

## ECOSYSTEM EFFECTS

**Food chain effects:** **Negligible**

The rock lobster and crab catches represent a very small biomass, and any impact of fishing on the general food chain is expected to be minimal.

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

Rock lobster potting has a very low impact on the largely granite habitat over which the fishery operates.

## SOCIAL EFFECTS

There are a large number of licensed pots in this fishery, but not a large number of active fishers. Most of the fishers have other forms of employment outside of the commercial rock lobster fishing season.

## ECONOMIC EFFECTS

**Estimated annual value (to fishers) for year (1999/2000):** **\$1.8 million**

The beach value of the fishery was about \$1.8 million in 1999/2000, based on a beach price of \$26/kg.

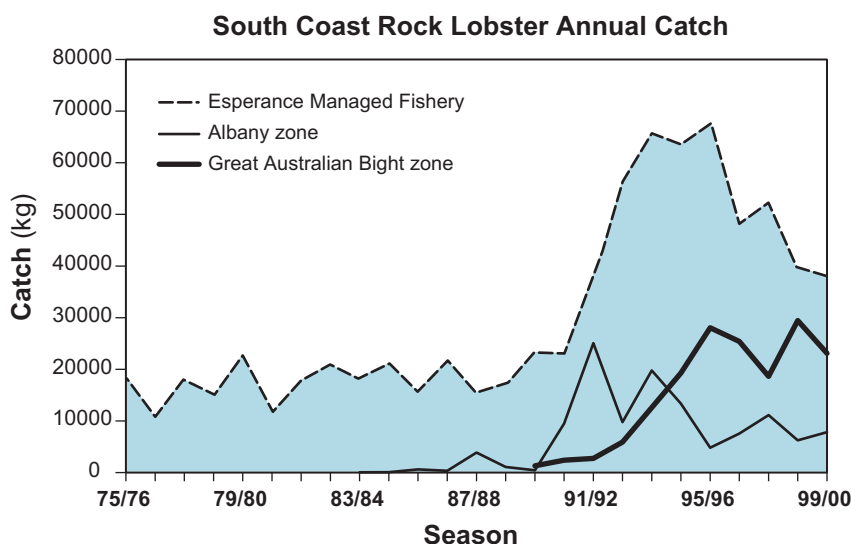
## FISHERY GOVERNANCE

**Acceptable catch range:** **50–80 tonnes**

This range is simply based on the landings that have been reported for this fishery over recent years

The ERLMF is a more productive fishery than the outer zones. It would appear to be reasonably stable in the short to medium term, but landings are in the upper bounds of what is predicted to be sustainable by the model.

If the management objective were to fish the eastern and western zones to economically viable levels, then current effort levels would need to be drastically reduced. However, it has been accepted that reducing fishing effort in these zones to such levels is unattainable in the medium term and the agency has therefore adopted a policy whereby it will reduce the number of pot entitlements as the opportunity arises and manage the fishery as an adjunct to fishers' other activities.



### SOUTH COAST ROCK LOBSTER FIGURE 1

Seasonal catches of southern rock lobster by management area, 1975/76 to 1999/2000.

## Abalone Managed Fishery

### MANAGEMENT SUMMARY

The Abalone Managed Fishery harvests three abalone species: greenlip abalone (*Haliotis laevis*), brownlip abalone (*Haliotis conicopora*) and Roe's abalone (*Haliotis roei*). The large greenlip and brownlip abalone are confined to the lower south-west and south coasts of the State, while Roe's abalone are found in commercial quantities from the South Australian border to Shark Bay, although they are not uniformly distributed throughout this range.

The commercial abalone 'season' operates from 1 April each year to 31 March the following year. The fishery is divided into eight areas so that the spatial nature of the abalone stocks can be better managed. Each February, total allowable catches are determined for each area in the fishery. The set number of units in each area is then assigned a unit value based on the number of units in that area. Every fishery licence is endorsed with a certain number of tradeable units of entitlement to a specific area or areas. Multiplying the number of area units on a licence by the unit value for that area indicates the weight of abalone that can be taken in that area by the holder of that licence (or their nominated operator).

Since a major management plan change in March of 1999, each licence in the fishery must be permanently endorsed with a minimum of 800 units for Roe's abalone and 450 units for greenlip/brownlip abalone. There are a number of licences, however, that are permitted to exist below the minimum unit holding level because these licences continue to be fished as they had been prior to the major management plan change.

There are 42 current abalone licences. This includes 15 greenlip/brownlip abalone licences, with the remainder endorsed to take Roe's abalone. There are a total of 13,800 greenlip units, 2,300 brownlip units and 25,180 Roe's abalone units in the fishery. During 2000/2001, fishermen were entitled to catch nearly 116 tonnes whole weight of Roe's abalone, 195 tonnes whole weight of greenlip abalone and 35 tonnes whole weight of brownlip abalone.

Abalone divers are required to provide daily catch information in the form of a catch and disposal record. Details including the weight of abalone collected, the quantity (for greenlip/brownlip only), the date and location of collection and the personal details of the diver are all recorded and used to assist in research, compliance and management matters.

#### Governing Legislation/Fishing Authority

Abalone Management Plan 1992  
Abalone Managed Fishery Licence

#### Consultation Process

Abalone Management Advisory Committee  
Agency-industry meetings

### RESEARCH SUMMARY

The 2000 quota period represents the second full season of abalone fishing under new management arrangements. Prior to 1999 the Abalone Managed Fishery was divided into three zones. For the 1999 and 2000 fishing seasons fishing was separated by species into a greenlip abalone fishery, brownlip abalone fishery and Roe's abalone fishery, with transferable units of quota allocated over eight areas throughout the State (Abalone Figure 1).

# Commercial Fisheries

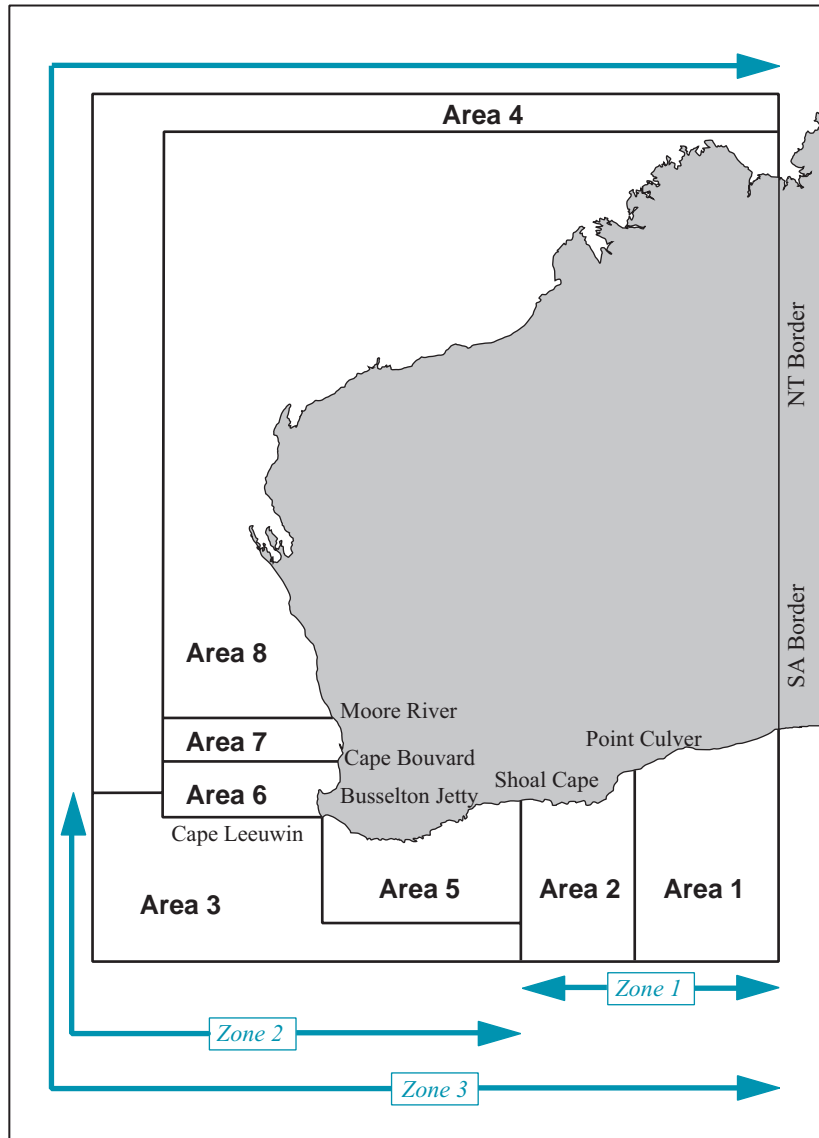
Although the TAC in each area remains similar to what was previously taken when the fishery was divided into three zones, in some cases it is difficult to compare 1999 and 2000 catch rates with historical data.

The introduction of individual quotas for greenlip and brownlip abalone is a new initiative within the management plan. Previously brownlip abalone, which have a lower value than greenlip abalone, were usually caught as incidental catch while fishing greenlip abalone. The separate quotas have the advantage that fisheries managers will be able to manipulate quotas more accurately to reflect changes in the abundance of particular abalone stocks.

Basic research monitoring for the eight abalone catch areas is undertaken annually utilising industry data from

the daily catch records, information from processors, fishers' monthly returns and data collected during specific research projects. In each of the eight areas, the fishing effort required to achieve the catch is examined annually to ensure that the quota level is sustainable. The quota period for all areas for the last two seasons of the Abalone Managed Fishery was 1 April to 31 March in the following year. (For simplicity, data will be reported against the quota period for the year in which it began. For example, for the 2000/2001 quota period, data will be reported as taken in the 2000 season.)

The approximate value of the Western Australian commercial abalone fishery in 2000 was \$19 million. The following status reports utilise the research findings for the greenlip, brownlip and Roe's fisheries from the eight fishing areas.



**ABALONE FIGURE 1**

General map showing old zonal arrangements and new area management regime of the commercial abalone fisheries of Western Australia.

## Greenlip and Brownlip Abalone Status Report

Prepared by K. Friedman and F. Fabris

### FISHERY DESCRIPTION

#### Boundaries and access

The greenlip/brownlip abalone fisheries include Areas 1, 2 and 3, which extend from the SA/WA border to Busselton Jetty. The quota period for all areas was 1 April 2000 to 31 March 2001.

#### Main fishing method

Diving. Abalone divers operate from small fishing vessels (generally < 9 m).

### RETAINED SPECIES

#### Commercial production (season 2000):

**Greenlip 189.84 tonnes whole weight**  
**Brownlip 33.53 tonnes whole weight**

#### Landings

Catches are currently controlled by quotas, with the TAC for the 2000 quota year being 194.67 tonnes whole weight (73 tonnes meat weight) for greenlip abalone and 34.87 tonnes whole weight (14 tonnes meat weight) for brownlip abalone. The greenlip catch was 189.84 tonnes whole weight (71 tonnes meat weight) and brownlip catch was 33.53 tonnes whole weight (13 tonnes meat weight) for the 2000 season (Abalone Table 1).

#### Fishing effort

Total effort for 2000 was 1,173 days fished for greenlip and brownlip abalone, which was similar to 1999 and within the projected effort range of 1,100–1,520 days.

#### Catch rate

In 2000 the catch rate was 195.7 kg whole weight per diver day (72.1 kg meat weight per diver day).

#### Recreational component (2000): **21% (estimate)**

Based on recreational telephone surveys, recreational fishing accounted for an estimated 21% of the combined commercial and recreational catch of greenlip and brownlip abalone in 2000. See Recreational Abalone Fishery Status Report, pp. 130-34.

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

Presently greenlip and brownlip abalone stocks are assessed by analysing industry data from the daily catch records, information from processors, fishers' monthly returns and data collected during specific research projects.

Industry has collaborated with Fisheries WA to develop strategies for the sustainable harvesting of stunted populations of abalone. In Area 1 there are extensive, isolated populations of stunted greenlip abalone. The generally small size of these abalone (surveyed in 1974, 1994 and 2000) has limited catches from this part of the fishery, with less than 200 kg fished annually since 1994. In 2000, industry divers and Fisheries WA researchers

carried out exploratory fishing at Twilight Cove to determine the distribution and density of the stocks and obtain data needed for the development of a new strategy for sustainable fishing of these particular stocks. The survey revealed that less than 5% of stocks were of legal size (140 mm+) and that stocks reaching legal size were localised to small areas.

In Area 2, the recent improvement in average meat weights of non-stunted greenlip stocks recorded in 1999 has not been sustained this season. In 2000 the average greenlip meat weight reverted to 177 g, a decrease of just over 10 g from the previous season's average when controlled harvesting of stunted stocks relieved fishing pressure (and effort) from traditionally fished stocks. The Area 2 catch rate for greenlip abalone was 54.63 kg/day in 2000. In addition to decreasing average meat weights, fishing 10% more abalone (by weight) from traditional stocks than in 1999 also saw catch rates decrease by 9 kg/day. Although lower than last season by 4 g, the generally consistent average meat weight of brownlip abalone in Area 2 does not indicate any present cause for concern.

Area 3 has utilised a combination of temporary quota reductions and closures/openings of the most productive locations in the recent past as controls to direct effort. In addition, raising minimum size limits (by industry agreement) has increased the average meat weight of greenlip abalone substantially since 1997. In 2000, the average meat weight for greenlip abalone was 231 g, the highest average recorded in the 1990s. During the season the catch of greenlip from traditionally fished grounds was decreased 3.75% by fishing 1.5 tonnes of 'stunted stock' east of Hopetoun. Information on brownlip abalone stocks in this area is limited, as divers have in the past primarily targeted greenlip abalone. The quota for brownlip abalone in Area 3 was increased by 2 tonnes for the 2000 season to allow divers to target new areas for brownlip abalone. Average meat weights and diver catch records indicate that this approach has been partially effective. The average meat weight for brownlip abalone in 2000 was 274.5 g, the highest since 1995.

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

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

The literature lists greenlip abalone as maturing between 70 and 90 mm shell length (2–4 years of age), and brownlip abalone maturing at between 90 and 130 mm shell length. However, maturity in abalone is generally related to age and not size. Despite growth varying markedly between fast-growing and stunted stocks in Western Australia, the minimum legal size limit is considered adequate. The breeding stock for both species is further protected, as industry sets self-imposed length limits in excess of the minimum legal limits in areas of fast-growing stocks. For example, in Area 2 there is a general 145 mm minimum length across the fishing grounds (other than stunted stocks), whereas within fast-growing areas of Area 3, fishers take abalone over 153 mm shell length (5.5–7 years of age).

A new finer-scale reporting system initiated by Fisheries WA researchers in 2000 is giving a clearer picture of



# Commercial Fisheries

stock utilisation and spatial variations in catches which was difficult to assess from the previous 10 x 10 mile grid reporting system. The new system will allow greater protection of breeding stocks by helping to identify and limit serial depletion of sub-stocks.

## NON-RETAINED SPECIES

### Bycatch species impact: **Negligible**

Divers have the ability to target abalone of choice (species, sizes and quality of abalone) and do not inadvertently harvest bycatch in their normal fishing activities.

### Protected species interaction: **Negligible**

The only protected species interaction occurring in this fishery is with the great white shark (*Carcharodon carcharias*), which has been known to attack divers. Most divers now use diving cages or electronic shark deterrence devices for their personal protection, which has the secondary effect of reducing the incentive to harm this protected species.

## ECOSYSTEM EFFECTS

### Food chain effects: **Negligible**

Commercial abalone diving occurs over a small proportion of the total abalone habitat of the Western Australian coastline. In view of the relatively low exploitation rates and consequent maintenance of a high proportion of the natural biomass of abalone, it is considered unlikely that the fishery has any significant effect on the food chain in the region.

### Habitat effects: **Negligible**

The fishing activity makes minimal contact with the habitat, which typically consists of hard rock surfaces in a high wave energy environment. As abalone are drift algae feeders, their removal is unlikely to result in any changes to the algal growth cover in areas fished.

## SOCIAL EFFECTS

There are close to 30 vessels in the Western Australian abalone industry. Of these, 14 vessels fish greenlip and brownlip abalone, employing approximately 35 divers and deckhands. The dispersed nature of the greenlip and brownlip abalone fishery means that small coastal towns from Busselton to the South Australian border receive income from the activity of divers.

## ECONOMIC EFFECTS

### Estimated annual value (to fishers) for year (2000): **\$13.38 million**

The estimated average wholesale price was \$163/kg meat weight for greenlip and \$132.50/kg meat weight for brownlip abalone. On the basis of the average prices, the greenlip and brownlip abalone fishery was worth approximately \$13.38 million. These prices were significantly higher than last year's values of \$120/kg meat weight and \$110/kg meat weight for greenlip and brownlip abalone respectively.

## FISHERY GOVERNANCE

### Acceptable catch and effort range:

**1,110–1,520 diver days for  
229.54 tonnes whole weight**

To be fished at a historically sustainable level, the 2001 quotas for greenlip abalone (194.67 tonnes whole weight) and brownlip abalone (34.87 tonnes whole weight) should be taken within the five-year range (1994–1998) of 1,110–1,520 diver days. The effort recorded in 2000, at 1,173 days, was at the lower end of this range. The mean ( $\pm$  SD) catch rate (based on total annual catch divided by days dived that year) within the five-year range was  $154 \pm 20$  kg whole weight per day for greenlip/brownlip abalone (meat to whole weight conversion rate for greenlip abalone = 2.667). Although effort in number of days fished may vary due to variations in total catch in the more remote parts of the fishery, the season's mean kg/day catch rates should not fall significantly below the average presented.

## EXTERNAL FACTORS

In the last few years there has been a change in the normal operating procedure of the fishery, away from owner-operators to lease divers. This change has resulted in divers spending longer in the water for a day's fishing in an attempt to minimise fishing costs. This shift impacts on the assessment of effort in the fishery. In some locations in the abalone fishery there has also been an increase in the prevalence of divers targeting deeper-water stocks (> 30 m) that historically have contributed little to general catch. At present fishing depth is not recorded on the daily catch record.

A new industry catch reporting system, which is on a finer scale than previous systems, has been initiated by Fisheries WA for all greenlip/brownlip abalone fishing areas in the 2000 season. This data will enable more effective assessment of these increasingly valuable stocks, and will improve the reliability of management in the future.

Further assessment and supervised fishing of stunted stocks are planned for 2001. In addition, Fisheries WA in collaboration with the industry is developing new techniques for greenlip and brownlip abalone stock surveys using underwater digital video camera equipment.

## ABALONE TABLE 1

Greenlip and brownlip abalone catch and effort by quota period.

Quota period	Greenlip TAC kg whole weight	Brownlip TAC kg whole weight	Greenlip caught kg whole weight	Brownlip caught kg whole weight	Combined catch kg whole weight	Diver days
1990	126,500	-	114,414	18,768	133,182	809
1991	148,500	-	131,266	14,660	145,926	1,145
1992	192,500	-	175,054	30,285	205,339	1,284
1993	197,450	-	178,794	31,155	209,949	1,347
1994	200,750	-	177,166	32,223	209,389	1,522
1995	187,264	-	151,863	27,263	179,126	1,327
1996	189,750	-	176,668	21,933	198,601	1,113
1997	207,350	-	187,993	26,298	214,291	1,259
1998	200,750	-	187,644	22,198	209,842	1,246
1999	189,750	28,000	180,620	27,673	208,293	1,121
2000	194,669	34,875	189,846	33,531	229,309	1,173

### Notes

1. Data source: quota returns.
2. Standard conversion factors for meat weight to whole weight for greenlip abalone were 2.75 prior to 2000 and 2.667 for 2000. Brownlip abalone conversion factor for meat weight to whole weight was 2.5.
3. The length of quota period has varied with management changes, and for simplicity has been recorded against the nearest calendar years.
4. Brownlip allocations not fixed across Areas 2 and 3 (ex-Zone 1 and 2) prior to 1999. Brownlip TAC fixed for the first year in 1999.

## Roe's Abalone Status Report

Prepared by K. Friedman, A. Hancock and F. Fabris

### FISHERY DESCRIPTION

#### Boundaries and access

The Roe's abalone fishery includes Areas 1, 2, 5, 6, 7 and 8 and extends from Steep Point (Shark Bay) in the north to the SA/WA border.

#### Main fishing method

Diving. Abalone divers generally operate from small fishing vessels (generally < 9 m), although on occasion they can approach stocks from the shore.

### RETAINED SPECIES

**Commercial production (season 2000):**  
**107.7 tonnes whole weight**

#### Landings

Catches are currently controlled by quotas, with the TAC for the 2000 quota year being 115.9 tonnes whole weight for Roe's abalone. The catch of 107.7 tonnes whole weight for the 2000 season (Abalone Table 2) was lower than the TAC as some stock in remote locations remained unfished and there was a voluntary 4 tonne reduction in catch from Area 8 due to concerns over the size of the quota.

#### Fishing effort

Total effort in 2000 was 755 diver days, which was similar to 1999 and within the projected effort range of 750–950 days. Note that the full quota was not taken.

#### Catch rate

The Roe's abalone catch rate in 2000 was 142.63 kg whole weight per diver day.

**Recreational component: 32% (estimate)**

The recreational catch estimates for 2000 were approximately 32% of the total Roe's abalone catch. See Recreational Abalone Fishery Status Report, pp. 130-34.

**Stock assessment completed: Yes**

Presently stocks of Roe's abalone are assessed by analysing industry data from the daily catch records, information from processors, fishers' monthly returns and data collected during specific research projects. Unlike greenlip and brownlip abalone, Roe's abalone are not counted by divers, so there is no process for assessing average meat weights within this fishery.

The population structure has now been assessed through genetic analysis (gel electrophoresis). Results demonstrate moderate levels of connection (gene flow) between populations throughout the species distribution, hence Roe's stocks can be examined on a State scale. Statewide connection occurs despite mixing within each generation occurring on a smaller scale of < 13 km. This means that, although there is gene flow across the complete range of Roe's abalone, the majority of recruitment occurs as a local event on continuous reef complexes; therefore most fisheries management and research occurs on a smaller scale by Area.

In general, assessment of Roe's stocks using daily catch records is limited to reviewing catch per unit effort (CPUE) and movement of catch and effort within the



# Commercial Fisheries

10 x 10 mile grid reporting system. In general these catch statistics describe a well-managed stock, as the catch was fished in two less days than was the case last year and within the acceptable catch and effort range projected last season. However, comparative assessments of changes in catches from particular locations beyond gross catch weight, e.g. by assessing changes in average meat weight, are needed to be able to monitor fluctuations in catches prior to any critical change in stock health. In 2001/2002 Fisheries WA will be working with industry to institute the development of a system which is able to monitor changes in the average meat weight or grade of catch from particular locations.

In 1999 there was some concern at the condition of the commercial stocks at specific locations at the margins of the fishery. In Area 1 there was evidence of localised depletion of Roe's abalone in the vicinity of the launch area at Twilight Cove (first 10 km east of cliffs). This concern has been somewhat allayed by an increase in the legal minimum size limit for Area 1 from 60 mm to 75 mm shell length. Although the abundance of Roe's abalone is not of concern at other locations on the south coast, a portion of the quota consistently remains unfished due to the remoteness of the fishing locations and the unpredictable nature of the weather. In Area 8, the most northerly margin of the fishery, observations from divers suggested that the quota setting for 1999 and 2000 was too high, despite a reduction in quota in 2000. The abundance of legal-sized Roe's abalone in this area has declined due to localised depletion of abalone caused by inappropriate distribution of fishing effort by less experienced fishers (on a spatial scale smaller than previously reported). In addition, some natural losses have occurred as a result of environmental factors outside of the control of the commercial fishery, for example in shallow water areas where unusually hot weather coincided with extreme low tides. In 1999, fishers in Area 8 instituted a voluntary reduction of 6 tonnes from their 30 tonne TAC. Despite arguing for a 20 tonne TAC for 2000, fishers again instituted a voluntary reduction of 4 tonnes during the season following concerns that the quota was still too high. For the 2001 season, a further reduction in quota is planned to improve the abundance of legal-sized abalone, and industry operators have traded quota units to ensure that only divers experienced in fishing these remote colonies operate in the north of Area 8.

**Exploitation status:** Fully exploited

**Breeding stock levels:** Adequate

Research has shown that the size at sexual maturity (50% of animals mature) of Roe's abalone in the Perth metropolitan area is 40 mm (approximately 2.5 years of age). Preliminary growth data for these same metropolitan Roe's abalone indicate that they have a minimum of one year's spawning before reaching 60 mm, the minimum legal size at which Roe's abalone are harvested anywhere in Western Australia. This is considered to provide adequate protection for the breeding stock, especially since the commercial fishery's legal minimum size in Area 7 (the metropolitan area) is 70 mm, 10 mm larger than that used by the recreational sector. In Area 1, the commercial fishery's legal minimum length is 75 mm.

## NON-RETAINED SPECIES

**Bycatch species impact:** Negligible

Divers have the ability to target abalone of choice (species, sizes and quality of abalone) and do not inadvertently harvest bycatch in their normal fishing activities.

**Protected species interaction:** Negligible

The only potential protected species interaction in this fishery would be with the great white shark (*Carcharodon carcharias*) while fishing in some of the more open-water locations. Some Roe's abalone divers are adopting the shark pod technology generally used by greenlip/brownlip divers for their personal protection, which has the secondary effect of reducing the incentive to harm this protected species.

## ECOSYSTEM EFFECTS

**Food chain effects:** Negligible

Commercial abalone diving occurs over a small proportion of the total abalone habitat of the Western Australian coastline. As a consequence of the relatively low exploitation rates which leave a significant biomass of abalone on the reef at all times, it is unlikely that the fishery has any significant effect on the food chain in the habitat.

**Habitat effects:** Negligible

The fishing activity makes minimal contact with the habitat, which typically consists of hard rock surfaces in a high wave energy environment. As abalone are drift algae feeders, their removal is unlikely to result in any changes to the algal growth cover in areas fished.

## SOCIAL EFFECTS

There are close to 30 vessels in the Western Australian abalone industry. Of these, 26 vessels fish for Roe's abalone, employing approximately 50 people. The dispersed nature of the Roe's abalone fishery means that small coastal towns from Kalbarri to Eucla receive income from the activity of divers.

## ECONOMIC EFFECTS

**Estimated annual value (to fishers) for year (2000):**  
\$5.9 million

The estimated average price was about \$55/kg whole weight for Roe's abalone. On the basis of the average price the fishery was worth approximately \$5.9 million. The price of Roe's abalone was significantly lower last year, at \$35/kg whole weight.

## FISHERY GOVERNANCE

**Acceptable catch and effort range:**  
725–929 diver days for  
107.9 tonnes whole weight

As a consequence of management changes in 1999, such as the removal of the daily catch limits in Area 7, the historical effort data set from the metropolitan area (Area 7) is no longer comparable with present-day effort recordings. A new estimation of the acceptable effort range for Area 7 has been calculated for this report by varying the average 1999 and 2000 catch rate (first two

years of new management arrangements) by the mean annual variation of catch rate recorded within other areas of the fishery between 1994 and 1998 ( $\pm 16.5\%$ ). With the inclusion of this variation in catch rate for Area 7, the full quota for the Roe's abalone fishery in 2001 (107.9 tonnes whole weight) should be achieved in 725–929 days of fishing. Although effort in number of days fished may vary due to variations in total catch in the more remote parts of the fishery, the season's mean kg/day catch rates should not fall significantly below 142.63 kg whole weight Roe's abalone per diver day.

#### EXTERNAL FACTORS

The 1999 quota period saw several major management changes within the metropolitan area (Area 7). The 100 kg maximum daily limit was removed, along with the restricted two-month fishing season; subsequently effort was greatly reduced due to larger daily catch rates and decreased diver days in the water. A new catch reporting system, which is on a finer scale than previous systems, has been initiated by Fisheries WA, with industry support, for all Roe's abalone fishing areas in the 2000 season. This will permit improved monitoring of the exploitation rates in the fishery.

#### ABALONE TABLE 2

Roe's abalone catch and effort by quota period.

Quota period	Roe's TAC kg whole weight	Roe's caught kg whole weight	Diver days <sup>Δ</sup>
1990	105,000	117,558	1114
1991	101,000	110,334	1005
1992	105,000	112,275	942
1993	128,000	116,390	1058
1994	125,960	119,849	1146
1995	125,960	115,218	1206
1996	125,960	122,065	1176
1997	126,790	119,080	970
1998	93,960*	86,530	799
1999	119,900 <sup>+</sup>	108,278	757
2000	115,900 <sup>+</sup>	107,683	755

<sup>Δ</sup> Diver days from dedicated Roe's abalone divers only.

\* Reduced quota for a six-month season.

<sup>+</sup> Industry-instigated voluntary 6 tonne reduction in quota for 1999 and voluntary 4 tonne reduction in quota for 2000 in response to concerns over the low abundance of legal-sized abalone.

#### Notes

1. Data source: quota returns.
2. Standard conversion factors for meat weight to whole weight for Roe's abalone were 2.5 prior to 2000 and 3.0 in 2000.
3. The length of quota period has varied with management changes, and for simplicity has been recorded against the nearest calendar year.

# Commercial Fisheries

## South Coast Estuarine Fishery

### MANAGEMENT SUMMARY

Consultation for the review of the South Coast Estuarine Fishery was completed in 2000 and the new management arrangements for the fishery have been approved.

Development of the new legislation is under way and it is anticipated that the new management plan for the fishery will be in place at the beginning of 2002.

The new arrangements will not result in dramatic changes to the fishery, but will define permitted fishing methods, with limits. They will also provide for transferability of authorisations when the number of units in the fishery has been reduced to the optimum level of 15. The invitational period for the Voluntary Fisheries Adjustment Scheme for this fishery closed on 1 April 2001, with the negotiation phase to be completed by 31 December. Prior to the recent VFAS there were 27 licensed units, and it is unlikely that the latest scheme alone will reduce the number of units to the target number.

#### Governing Legislation/Fishing Authority

Fishing Boat Licence Condition 19  
Commercial Fishing Licence Condition 17  
Various orders under Section 43 of the *Fish Resources Management Act 1994* (closed waters and permitted gear)

#### Consultation Process

Agency–industry meetings

### RESEARCH SUMMARY

Research monitoring of fish stocks in the south coast estuaries is primarily based on CAES returns provided by industry. These data are interpreted using the extensive scientific knowledge of the fish stocks in estuaries derived from research by Fisheries WA and Murdoch University scientists during the 1970s and 1980s. This database from commercial fishermen provides a valuable and consistent source of information for monitoring recreationally important stocks where they are harvested by both groups.

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

## South Coast Estuarine Fishery Status Report

Prepared by S. Ayyazian and G. Nowara

### FISHERY DESCRIPTION

#### Boundaries and access

The following estuaries and inlets located between Cape Beaufort and the WA/SA border are reported under the South Coast Estuarine Fishery (SCEF): Oyster Harbour, Wilson Inlet, Irwin Inlet, Broke Inlet, Princess Royal Harbour, Parrys Inlet, Beaufort Inlet, Gordon Inlet, Hamersley Inlet, Culham Inlet, Oldfield Inlet, Torradup Inlet, Stokes Inlet and Jerdacuttup. The level of access stood at 31 fishing units in April 2000.

South coast licensees have access to each of the individual south coast estuaries, except Beaufort Inlet where only three licensees a year are granted entry. The South Coast Estuarine Fishery comprises many finfish species. This report presents specific data for three of the most important estuarine fish stocks, namely black bream, cobbler and King George whiting.

#### Main fishing method

Gillnet/haul net.

### RETAINED SPECIES

**Commercial production (season 2000): 252 tonnes**

#### Landings

The total reported landings of 252 tonnes from the south coast estuaries incorporate molluscs and crustaceans as well as finfish, and include the following catches of key target species:

Cobbler	62.0 tonnes
Black bream	30.0 tonnes
Australian herring	28.5 tonnes
Sea mullet	21.8 tonnes
King George whiting	19.4 tonnes

The reported catch from south coast estuaries shows a stable history between 1993 and 1997, with an increase in catches reported in 1998 followed by a decline in 1999. The reported 2000 catch figure has decreased from the 1999 levels (South Coast Estuarine Figure 1). In 2000, higher catches were reported from Princess Royal Harbour, Gordon Inlet and Beaufort Inlet, which each showed an increase of more than 1 tonne over 1999 levels. Decreased catches compared to the previous year were recorded from Oyster Harbour, Wilson Inlet, Broke Inlet and Stokes Inlet. The 2000 reported catches were similar to the 1999 catches for Irwin Inlet and Oldfield Inlet. Catches were reported from the Jerdacuttup Lakes, Culham Inlet, Hamersley Inlet and Torradup Inlet during 2000 after several years without fishing activity. There was no fishing reported in Parrys Inlet.

While over 40 species of sharks, rays, finfish and invertebrates are represented in the annual catch from south coast estuaries, the predominant finfish species are cobbler, King George whiting, sea mullet, Australian herring and black bream.

*Black bream:* In 2000, the reported catches of black bream in south coast estuaries increased from 1999 levels (South Coast Estuarine Figure 2). The greatest catches in 2000 were reported from Beaufort Inlet, Stokes Inlet, Gordon Inlet and Wilson Inlet.

*Cobbler:* During 2000, the catch was concentrated in three south coast embayments/estuaries, namely Wilson Inlet, Oyster Harbour and Princess Royal Harbour, with the highest catches (76%) reported from Wilson Inlet. In a number of estuaries, special regulations specific to the target fishing of cobbler have been introduced to protect spawning aggregations and areas. The 2000 catches from Wilson Inlet decreased by 9 tonnes from the 1999 catch (South Coast Estuarine Figure 3).

*King George whiting:* During 2000, the majority of catches were reported from Wilson and Irwin Inlets. The King George whiting catch from Wilson Inlet for 2000 continued to decline from the high 1998 level but was still above the catch during the early 1990s (South Coast Estuarine Figure 4). The very high 1998 catches resulted from high juvenile recruitment into Wilson Inlet several years earlier. This same trend is reflected for the overall King George whiting catch from the south coast estuaries.

**Fishing effort**

Fishing effort has been reported as the average number of boats fishing per month. This measure of effort gives only a very general indication of effort changes. The number of days fished is also recorded, but it is difficult to determine targeted effort from this measure.

Since 1992, the fishing effort in the SCEF has declined (South Coast Estuarine Figure 1). In particular, Wilson Inlet and Oyster Harbour are reporting effort declines for 2000 compared to the previous year.

**Catch rate**

CPUE has closely followed the trend in catches overall in south coast estuaries. The catch rate reported for the south coast estuaries in 2000 was similar to 1999 levels.

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

**Stock assessment completed:** **Yes**

*Black bream:* Black bream populations are genetically unique within each south coast estuary. A preliminary yield-per-recruit stock assessment was developed for the black bream (*Acanthopagrus butcheri*) stock in the Wellstead Estuary using biological data for the Wellstead Estuary population from research by Sarre (1999), the results of which were presented in the *State of the Fisheries Report 1999–2000*. However, assessments for other south coast estuarine stocks are unavailable at this time.

*Cobbler:* The multi-species targeting aspects of the effort data from Wilson Inlet make a formal assessment of the State’s major cobbler fishery in this estuary difficult. However, the current level of catch, which is at the upper end of the historical range, and average catch per vessel operating, indicate that this valuable stock is being harvested sustainably.

*King George whiting:* Approximately 70% of the south coast catch of King George whiting is fished from Wilson Inlet, which provides critical nursery habitat for this species to the age of 3+ years. High catches during the late 1990s were most likely related to a substantial increase in recruits entering the estuary, and not to changes in the overall fishing effort level in this estuary which, although at the maximum end of the historical range, has been relatively steady during the 1990s. This indicates that the stock is being fished sustainably.

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

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

*Black bream:* A preliminary eggs-per-recruit model was developed for the black bream stock in the Wellstead Estuary using biological data for the Wellstead Estuary population from research by Sarre (1999), the results of which were presented in the *State of the Fisheries Report 1999–2000*. Since the size at maturity is lower than the legal minimum length, it is believed that breeding stock levels are adequate. As with the west coast stocks of black bream, this estuarine species exhibits different growth rates in different south coast estuaries. In all cases the size at maturity is lower than the legal minimum length, affording protection to the breeding stock.

*Cobbler:* The breeding stock for cobbler in the Wilson Inlet stock is contained within the estuary. The legal minimum length for the capture of cobbler is 430 mm total length. Research by Laurenson et al. (1993b) on cobbler in Wilson Inlet demonstrated a length at maturity of approximately 425 mm, which corresponds to an age of 3+ to 4+ years. In this estuary, the breeding size and the legal minimum length are very similar. This important species is afforded some additional protection by a closed fishing area in Wilson Inlet. Cobblers exhibit different growth rates in different south coast estuaries, however the size at maturity is generally less than the legal minimum length of 430 mm, thus affording some protection to the breeding stock.

*King George whiting:* Between 1997 and 1999, the Wilson Inlet catch of King George whiting surpassed the catch in other Western Australian estuaries. These high commercial catches of King George whiting from the inlet indicate a successful ocean spawning and subsequent settling of juveniles into estuarine nursery habitats. There is little fishing pressure for this species outside of Wilson Inlet, suggesting that the breeding stock is adequate for this species.

**NON-RETAINED SPECIES**

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

The selective fishing methods employing specific mesh sizes have historically not taken significant quantities of bycatch species. However, over recent years, fishing operations targeting finfish have been compromised by the presence of increasing quantities of blue swimmer crabs.

**Protected species interaction:** **Negligible**

No protected species interact with these fisheries.

**ECOSYSTEM EFFECTS**

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

Recruitment-driven variations in abundance, independent of fishing in these estuarine systems, suggest that significant food chain effects due to fishing are highly unlikely.

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

The operation of the nets used is unlikely to have any significant impact on the benthic habitats in these estuaries.

**SOCIAL EFFECTS**

The South Coast Estuarine Fishery involved an average of around 38 fishers during the 2000 fishing season.



# Commercial Fisheries

## ECONOMIC EFFECTS

**Estimated annual value (to fishers) for year (2000):**  
**\$1.06 million**

## FISHERY GOVERNANCE

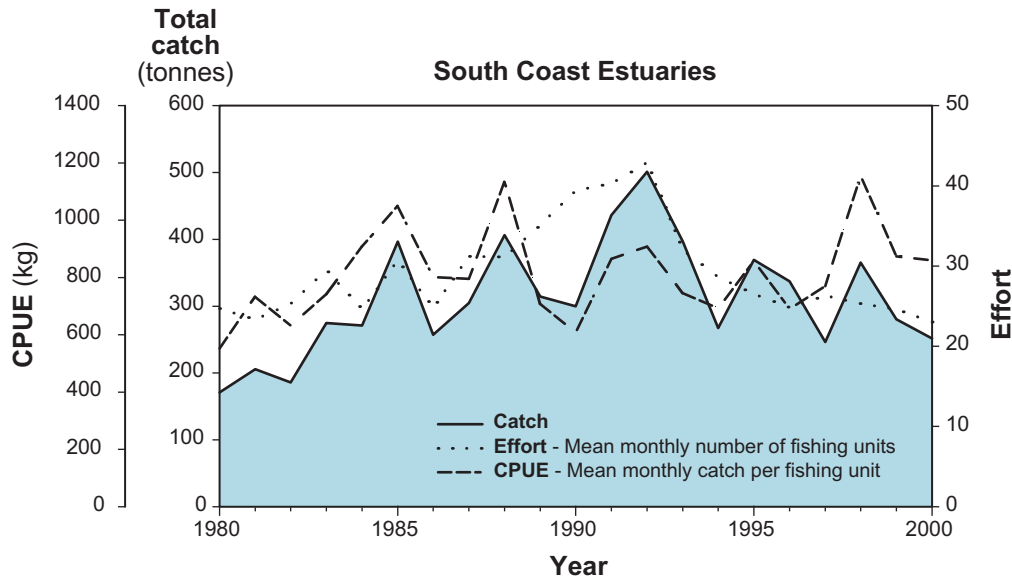
**Acceptable catch range:** **200–500 tonnes**

The acceptable catch range under current management arrangements is 200–500 tonnes (rounded to the nearest 50 tonnes). The acceptable catch range is derived by double exponential smoothed forecasting of the past annual catches through to 1998 and the variation of observations around the predictions. The confidence intervals are set at 80%. Future annual catch values which fall outside of this range will be investigated.

Where consecutive values occur outside of the range, changed management arrangements may need to be considered.

## EXTERNAL FACTORS

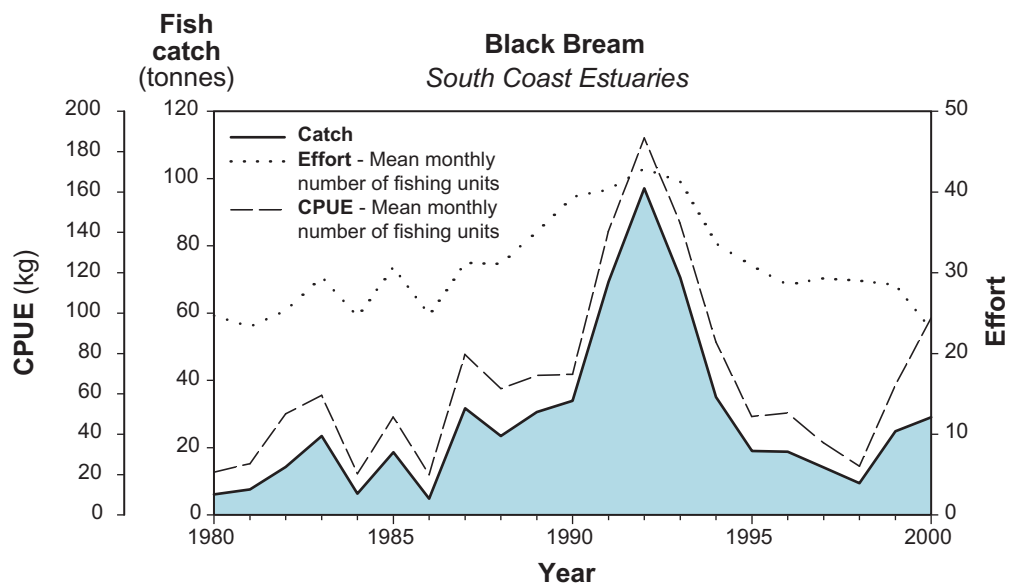
Variation in fish abundance in these south coast estuarine stocks is largely driven by environmental influences on recruitment. In the South Coast Estuarine Fishery this is further complicated by the natural closure of some estuaries and the need for human intervention to breach estuarine bars, mostly for a range of reasons related to estuarine amenity coupled with ecosystem ‘health’. These factors, which are outside the control of Fisheries WA, often have a dominant influence on the catch and effort from year to year.



## SOUTH COAST ESTUARINE FIGURE 1

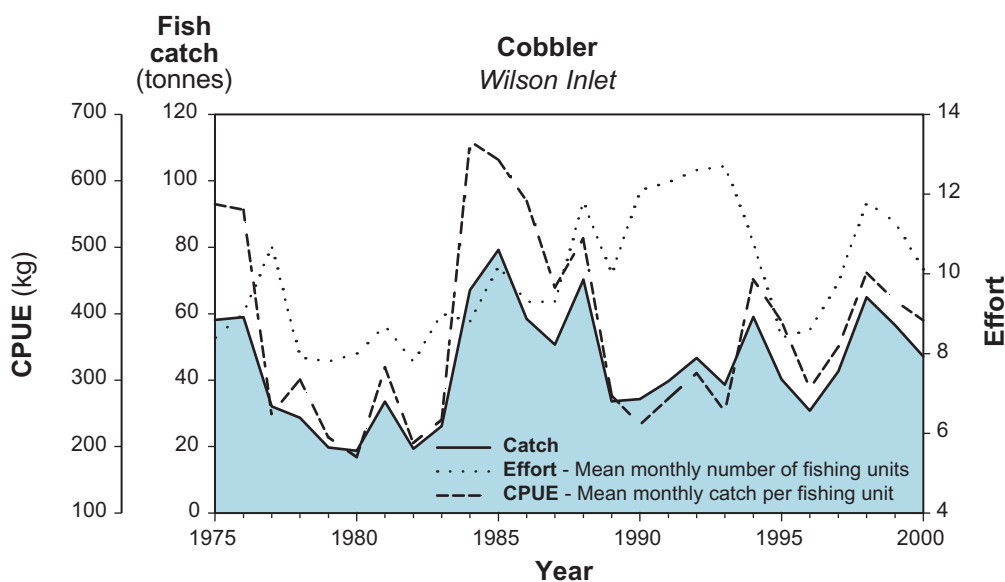
The annual catch, effort and catch per unit effort (CPUE) for the South Coast Estuarine Fishery over the period 1980–2000.

Note that prior to 1993, the south coast estuarine catch figures included King George Sound, which was not strictly part of the SCEF. From 1993, when a separate fishing block was created for Princess Royal Harbour, the catch figures include Princess Royal Harbour but not King George Sound.



**SOUTH COAST ESTUARINE FIGURE 2**

The annual catch, effort and catch per unit effort (CPUE) for the black bream (*Acanthopagrus butcheri*) fishery in south coast estuaries over the period 1980–2000.

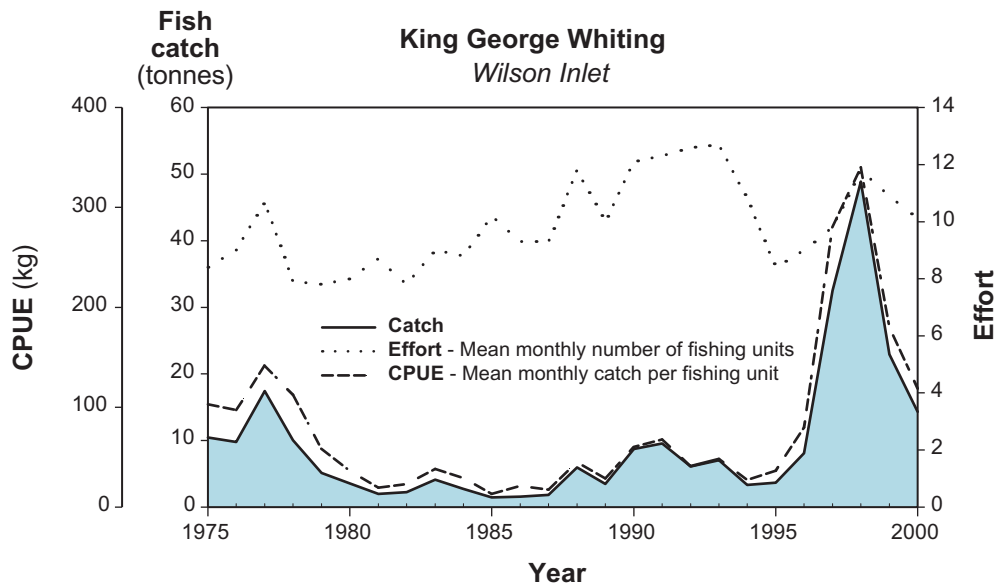


**SOUTH COAST ESTUARINE FIGURE 3**

The annual catch, effort and catch per unit effort (CPUE) for the cobbler (*Cnidogobius macrocephalus*) fishery of Wilson Inlet over the period 1974–2000.



# Commercial Fisheries



## SOUTH COAST ESTUARINE FIGURE 4

The annual catch, effort and catch per unit effort (CPUE) for the King George whiting (*Sillaginodes punctata*) fishery of Wilson Inlet over the period 1974–2000.

## Western Australian Salmon Fisheries

### MANAGEMENT SUMMARY

Western Australian salmon (*Arripis truttaceus*) are taken primarily during their annual east-to-west migration, usually between March and May each year, by fishing teams using a beach seine net from small boats. Salmon may also be taken outside this period, particularly on the south coast.

There are two managed salmon fisheries:

- The South Coast Salmon Managed Fishery permits authorisation holders to operate from specifically assigned beaches between Shoal Cape and Cape Beaufort.
- The South West Coast Salmon Managed Fishery operates north of Cape Beaufort, comprising specific beaches that are shared by the authorisation holders through priority of netting rules.

Market price and transport costs play a major role in reducing the profitability of this fishery, and many industry members are investigating ways of improving fish handling and value-adding techniques to improve the profit margin. This subject will be listed for discussion at this year's annual meeting of the Australian Salmon and Herring Industry Advisory Committee.

### Governing Legislation/Fishing Authority

#### South Coast

South Coast Salmon Fishery Management Plan 1982  
South Coast Salmon Managed Fishery Licence  
Proclaimed Fishing Zone Notice (South Coast) 1975

#### South West Coast

South West Coast Salmon Fishery Management Plan 1982  
South West Coast Salmon Managed Fishery Licence  
Proclaimed Fishing Zone Notice (South West Coast) 1975

### Consultation Process

Australian Salmon and Herring Industry Advisory Committee  
Agency–industry meetings

### RESEARCH SUMMARY

The main information used to monitor this important commercial and recreational stock is from industry CAES data and historical biological research.

Presently, a juvenile index of recruitment for Australian salmon in Western Australian waters is being developed as part of an FRDC-funded project. This index and the potential link to subsequent recruitment will be completed by late 2002. Time-series analysis of the historic Australian salmon catches to predict future catches is also being investigated through a separate FDRC-funded project also due to be completed by the end of 2002.

These two projects will be using different methods to try to predict future commercial Australian salmon catches.

## Western Australian Salmon Fisheries Status Report

Prepared by S. Ayvazian and G. Nowara

### FISHERY DESCRIPTION

#### Boundaries and access

As at April 2000, each of 18 licensed south coast teams has access to a nominated beach in this sector, the boundaries of which are 'Western Australian waters below high water mark from Cape Beaufort to the waters up to the eastern boundary of the State on the south coast of Western Australia'. A further 12 licensees collectively have access to beaches in the west coast sector, the boundaries of which are 'Western Australian waters from the eastern boundary of the State on the north coast of Western Australia to Cape Beaufort on the south-west coast of Western Australia'. Three licensees have access to the west coast sector north of Busselton Jetty. These licensed fishers are the only ones with authority to catch and sell Australian salmon.

#### Main fishing method

Beach seine.

### RETAINED SPECIES

**Commercial production (season 2000): 2,283 tonnes**

#### Landings

The total State catch for the year was 2,283 tonnes, which was about 500 tonnes more than the previous year (Salmon Figure 1). The 2000 south coast commercial catch of Australian salmon was 2,282.6 tonnes. This catch was taken from the designated salmon beaches, with a minor catch component from the estuaries. Between March and May 2000, the south coast catch of salmon was 2,136 tonnes. There were 133 tonnes caught in the 'back run' between June and December. The January and February catch was 13 tonnes, which would have been part of the back run from 1999.

The highest proportion of the 2000 south coast catch (1,459 tonnes or 63.9%) was taken from the central sector of the fishery (east of Albany to Cape Riche). A total of 570 tonnes (25%) was taken in the western region of the fishery (west of Albany to Windy Harbour). Fewer fish (254 tonnes or 11.1%) were taken from the eastern sector of the fishery (from Cape Riche to the east).

The south-west and west coast catch for 2000 totalled less than 1 tonne, apparently due to limited migration to the west coast which is usually related to a strong Leeuwin Current.

#### Fishing effort

There are 18 south coast and 15 south-west and west coast fishing teams (three with access only north of Busselton Jetty).

### Catch rate

During 2000, the average catch per fishing team was 126.8 tonnes for the south coast, and effectively zero for the west coast where less than 1 tonne was taken overall.

**Recreational component: 6% (approx.)**

The most recent surveys, conducted in 1994 and 1995 (Ayvazian et al. 1997), indicated that the recreational catch share was about 6% of the total south coast catch and 8–16% of the west coast catch. Given the very low commercial west coast catch in 2000, there would have been little recreational catch for the year.

**Stock assessment completed: Yes**

The results from preliminary yield-per-recruit and egg-per-recruit analyses were presented in the *State of the Fisheries Report 1999–2000*. Before an accurate determination of the status of the stock can be completed more complex analyses are needed to account for the environmental impacts on recruitment. However, there are insufficient resources available to progress this aspect of the research.

**Exploitation status: Fully exploited**

**Breeding stock levels: Adequate**

Current commercial catches indicate the breeding stock is still at an acceptable level. However, egg-per-recruit analysis indicates that the current exploitation level on the western Australian salmon population is high, owing to the nature of the fishery. Any further increase in the catch from either commercial or recreational fishers, or significant reduction in recruitment due to unusual environmental effects, could take the stock below a limit biological reference point of 30% of virgin egg biomass.

### NON-RETAINED SPECIES

**Bycatch species impact: Negligible**

The fishery uses beach seine nets to specifically target schooling salmon, primarily during the annual summer–autumn spawning migration. As a result of the fishing method and the design of the gear used, the fishery involves minimal bycatch.

**Protected species interaction: Negligible**

This fishery has no interaction with protected species.

### ECOSYSTEM EFFECTS

**Food chain effects: Low**

As salmon are a top-end predator in the marine food chain of the lower west and south coasts, the fishery has the potential to reduce the mortality on salmon prey species. However, given the naturally occurring variability in Australian salmon biomass, the fishery effect is likely to be similar in magnitude to other factors contributing to the natural variation on prey species. Overall, the ecological impact of the fishery is assessed as low.

**Habitat effects: Negligible**

No habitat impacts occur as the fishery operates seine nets only on sandy surf beaches.



# Commercial Fisheries

## SOCIAL EFFECTS

The south coast fishery involved an average of about 67 fishers and the south-west and west coast fishery involved an average of about 13 fishers during the 2000 fishing season.

## ECONOMIC EFFECTS

**Estimated annual value (to fishers) for year (2000):**  
**\$1.14 million**

The south coast catch in 2000 was received by five processors: Albany Bait Producers, Princess Royal Seafoods, Allerton's Bait Supply, Bremer Bay Fish Processors and Bevan's Fish Supplies.

## FISHERY GOVERNANCE

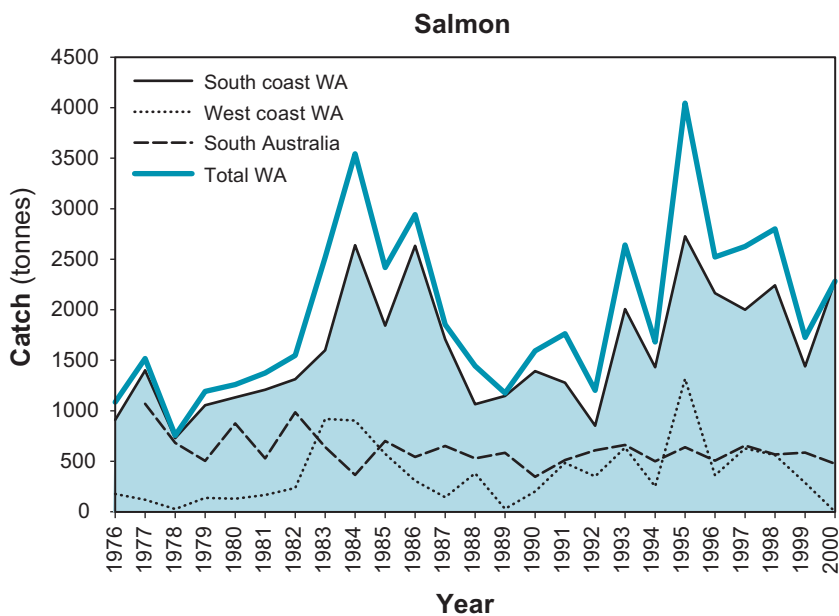
**Acceptable catch range:** **1,300–3,600 tonnes**

The expected catch range under the current management regime is 1,300–3,600 tonnes (rounded to the nearest 50

tonnes) of salmon. This projection is derived by double exponential smoothed forecasting of the past 35 years of annual catches to 1998 and the variation of observations around the predictions. The confidence intervals have been set at 85%. Future annual catch values that fall outside of this range will be investigated. Where consecutive values occur outside of the range, changes to the management arrangements to protect the stock may need to be considered.

## EXTERNAL FACTORS

The minimal catch of Australian salmon from the west coast during 2000 is thought to be associated with the behaviour and strength of the southward-flowing Leeuwin Current, which was relatively high during the autumn period of 2000. It is believed that the salmon avoid the warmer waters and remain offshore where they are not vulnerable to commercial and recreational fishing gear.



**SALMON FIGURE 1**

Australian salmon catches for South Australia and Western Australia for the period 1976 to 2000. Catches prior to 1977 for South Australia are unavailable.

## Australian Herring Fishery

### MANAGEMENT SUMMARY

The majority of the commercial catch of Australian herring (*Arripis georgianus*) is taken using herring trap nets (also known as 'G' trap nets) from south coast beaches.

Herring trap nets may only be used by specific endorsement holders on individually assigned south coast beaches. There is a closed season (10 February to 25 March each year) which coincides with the peak salmon season along the south coast. Herring caught in Cockburn Sound are managed under the Cockburn Sound (Fish Net) Managed Fishery. Apart from these restrictions, herring may be commercially caught by beach seine and set net by any licensed commercial fisher holding an unrestricted fishing boat licence, provided the use of this method is permitted in the particular area and the waters being fished are not subject to other fishery management arrangements.

Herring is also a very important recreational fishing resource. In recognition of this, the South Coast Herring Fishery Voluntary Fisheries Adjustment Scheme was introduced for the period February 1998 to 30 June 2000. In this process, fishermen were able to offer the surrender of their herring trap endorsement to the scheme and be compensated by a negotiated amount. This scheme removed a total of 10 endorsements.

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

Fisheries Notice no. 478 (Section 43 order)  
Condition 42 on Fishing Boat Licence

#### **Consultation Process**

Australian Salmon and Herring Advisory Committee  
Agency–industry meetings

### RESEARCH SUMMARY

The annual assessment of the status of the herring stock has been undertaken utilising CAES data supplied by industry and detailed biological information from a national research project conducted between 1996 and 1999.

Two FRDC-funded research projects are currently under way which will assist in the prediction of future catches. One is focused on the development of a juvenile index of recruitment for Australian herring, while the other is using time-series analysis of historic commercial catches. Both projects are due for completion by the end of 2002.

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

## Australian Herring Stock Status Report

*Prepared by S. Ayyazian and G. Nowara*

### FISHERY DESCRIPTION

#### **Boundaries and access**

There are 13 licensed fishing teams (most of whom are also Australian salmon fishers) permitted to take herring

using 'G' trap nets set on 12 nominated south coast beaches. On the west coast, the Cockburn Sound (Fish Net) Managed Fishery specifically fishes for herring. In addition, small quantities of herring are also taken by wetline vessels, and by some estuarine licensed fishers on both the south and west coasts. For completeness, these small catches have been included in this status report.

#### **Main fishing method**

Trap ('G') net and beach seine.

### RETAINED SPECIES

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

**State 818 tonnes**  
**South coast 705 tonnes**

#### **Landings**

The total catch of Australian herring for the State in 2000 was 818 tonnes, an increase of approximately 53 tonnes from the 1999 catch (Herring Figure 1). The south coast catch was 705 tonnes, which comprised 86% of the total State catch. The south coast landings included 676 tonnes from the ocean (668 tonnes from trap nets and 8 tonnes from other gear) and 28.5 tonnes from estuaries and embayments. The south coast catch to the end of May 2000 (traditionally the end of the trap net fishing season) was 686 tonnes, or 97% of the annual south coast catch. The west coast catch was 113 tonnes and included 35.2 tonnes from the ocean, 8.5 tonnes from estuaries and 69.6 tonnes from embayments (Geographe Bay and Cockburn Sound).

#### **Fishing effort**

There are 13 south coast fishing teams with access to the trap net fishery. These fishers exert targeted effort on Australian herring. However, most licensed commercial fishers are permitted to take Australian herring in any Western Australian waters under their basic fishing boat licence wetline entitlement.

#### **Catch rate**

The average catch per south coast trap net fishing team during 2000 was 54.2 tonnes, which is an increase from 1999 levels.

#### **Recreational component: Approx. 10% (south coast)**

Recreational catch and effort figures are not available for 2000. However, data collected in 1994 and 1995 (Ayyazian et al. 1997) indicated that the recreational catch shares at that time for the south and west coasts were around 10% and 60% respectively.

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

**Yes**

Two age-structured stock assessment models have been developed, one for the west coast of Western Australia and one for the southern coast of Australia, using historic information and data gathered during the three-year Australian herring research project. The results of the age-structured models suggest that the stock on the west coast of Western Australia is smaller than the stock on the southern coast of Australia. The Australian herring populations in all regions appear to be at satisfactory levels, and above a prudent biological limit reference



# Commercial Fisheries

point of 40% of the total virgin biomass (Quinn and Deriso 1999, p. 474). Further analyses are continuing to improve model estimates and to reduce uncertainty around some of the results of the model.

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

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

As is the case with Australian salmon, virtually the entire commercial herring catch consists of mature individuals with peak seasonal catches being taken during the annual autumn spawning migration. Increasingly, evidence suggests that the influence of factors other than fishing may be largely responsible for fluctuations in the catch and, therefore, breeding stock levels (see 'External Factors').

## NON-RETAINED SPECIES

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

The main south coast fishery operates primarily through fixed trap nets on 12 beaches which are manned daily during the short autumn fishing season. The operation of the fishing gear generally allows any bycatch species to be removed and returned to the water. Overall, the ecological effect of this fishery is assessed as low.

**Protected species interaction:** **Negligible**

This fishery has no interaction with protected species.

## ECOSYSTEM EFFECTS

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

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

The fishing methods used in this fishery do not impact on the habitat.

## SOCIAL EFFECTS

The south coast trap net fishery involved an average of 41.5 fishers during 2000. Additional employment is created in the processing and distribution networks and retail fish sales sectors.

## ECONOMIC EFFECTS

**Estimated annual value (to fishers) for year (2000):**  
**\$0.27 million**

This estimate is for the south coast trap net fishery only

## FISHERY GOVERNANCE

**Acceptable catch range:**  
**South coast 450–1,200 tonnes**

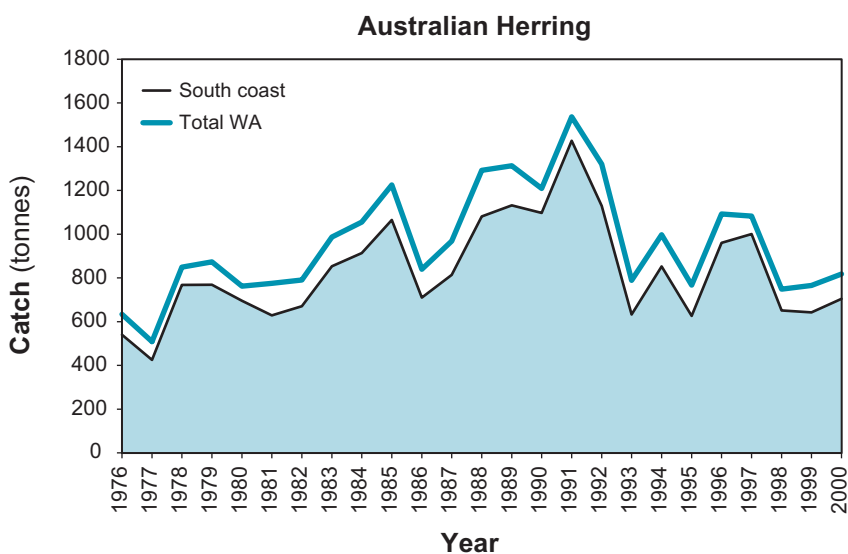
The acceptable catch range for the south coast Australian herring trap net fishery under the current management regime is 450–1,200 tonnes (rounded to the nearest 50 tonnes). This projection is derived by double exponential smoothed forecasting of the past annual catches to 1998 and the variation of observations around the predictions. The confidence intervals are set at 80%. Future annual catch values which fall outside of this range will be investigated. Where consecutive values occur outside of the range, management changes to protect the stock will need to be considered.

Using the above methods, the commercial west coast herring catch is expected to be between 60 and 125 tonnes.

## EXTERNAL FACTORS

As is the case with salmon, a proportion of the Australian herring resource is recruited from South Australian nursery areas. However, it is thought that on a year-to-year basis, 'local' recruitment is far more important to the Western Australian fishery than recruitment from South Australia. This is likely to be particularly true for the west coast sector of the resource, where it is believed that protected marine habitats, such as Geographe Bay, are substantial nursery areas and can be a source of significant recruitment. Indeed, historical catch records between 1976 and 1998 indicate that the size of the west coast catch is unrelated to the size of the south coast catch, which is consistent with the above view (correlation coefficient = 0.38; non-significant value).

At present an FRDC-funded research project is focused on the development of a juvenile index of recruitment for Australian herring that may be used to predict to future catches. This research will be completed by 2002. A second FRDC-funded research project is using time-series analysis of historic commercial catches of Australian herring to predict future catches and is also due for completion by the end of 2002.



### HERRING FIGURE 1

Catches of Australian herring from the south coast and the total Western Australian catch for the period 1976 to 2000.

## South Coast Purse Seine Managed Fishery

### MANAGEMENT SUMMARY

This fishery is based on the capture of pilchards (*Sardinops sagax*) and other small pelagic fish by purse seine nets in the waters off the south coast of Western Australia between Cape Leeuwin and the WA/SA border under the provisions of the South Coast Purse Seine Management Plan 1994. Pilchards have a variety of uses, being sold for human consumption, angling bait, commercial bait, tuna food and pet food. The recreational angling bait market is currently the main focus.

The spread of a Herpesvirus throughout the pilchard population in 1995 and again in 1998/99 has had a serious impact on the stock. Understanding of the pathogen has increased significantly since the first outbreak, but there are still important knowledge gaps, such as the source of the virus, and the possibility of a further outbreak represents a real threat to the industry.

Commercial fishing is controlled by the setting of total allowable catches (TACs) that represent the combination of transferable quota units within each of the five zones. With the exception of Zone 4 (Esperance region), TACs were reduced to zero for the 2000/2001 season to allow continued rebuilding of the stock. The TAC for Esperance was initially set at 1,060 tonnes, but was increased to 1,300 tonnes (for a 15-month period) following a change to the end date of the season, which

was extended by three months to 30 June 2001. The season for the South Coast Purse Seine Managed Fishery will now run from 1 July to 30 June each year.

The TAC-setting process is coordinated through the Purse Seine Management Advisory Committee, an expertise-based committee established to advise the Minister on matters relating to the management of purse seine fishing in Western Australia.

#### Governing Legislation/Fishing Authority

South Coast Purse Seine Management Plan 1994  
South Coast Purse Seine Managed Fishery Licence

#### Consultative Process

Purse Seine Management Advisory Committee  
Agency–industry meetings

### RESEARCH SUMMARY

Data for setting catch quotas is derived from fishery-independent spawning biomass surveys, quota returns and biological monitoring of the catch composition.

Research during 2001 will focus on fishery-independent spawning biomass surveys, which will continue for the next five years as part of an FRDC-funded project to examine regrowth of the pilchard stocks in Western Australia. Detailed monitoring of catches will continue. Biomass surveys and analysis of catches together allow the annual review of stocks in each major zone and compilation of the following status report.

# Commercial Fisheries

## South Coast Purse Seine Managed Fishery Status Report

Prepared by D. Gaughan

### FISHERY DESCRIPTION

#### Boundaries and access

The South Coast Purse Seine Managed Fishery consists of three primary management zones, with separate quota units for each zone. The Albany zone extends from Point D'Entrecasteaux to Cape Knob. The King George Sound zone is a subset of this area and the two zones are reported together. The boundaries of the Bremer Bay zone are Cape Knob and Point Charles. The boundaries of the Esperance zone are Point Charles and the WA/SA border. A further zone between Cape Leeuwin and Cape D'Entrecasteaux exists, but, to date, has not been significantly fished.

The access to the fishery is under a limited entry system with each vessel having individually transferable quota.

#### Main fishing method

Purse seine net.

### RETAINED SPECIES

**Commercial production (season 2000): 988 tonnes**

#### Landings

Pilchard (*Sardinops sagax*) is typically the dominant species in this fishery, and the only species subject to TACs; smaller quantities of maray (*Etrumeus teres*) and anchovy (*Engraulis australis*) are also retained. Yellowtail scad (*Trachurus novaezelandiae*) are sometimes retained, but market demand is limited and catches are normally only retained when pilchards are scarce.

Using data from the quota returns, the catch of pilchards (*Sardinops sagax*) on the south coast in 2000 was 988 tonnes, with all but 5 tonnes of this from the Esperance zone (South Coast Purse Seine Figure 1). Five tonnes were caught at Bremer Bay as part of the 1999/2000 quota, and no commercial landings were made at Albany. Note that annual TACs for these latter two regions were set at 0 tonnes for the 2000/2001 season.

(In future, following the change in the season dates, catches will be reported by financial year rather than calendar year, to match the quota period.)

#### Fishing effort

**Albany zone:** Following the 1998/99 pilchard mortality event, the fishery was set a TAC of 0 tonnes for the period 1 April 2000–31 March 2001.

**Bremer Bay zone:** As for Albany.

**Esperance zone:** The recorded number of CAES days in 2000 was about 453, 28% greater than in 1999.

#### Catch rate

**Albany zone:** Not applicable.

**Bremer Bay zone:** Not applicable.

**Esperance zone:** The 2000 catch rate of 2,171 kg/day, an increase on the 1999 catch rate of 1,224 kg/day, represents a return to the catch rates recorded in 1996 and 1997 (~1,940 kg/day). Estimates of fuel use, which would provide a more meaningful estimate of effort incorporating searching time, were not available.

**Recreational component:**

**Nil**

**Stock assessment completed:**

**Yes**

The south coast population of pilchards is considered to consist of a single breeding stock, but with functionally distinct adult assemblages at Albany, Bremer Bay and Esperance. Estimates of quantities of pilchards killed in the 1998/99 mass mortality indicate that 70% of the stock died. The assessment model predicts that in 2001 there will be a small increase in pilchard biomass at Albany, a small decrease at Bremer Bay and a substantial increase at Esperance. The marginal changes at Albany and Bremer Bay indicate that the recovery of the stocks in these regions has initially been slow. Egg surveys during 1999 indicated that the Albany stock is still less than 10% of the size of the virgin stock, while the Bremer Bay stock is still around the 20% level. In contrast, the model data indicate that the biomass in Esperance is growing quickly, with an increase from 41.3% to 56.4% of virgin biomass. During 2000, some recruitment was recorded within each zone, with pilchards less than 4 years old dominating the catch. At Esperance, where sample sizes were comparable to those in past years, recruitment was very strong. Smaller sample sizes at both Bremer Bay and Albany preclude comments on the magnitude of recruitment. However, the data clearly show that recruitment to these regions has occurred. Thus, although it is clear that recruitment has occurred to both Bremer Bay and Albany, whether this has been at levels sufficient to produce a significant change in stock size cannot be determined at this time. The slow rate of recovery suggested by the model for Albany and Bremer Bay can be partly explained by the age structure of pilchards in each region. The loss of older age classes translates as a decrease in average weight of fish and a concomitant decrease in egg production; these factors explain the initially poor levels of recovery predicted for Albany and Bremer Bay. Given that the age structure at Esperance is similar to that in the other two south coast regions, in that it is dominated by fish less than 4 years old, the model prediction of a rapid recovery at Esperance may be somewhat unrealistic. The age structure of the catch indicates that a substantial proportion of the stock consists of fish spawned after the 1998/99 mass mortality. Thus, a large number of pilchards that have contributed to the recovery of the stock at Esperance were too young to reproduce; the stock thus missed out on the 'compounding effect' of allowing at least some egg production prior to capture.

**Albany zone:** The assessment model indicated that the biomass at Albany has been declining since 1994 and, as of December 1998, was at its lowest recorded level. Following the mass mortality, the stock was considered to be critically low and in a severely depressed state. There has been no unequivocal evidence to indicate that substantial recruitment has occurred in the Albany region,

which is a prerequisite for recovery of the stock. Thus, the model indicates that the stock is still at a very low level.

**Bremer Bay zone:** As with the Albany stock, the integrated model indicated that the Bremer Bay stock had been declining since the mid-1990s. Following the 1998/99 mass mortality, the Bremer Bay stock appeared to be severely depressed. Research samples collected in 2000 have shown high proportions of recruit-aged (1- to 2-year-old) pilchards in the Bremer Bay region. However, the numbers of samples collected were insufficient to allow determination of the magnitude of this apparent influx of recruits.

**Esperance zone:** As in 1999, Esperance again had a high level of recruitment in 2000. The relatively stable nature of the biomass at Esperance can be attributed both to fewer years of poor recruitment than in the other south coast regions, and to a history of much lower exploitation rates. The reasonable catch rates at Esperance were reflected in the strong production of nearly 1,000 tonnes. Current exploitation rates are less than 10% of the spawning biomass and appear to be sustainable. However, because there continue to be uncertainties over the level of interchange of pre-recruit-aged pilchards between the south coast zones, the level of exploitation at Esperance will likewise continue to be kept at a precautionary level. No significant change to the TAC is expected for 2001.

**Exploitation status:**  
**Overall south coast stock fully exploited**

**Breeding stock levels:** **Depleted**  
 Breeding stock for the entire south coast pilchard population decreased by approximately 70% due to the disease event in the first two months of 1999. Estimates of vulnerable biomass (which closely reflects spawning biomass) at the end of 2000 were derived from the integrated model and are as follows: Albany 1,051 tonnes (630–1,607 tonnes), Bremer Bay 3,301 tonnes (2,784–5,202 tonnes), Esperance 22,563 tonnes (12,315–43,214 tonnes). The total estimated spawning biomass across the south coast was 26,915 tonnes, which represents 35% of the virgin biomass, a small increase from the previous year's level of 28%. Although the breeding stock levels at Albany and Bremer Bay remain depleted, for the south coast as a whole the breeding stock appears to be recovering.

**NON-RETAINED SPECIES**

**Bycatch species impact:** **Low**  
 This fishery targets specific schools of small pelagic fish, so bycatch is insignificant. Small pelagic fish which are sometimes caught in small quantities and released from the net or later discarded include yellowtail scad (*Trachurus novaehollandiae*) and blue mackerel (*Scomber australasicus*).

**Protected species interaction:** **Low**  
 Several species of seabirds, pinnipeds, cetaceans and protected sharks are attracted to schools of pilchards and other small pelagic fish, but there is currently no evidence

to indicate any interaction between these and the purse seine industry.

**ECOSYSTEM EFFECTS**

**Food chain effects:** **Medium**

Small pelagic fish, typically pilchards or anchovies, occupy a pivotal position of energy transfer in food webs in which they occur and are often the main link between primary (phytoplankton) and secondary (zooplankton) production and larger predators. This trophic position has been termed the 'wasp's waist', since pilchards feed on many species and are eaten by many species. As a result of the mortality event outside of the control of the fishery, the reduced biomass of pilchards is likely to have a significant impact on predatory species such as seabirds, mammals and tuna. It should be noted, however, that in 'normal' circumstances the quota for pilchards is set at 10–15% of the spawning biomass, thus leaving 85–90% available to natural predators.

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

Purse seining appears to have very little effect on the habitat. Although the purse seine gear used in Western Australia can contact the sea floor in some areas, the relatively light construction of the gear suggests that there is no significant impact occurring to, for example, seagrass beds.

**SOCIAL EFFECTS**

The south coast purse seine industry has undergone a major decline over recent years, with many licence holders and their crew moving elsewhere. Likewise, processing factories have experienced significant declines in staff, and those which focused on pilchards have shut down for extended periods. These effects were felt mainly in the Albany and Bremer Bay regions. In Esperance, where an economically significant TAC has remained, there were five vessels working in 2000, employing approximately 15 staff (skipper and crew). The catch from these was directed through two factories, which in turn employed approximately 10–20 casual staff as well as 6 full-time staff, including the owners.

**ECONOMIC EFFECTS**

**Estimated annual value (to fishers) for year (2000):**  
**\$0.84 million**

The higher value angling blocks/trays and individually quick frozen (IQF) fish represented more than 95% of the total catch processed. The different product types for each zone are shown in South Coast Purse Seine Table 1. Total catch value for 2000 was \$0.84 million (988.5 tonnes at an average price of \$850/tonne), marginally higher than last year's \$0.7 million.

**FISHERY GOVERNANCE**

**Acceptable catch (or effort) range:** **Effort not available**

The south coast purse seine fishery is still in a state of flux owing to implementation of measures to protect the stock following the 1998/99 virus epidemic. The resulting changes in the way the fleets operate in each region have been significant, particularly at Albany and Bremer Bay where fishers have been requested to modify



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their ‘normal’ fishing patterns so as to ensure continuity in supply of samples for research purposes. In effect, the quotas set for Albany and Bremer Bay in 2001/02 are ‘research’ quotas to ensure the stock rebuilding process can be monitored. For these reasons, a projection of the effort level required to land the TAC at each region is not available.

The quotas for the 2001/02 season are as follows:

South coast total	1,175–1,350 tonnes
Albany zone	50–100 tonnes
Bremer Bay zone	100–200 tonnes
Esperance zone	1,000–1,200 tonnes

## EXTERNAL FACTORS

Following the loss of stock due to the mass mortality event, serious concerns about the sustainability of pilchard stocks in Western Australia have continued. In particular, these concerns led to TACs of zero tonnes for Albany and

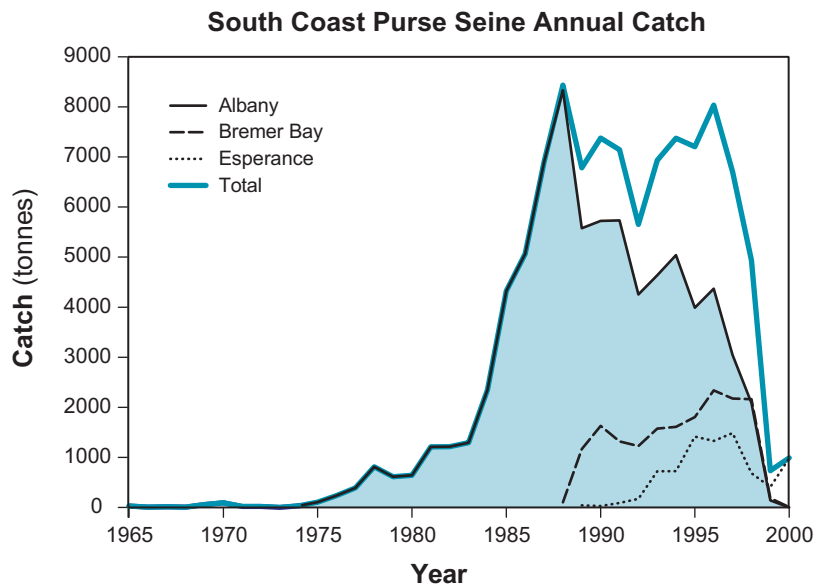
Bremer Bay during the 2000/2001 quota season (1 April 2000 – 31 March 2001). Because there are still significant gaps in our knowledge of the pilchard Herpesvirus, it is not known if or when there may be another outbreak of the disease. Although the stock is likely to recover, the rebuilding process is expected to be relatively slow and the future viability of the fleet is in question. The short- and medium-term viability of the purse seine fisheries off southern Western Australia currently remains a problem. The gap left in the angling bait market by the decreased volume of Western Australian pilchards has been filled by *Sardinops sagax* imported from overseas, which presents a degree of disease risk to the local pilchard stocks.

Environmental factors such as Leeuwin Current flow possibly associated with global warming are likely to be affecting both the distribution and the biology of the species, and will be assessed further as more years of data become available.

## SOUTH COAST PURSE SEINE TABLE 1

Processing details (in tonnes) from Albany, Bremer Bay and Esperance for 2000.

Product	Albany	Bremer Bay	Esperance	Total south coast
Trays	0	5.0	830.5	835.5 (84.5%)
IQF	0	0	122.6	122.6 (12.4%)
Pet/tuna food	0	0	30.5	30.5 (3.1%)
Total	0	5.0	983.6	988.6



## SOUTH COAST PURSE SEINE FIGURE 1

Annual catches of pilchards along the south coast, by fishing zone.

## Demersal Gillnet and Demersal Longline Fisheries

### MANAGEMENT SUMMARY

The take of demersal finfish, including shark, by demersal gillnet and longline is controlled on the south coast and the west coast (as far north as Shark Bay) through two complementary management plans, described below.

The threat of over-exploitation and the potential for activation of latent effort remain important issues in both the southern and western fisheries. Also of concern is the ability of fishers outside of the two managed fisheries to take sharks by wetlining, pot hooks and other methods, as well as the latent effort in these other fisheries. High demand for shark fins has led to reports of increased activity and targeting of sharks by wetliners (i.e. wetline fishery operators).

*Joint Authority Southern Demersal Gillnet and Demersal Longline Fishery (JASDGDLF):* During 1997, the Minister for Fisheries approved the implementation of a five-year management package, beginning in 1997/98, which included phased effort reductions for this fishery. This package was developed by the WA Demersal Gillnet and Demersal Longline Fishery Management Advisory Committee (WADGDLFMAC) in response to an identified need to restore and maintain targeted shark stocks at 40% of their virgin biomass. In the 1999/2000 season, the fishery implemented the third phase of scheduled effort reductions. The results of scientific monitoring indicate that the reductions made to date have not increased the spawning biomass of the whiskery shark stock. A review of the current five-year management package is expected to be completed during 2001/2002, with another package to be implemented after consultation with industry.

In response to concerns regarding the at-sea 'finning' of sharks by both State and Commonwealth commercial fishing sectors, regulations were introduced under the *Fish Resources Management Act 1994* to prohibit the removal of fins from sharks and the discarding of the associated carcass at sea. The new regulations permit the removal of gut and head at sea, but all other parts of the sharks must be retained and brought ashore.

Having developed good stock assessment models, Fisheries WA will continue to monitor the effectiveness of management arrangements in the fishery in close association with the WADGDLFMAC.

*West Coast Demersal Gillnet and Demersal Longline Interim Managed Fishery (WCDGDLIMF):* Extensive research carried out on the commercially important shark species off the Western Australian coast indicates that this fishery shares a unit stock with the JASDGDLF. Because of the commonality of these key stocks, the WCDGDLIMF is reported under the south coast bioregion. The biomass targets for the south coast fishery also apply to the west coast fishery, and the declaration of a management plan was an important part of the management of the key species throughout their distribution.

Fisheries WA plans to progress management of this fishery from interim managed fishery status to managed fishery status upon completion of what has been a lengthy objections process.

### Governing Legislation/Fishing Authority

#### South Coast

Joint Authority Southern Demersal Gillnet and Demersal Longline Management Plan 1992

Joint Authority Southern Demersal Gillnet and Demersal Longline Managed Fishery Licence

#### West Coast

West Coast Demersal Gillnet and Demersal Longline Interim Management Plan 1999

West Coast Demersal Gillnet and Demersal Longline Managed Fishery Licence

### Consultation Process

Western Australian Demersal Gillnet and Demersal Longline Fisheries Management Advisory Committee  
Agency–industry meetings

### RESEARCH SUMMARY

A major FRDC-funded study of the shark fishery on the south and west coasts of Western Australia, undertaken over the period 1993/94 to 1998/99, has provided a detailed basis for managing the fishery. The extensive information from these studies has been incorporated in two FRDC final reports, and the data sets incorporated into the Fisheries WA research data records. A new three-year FRDC-funded project commenced in July 2000 focusing on the sandbar (thickskin) shark component of the fishery.

Research monitoring of the fishery involves analysis of CAES data and biological sampling of commercial catches. These research data are used to provide the following status report on the fishery.

## Demersal Gillnet and Demersal Longline Fisheries Status Report

*Prepared by R. McAuley and R. Lenanton*

### FISHERY DESCRIPTION

#### Boundaries and access

*Joint Authority Southern Demersal Gillnet and Demersal Longline Fishery:* The JASDGDLF was declared a limited entry fishery in 1988, managed under a Joint Authority with the Commonwealth Government. It covers the waters from latitude 33° S to the WA/SA border. For the purposes of management, the fishery is composed of two zones. Zone 1 extends from latitude 33° S around the coast as far as longitude 116°30' E, and Zone 2 from 116°30' E to the WA/SA border (129° E).

The fishery is currently managed using effort controls in the form of time/gear units. One unit allows a fisher to use one 'net' for one month. When management was introduced a net length was set at 600 m, but periodic effort reductions had brought this down to 378 m by 1998/99. During the 1999/2000 season, units were further



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reduced to 270 m of 20-mesh drop net or 324 m of 15-mesh drop net. The financial effects of net-length reductions, aimed at reducing effort directed at whiskery sharks, were partly offset by southern fishery operators being permitted to use 20-mesh drop nets, which increased their catch rates of other shark species. In the 1999/2000 season there were 57 JASDGLDF licences, of which 35 were active.

*West Coast Demersal Gillnet and Demersal Longline Interim Managed Fishery:* An interim management plan for the demersal gillnet and demersal longline fishery between latitude 33° S and a line drawn north of North West Cape (114°06' E) was introduced in 1997/98. However, shark fishing between Steep Point (26°30' S) and North-West Cape has been prohibited since 1993 to protect breeding stocks of whaler sharks. Under this plan, the fishery is managed using effort controls in the form of time/gear units, with each unit allowing a net length of 540 m. Implementation of the full management plan is currently being delayed by a number of legal challenges to the proposed unit allocation. Access to the WCDGDLIMF during 1999/2000 was limited to 26 licences which had powered net drum endorsements, and productive catch returns were received from 15 vessels.

## Main fishing method

Demersal gillnet

## RETAINED SPECIES

### Commercial production (season 1999/2000):

**All sharks 1,257 tonnes**  
**Key species 785 tonnes**

## Landings

The total shark catch of 1,257 tonnes from these fisheries comprised 829 tonnes from the JASDGLDF and 428 tonnes from the WCDGDLIMF, made up as follows:

### JASDGLDF:

Whiskery shark†	159 tonnes
Dusky whaler†	250 tonnes
Gummy shark†	240 tonnes
Other shark	180 tonnes
Total shark	829 tonnes

### WCDGDLIMF:

Whiskery shark†	51 tonnes
Dusky whaler†	85 tonnes
Other shark*	209 tonnes
Total shark	428 tonnes

† Original key target species subject to stock assessment.

\* This 'other shark' catch includes 139 tonnes of sandbar (thickskin) shark. This species was not previously reported separately, but is now emerging as an important commercial species on the west coast and is the subject of a research project commenced in July 2000.

In addition to these shark landings, approximately 10–20% of the overall demersal gillnet and longline catch is now comprised of finfish species which are retained for sale. In 1999/2000, scalefish landings totalled 134 tonnes in the JASDGLDF and 82 tonnes in the WCDGDLIMF. For a detailed breakdown of catch species composition in the two south coast zones and the west coast fishery, see Demersal Gillnet and Longline Figures 1-3.

Sharks are also caught by other user groups apart from the two dedicated fisheries, and these catches are reported here for the first time because of their importance to an understanding of the true exploitation rates. During 1999/2000, vessels licensed in other managed fisheries operating in the same overall area (i.e. between North West Cape and the SA border) reported catches of shark and ray totalling 87.5 tonnes. A further 'wetline' catch of 26.5 tonnes of shark and ray was taken by vessels without access to managed fisheries.

## Fishing effort

JASDGLDF:	169,116 kilometre gillnet hours
WCDGDLIMF:	113,649 kilometre gillnet hours

Effort is expressed as standardised kilometre gillnet hours to take into account the changes in net lengths used under the total allowable effort system (Demersal Gillnet and Longline Figure 5).

## Catch rate

See 'Stock assessment' below.

## Recreational component:

< 5%

The estimated recreational catch between Augusta and Kalbarri, from a Fisheries WA recreational trailered-boat survey conducted in 1996/97 (Sumner and Williamson 1999), was 3,700 sharks, with a further 3,500 released. This total catch included wobbegong and related species, of which 1,000 were kept. Assuming that the species caught recreationally are similar to those taken by the commercial fishery, at an average weight of 5 kg per shark, then the west coast recreational take of sharks at the time of the survey would have been about 15–20 tonnes, or approximately 4% of the west coast commercial shark catch in that year.

## Stock assessment completed:

**Yes (key species)**

Stock assessment is carried out for the three main shark species caught by the fishery, namely whiskery shark (*Furgaleus macki*), dusky whaler (*Carcharhinus obscurus*) and gummy shark (*Mustelus antarcticus*). Owing to changes in the target species of the west coast fishery, the procedure that determines the species composition of the southern and west coast demersal gillnet shark catch was modified this year and catches have been recalculated from 1994/95 onwards. As a result of these changes, the catches of these species are estimated to be slightly lower than previously reported. A summary of the results of the stock assessments follows.

*Whiskery shark:* Total whiskery shark landings increased by 13% in 1999/2000 to 210 tonnes, which was within the 'acceptable catch range' forecast last year. The catch rate of the species remained relatively stable over the last 12 months. Whiskery shark catch fell by 8% in Zone 2 of the JASDGLDF, due mainly to a significant decline in fishing effort. Despite a reduction in nominal effort, whiskery shark landings increased by 15% in Zone 1. Overall there was a 7% increase in whiskery shark catch in the JASDGLDF and 25% in the WCDGDLDF, where there was also a noticeable decline in nominal effort. Catch rates of whiskery sharks decreased substantially during the late 1970s and early 1980s but since the late

1980s have declined only slowly and have stabilised in recent years. Estimates of the current level of total biomass (relative to the virgin level) range from 3% to 40%, with the best estimate at 26%. At this level of biomass, the whiskery shark stock is considered to be exploited above the optimum level, and at current levels of fishing effort has a less than 7% probability of achieving the biomass target (40% of virgin) set by the WADGDLF MAC by 2010.

**Dusky whaler:** At 335 tonnes, the total catch of dusky whalers in 1999/2000 was 7% less than that of the previous year and was below the acceptable catch range forecast last year, due to an over-estimate of the acceptable catch range in last year's report. Whilst dusky shark catches in Zone 1 of the JASDGDLF increased by 3%, catches in Zone 2 and the WCDGDLF declined by 9% and 20% respectively. Catch rates were calculated to have risen by 10% in Zone 1 and fallen by 3% in Zone 2 and 14% in the WCDGDLF. Given that Zone 1 is the main area of dusky whaler recruitment, these regional catch rate figures suggest that recruitment continues at a reasonable level. However, although the weight of sharks landed in Zone 1 increased slightly during 1999/2000, the catch was reported by fishers to be made up of fewer, larger individuals, supporting their views that recruitment over the last three years has been low. This lower level of recruitment may indicate a reduction in the breeding stock of mature females, and is a cause for concern, noting that there appears to be an unreported catch of these animals in the offshore Commonwealth-managed longline fisheries.

**Gummy shark:** The total catch of gummy sharks in 1999/2000 was 240 tonnes, 22% lower than in the previous year and slightly below last year's 'acceptable catch range', however this range is considered to have been over-estimated in last year's report. A significant reduction in effort in Zone 2 of the JASDGDLF, where most gummy shark is caught, is thought to account for most of this reduction in catch. A 25% decline in gummy shark catch rate is, however, of some concern, although it is too early to say whether this is likely to be a trend. The previously stable catch rates and the results of previous stock assessments indicate that the stock is likely to be above the target level. However, given the fall in the catch rate and the imminent conclusion of the five-year management cycle, a new stock assessment needs to be conducted as soon as possible. The results of the 1998 assessment, the most recent available, estimated that the current level of biomass (relative to 1975) ranged from 23% to 60%, with the best estimate at 42.7%. At this level, the stock was considered to be just above the target level set by the WADGDLF MAC, and fully exploited. The effort targeted at gummy shark in 1999/2000 was calculated to be 65% of 1993/94 level, on which the last stock assessment was based. At this level of effort, it was calculated that there is a 72% probability that the gummy shark biomass target will be met in 2010.

**Exploitation status: Fully exploited**

Current effort levels in this multi-species fishery are considered to be fully exploiting the dusky whaler and gummy shark stocks, but causing some over-exploitation of the whiskery shark stock.

**Breeding stock levels: Adequate**

Current fishing levels are permitting the maintenance of adequate breeding stock levels of dusky whaler and gummy shark, but are causing a gradual decline in breeding stock levels of whiskery shark.

**NON-RETAINED SPECIES**

**Bycatch species impact: Low**

There is some discarded bycatch of unsaleable species of sharks, rays and scalefish, but this is considered to be of relatively minor impact to those stocks.

**Protected species interaction: Not assessed**

**ECOSYSTEM EFFECTS**

**Food chain effects: Not assessed**

**Habitat effects: Negligible**

The level of effort is such that the gear is deployed infrequently over approximately 40% of the target species' habitat. Demersal gillnet and longline fishing are not permitted between Steep Point (26°30' S) and a line drawn north of North West Cape (114°06' E), or within 3 nautical miles of the Abrolhos Islands baselines. The physical impact of the gear on the bottom is minimal.

**SOCIAL EFFECTS**

Estimated employment during 1999/2000 in the JASDGDLF was 50 skippers and crew, and in the WCDGDLF 20.

**ECONOMIC EFFECTS**

**Estimated annual value (to fishers) for year (1999/2000): \$5.1 million**

<i>JASDGDLF:</i>	\$2.7 million (shark and scalefish)
<i>JASDGDLF:</i>	\$850,000 (shark fins)
<i>WCDGDLF:</i>	\$1.2 million (shark and scalefish)
<i>WCDGDLF:</i>	\$350,000 (shark fins)

The value of the fisheries was similar to last year. The decline in total shark landings during the 1999/2000 season was offset by dramatic increases in the value of shark fins to between \$25/kg and \$120/kg, depending on fin size and species. As fishers are not able to record fin weights on their catch returns, an average of 3% of sharks' whole weight and a conservative price of \$35/kg were used to estimate fin values. Categories of shark which do not have saleable fins were excluded from fin valuation.

**FISHERY GOVERNANCE**

**Acceptable catch range: Key species 725–975 tonnes**

Acceptable catch ranges for the key species are as follows:

Whiskery shark	175–225 tonnes
Dusky whaler	300–400 tonnes
Gummy shark	250–350 tonnes

These acceptable ranges are based on the revised catches for the last 10 years, and hence are lower than previously shown.



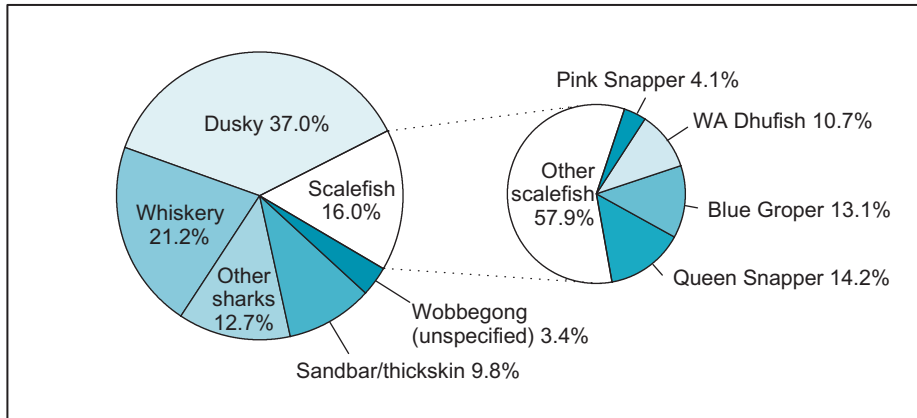
# Commercial Fisheries

## EXTERNAL FACTORS

The current level of exploitation of dusky whaler sharks appears to be sustainable provided the exploitation of mature animals does not exceed 4% annually. However, continued anecdotal evidence suggests that significant numbers of large dusky whaler sharks are now being taken by other user groups, including Commonwealth-managed tuna longlining vessels, illegal foreign vessels

and WA-licensed fishing vessels operating under their general 'wetlining' access. There is also anecdotal evidence that recruitment may be declining in recent years. There is thus an urgent need to quantify the take of sharks by the non-WA vessels, determine the size and age structure of the overall catch and update our estimates of the exploitation rate of juveniles taken in the target fisheries, in order to provide a basis to determine the true current exploitation rate of the dusky whaler stock.

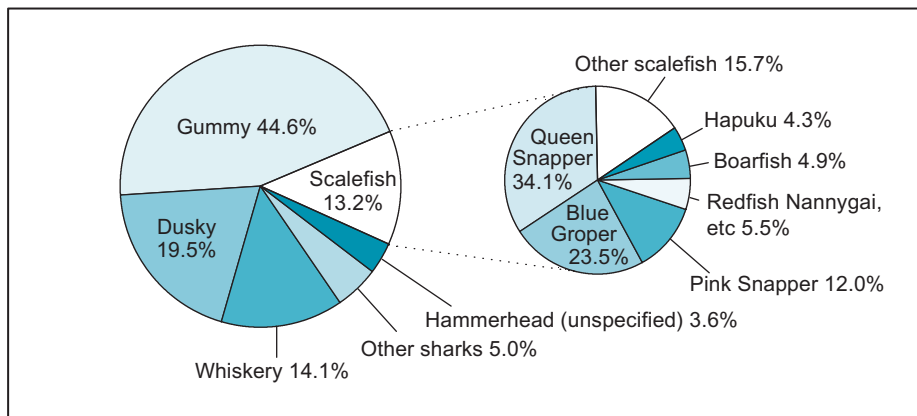
**South Coast Zone 1**



## DEMERSAL GILLNET AND LONGLINE FIGURE 1

Joint Authority Southern Demersal Gillnet and Demersal Longline Interim Managed Fishery Zone 1 catch species composition for 1999/2000.

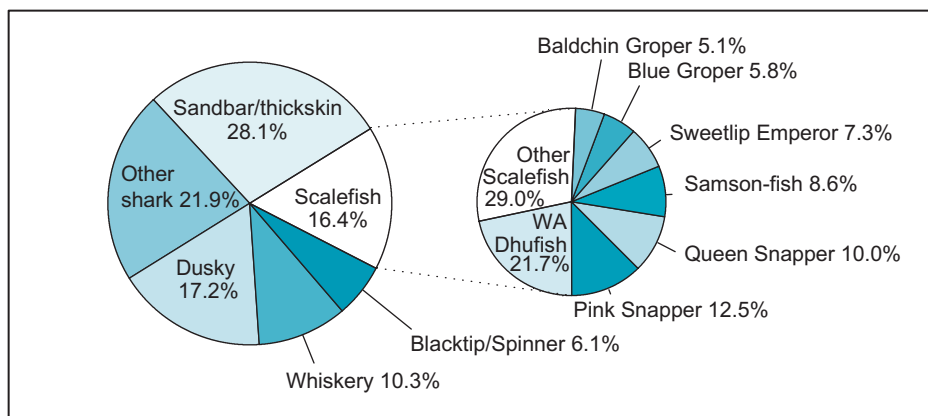
**South Coast Zone 2**



## DEMERSAL GILLNET AND LONGLINE FIGURE 2

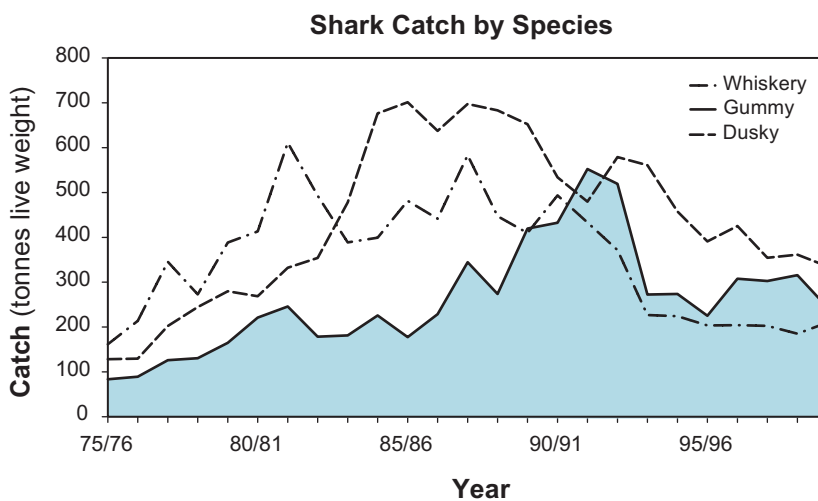
Joint Authority Southern Demersal Gillnet and Demersal Longline Interim Managed Fishery Zone 2 catch species composition for 1999/2000.

**West Coast**



**DEMERSAL GILLNET AND LONGLINE FIGURE 3**

West Coast Demersal Gillnet and Demersal Longline Interim Managed Fishery catch species composition for 1999/2000.

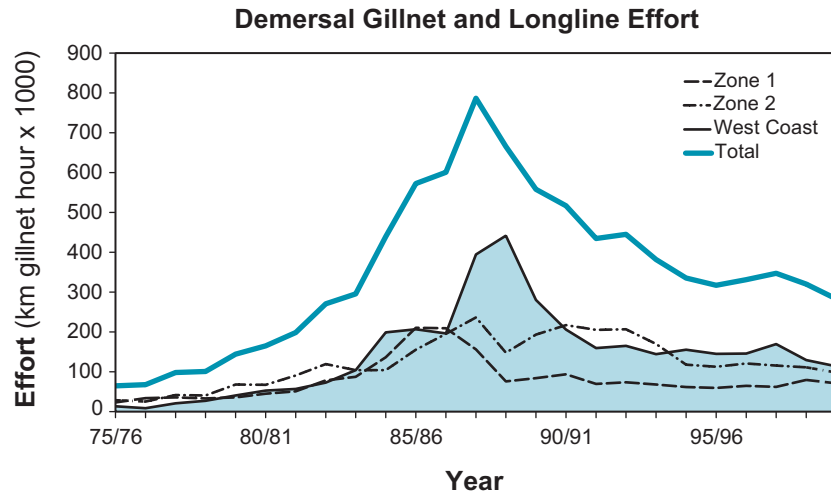


**DEMERSAL GILLNET AND LONGLINE FIGURE 4**

Combined annual catches of key target shark species from the JASDGDLF and WCDGDLF.



# Commercial Fisheries



## DEMERSAL GILLNET AND LONGLINE FIGURE 5

Historical effort in the JASDGLF and WCDGLF.