

# SOUTH COAST BIOREGION

## ABOUT THE BIOREGION

The continental shelf waters of the South Coast bioregion are generally temperate but low in nutrients, due to the seasonal winter presence of the tail of the tropical Leeuwin Current and limited terrestrial run-off. Sea surface temperatures typically range from approximately 15°C to 21°C, which is warmer than would normally be expected in these latitudes due to the influence of the Leeuwin Current. The effect of the Leeuwin Current, particularly west of Albany, limits the winter minimum temperatures away from terrestrial effects along the beaches to about 16 to 17°C.

Fish stocks in the region are predominantly temperate, with many species' distributions extending right across southern Australia. More tropical species are occasionally found which are thought to have been brought into the area as larvae, but are unlikely to form breeding populations.

The south coast is a high-energy environment, heavily influenced by large swells generated in the Southern Ocean. The coastline from Cape Leeuwin to Israelite Bay is characterised by white sand beaches separated by high granite headlands. East of Israelite Bay, there are long sandy beaches backed by large sand dunes, until replaced by high limestone cliffs at the South Australian border. There are few large areas of protected water along the south coast, the exceptions being around Albany and in the Recherche Archipelago off Esperance.

Along the western section of the coastline that receives significant winter rainfall, there are numerous estuaries fed by winter-flowing rivers. Several of these, such as Walpole/Nornalup Inlet and Oyster Harbour, are permanently open, but most are closed by sandbars and open only seasonally after heavy winter rains. The number of rivers and estuaries decreases to the east as the coastline becomes more arid. While these estuaries, influenced by terrestrial run-off, have higher nutrient levels (and some, such as Oyster Harbour and Wilson Inlet, are suffering eutrophication), their outflow to the ocean does not significantly influence the low nutrient status of coastal waters.

The marine habitats of the south coast are similar to the coastline, having fine, clear sand sea floors interspersed with occasional granite outcrops and limestone shoreline platforms and sub-surface reefs.

A mixture of seagrass and kelp habitats occurs along the south coast, with seagrass more abundant in protected waters and some of the more marine estuaries. The kelp habitats are diverse but dominated by the relatively small *Ecklonia radiata*, rather than the larger kelps expected in these latitudes where waters are typically colder and have higher nutrient levels.

## SUMMARY OF FISHING AND AQUACULTURE ACTIVITIES

The major commercial fisheries of the South Coast bioregion are the abalone fishery, the purse seine fishery targeting pilchards and other small pelagics, and a demersal gillnet fishery for sharks. Other smaller commercial fisheries are the long-standing beach seine fishery for western Australian salmon and herring, a trap fishery targeting southern rock lobsters and deep-water crabs, and the intermittent scallop fishery. There is also a commercial net fishery for finfish operating in a number of south coast estuaries. South coast commercial fishing vessel operators often hold a number of licences to create a viable year-round fishing operation.

As much of the south coast is remote or difficult to access, recreational beach and boat fishing tends to be concentrated around the main population and holiday centres. The major target species for beach and rock anglers are salmon, herring, whiting and trevally, while boat anglers target pink snapper, queen snapper, Bight redfish, a number of shark species, samson fish and King George whiting. The third major component of the recreational fishery is dinghy and shoreline fishing of estuaries and rivers, focused in the western half of the bioregion. Here the main angling targets are black bream and whiting (including King George whiting). Recreational netting, primarily targeting mullet, also occurs in these estuaries.

The predominant aquaculture activity undertaken on the south coast is the production of mussels and oysters from Oyster Harbour at Albany. This activity is restricted to this area where there are sufficient nutrient levels related to terrestrial run-off to provide the planktonic food necessary to promote growth of filter-feeding bivalves.

Other forms of aquaculture (e.g. sea cage farming) are restricted on the south coast by the high-energy environment and the very limited availability of protected deep waters typically required by this sector. As a consequence, most recent development activity has focused on land-based 'raceway' culture of abalone, using pumped sea water.

## ECOSYSTEM MANAGEMENT

The inshore marine habitats of the south coast are largely unaffected by human activities. While there are few permanent closures to trawling in this region, the actual level of such activities is very small with about 98% of the region not affected by these activities.

The estuaries and near-shore marine embayments where there is restricted water exchange, for example Princess Royal and Oyster Harbours and Wilson Inlet, have experienced eutrophication events associated with high nutrient loads from adjacent land-based activity.

The Walpole–Nornalup Marine Park was declared on the 8th May 2009 and is the first marine protected area on the south coast. There are three existing fishing closures under s.43 of the Fish Resources Management Act 1994 surrounding the wreck of the ‘Perth’ (Albany), wreck of the ‘Sanko Harvest’ (east of Esperance), and Esperance Jetty.

The Commonwealth Government’s Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) has also undertaken a Marine Bioregional Planning process for Commonwealth waters between Kangaroo Island, South Australia and Shark Bay. The federal minister for the environment has recently announced the final reserve network proposed for the south-west which spans the West Coast and South Coast bioregions.

The Department of Fisheries continues to provide advice to the Environmental Protection Authority on development proposals, which if implemented, have the potential to impact on the aquatic environment. The Department also continues to actively engage with the natural resource management groups for the south coast to promote sustainable use of the aquatic environment. New proposals currently being progressed for the South Coast include ones for mineral resource development and associated port facilities, and for petroleum exploration.

## ECOSYSTEM BASED FISHERIES MANAGEMENT

### Identification of Ecological Assets using the EBFM framework

Under the Integrated Marine and Coastal Regionalisation for Australia scheme, the South Coast bioregion has been divided into 2 meso-scale regions: WA South Coast, Eucla (IMCRA, V 4.0, 2006). This sub-regional scale of management has now been adopted by the Department through the implementation of an Ecosystem Based Fisheries Management (EBFM) framework (Fletcher, *et al.*, 2010) see How to Use section for more details.

In terms of ecological assets, the Department has recognised the following ecological values for the IMCRA regions within the South Coast Bioregion:

- Ecosystem structure and biodiversity (on a meso-scale basis);

- Captured fish species;
- Protected species (direct impact – capture or interaction);
- Benthic habitats; and
- External impacts.

For some issues a finer level of division of the IMCRA ecosystems is used by the Department. This relates to recent management initiatives necessary to recognise different suites of exploited fish and invertebrates across the continental shelf. These sub-components are defined by depth contours (Estuarine, Nearshore 0-20m; Demersal 20-250m and Pelagic). The full set of ecological assets identified for ongoing monitoring are presented in South Coast Ecosystem Management Figure 1.

### Risk Assessment of Regional Ecological Assets

The EBFM process identifies the ecological assets in a hierarchical manner such that the assets outlined South Coast Ecosystem Management Figure 1 are often made up of individual components at species or stock level. The risks to each of the individual stock or lower level components are mostly detailed in the individual fishery reports presented in this document. The following table (South Coast Ecosystem Management Table 1) provides an overview and cumulative assessment of the current risks to the ecological assets of the South Coast Bioregion, at a bioregional level and provides a mechanism for reporting on their status and the fisheries management arrangements that are being applied. These bioregional level risks are now used by the Department as a key input into the Department’s Risk Register which, combined with an assessment of the economic and social values and risks associated with these assets, is integral for use in the annual planning cycle for assigning priorities for activities across all Divisions in this Bioregion.

Currently there are no marine pest monitoring programs being undertaken by the Marine Biosecurity Research group in the South Coast bioregion. However, ongoing research includes an assessment of the likelihood of a marine pest being introduced into ports and quantification of the risk associated with recreational vessels for the introduction and translocation of marine pests into this bioregion. Further detail may be found in the Appendix section entitled “Activities of the Marine Biosecurity Research Unit during 2011/12”.

### SOUTH COAST ECOSYSTEM MANAGEMENT TABLE 1 RISK LEVELS FOR EACH ASSET.

Risk levels in this table are developed by combining the individual (lower level) elements that make up each of the higher level components. Low and Moderate values are both considered to be acceptable levels of risk. High and Significant risks indicate that the asset is no longer in a condition that is considered appropriate and additional management actions are required. Where the value is followed by (non-fishing) this indicates that all, or the majority of the risk value, was not generated by fishing activities.

#### Ecosystem Structure and Biodiversity

Ecosystem	Aquatic zone	Risk	Status and Current Activities
Estuarine	Marine	MODERATE (non fishing)	The most likely cause of changes to community structure in estuarine regions is changing rainfall levels and the manual opening or closing of bars at river mouths.
Marine	Marine	LOW	The recent assessment by Hall and Wise (2011) <sup>1</sup> of finfish community structure using commercial data for the past 30 years found no evidence of any concerning trend in mean trophic level, mean length or FIB. Few other species are captured in this region.
Eucla	Marine	NEGLIGIBLE	As above

#### Captured fish species

Fish species	Aquatic zone	Risk	Status and Current Activities
Finfish	Estuarine	MODERATE	The catch and catch rate of this suite has been reasonably stable for 10 years.
	Nearshore	HIGH	The capture of herring has been in decline for some years. A study is currently underway to determine if this is related to stock issues or merely marketing problems
	Demersal	HIGH	There is some concern that there could be an increase in targeting of demersal fishing on the south coast in the near future. The stock status is now to be the focus of an NRM/FRDC project..
	Pelagic	LOW	While the spawning biomass of sardines has returned to appropriate levels, their capture levels and that of other pelagic fish has not returned to pre-virus levels due to market problems and changed fish behaviour.
Crustaceans	Shelf	MODERATE	The catch levels of lobsters and crabs remains at relatively low but consistent levels.
Molluscs	Nearshore	MODERATE	The stocks of abalone are maintained at appropriate levels
	Shelf	NEGLIGIBLE	The stocks of scallops varies annually and fishing only occurs when stocks are abundant

<sup>1</sup> Hall, N.G. and Wise, B.S. 2011. Development of an ecosystem approach to the monitoring and management of Western Australian fisheries. FRDC Report – Project 2005/063. Fisheries Research Report No. 215. Department of Fisheries, Western Australia. 112pp.

**Protected species**

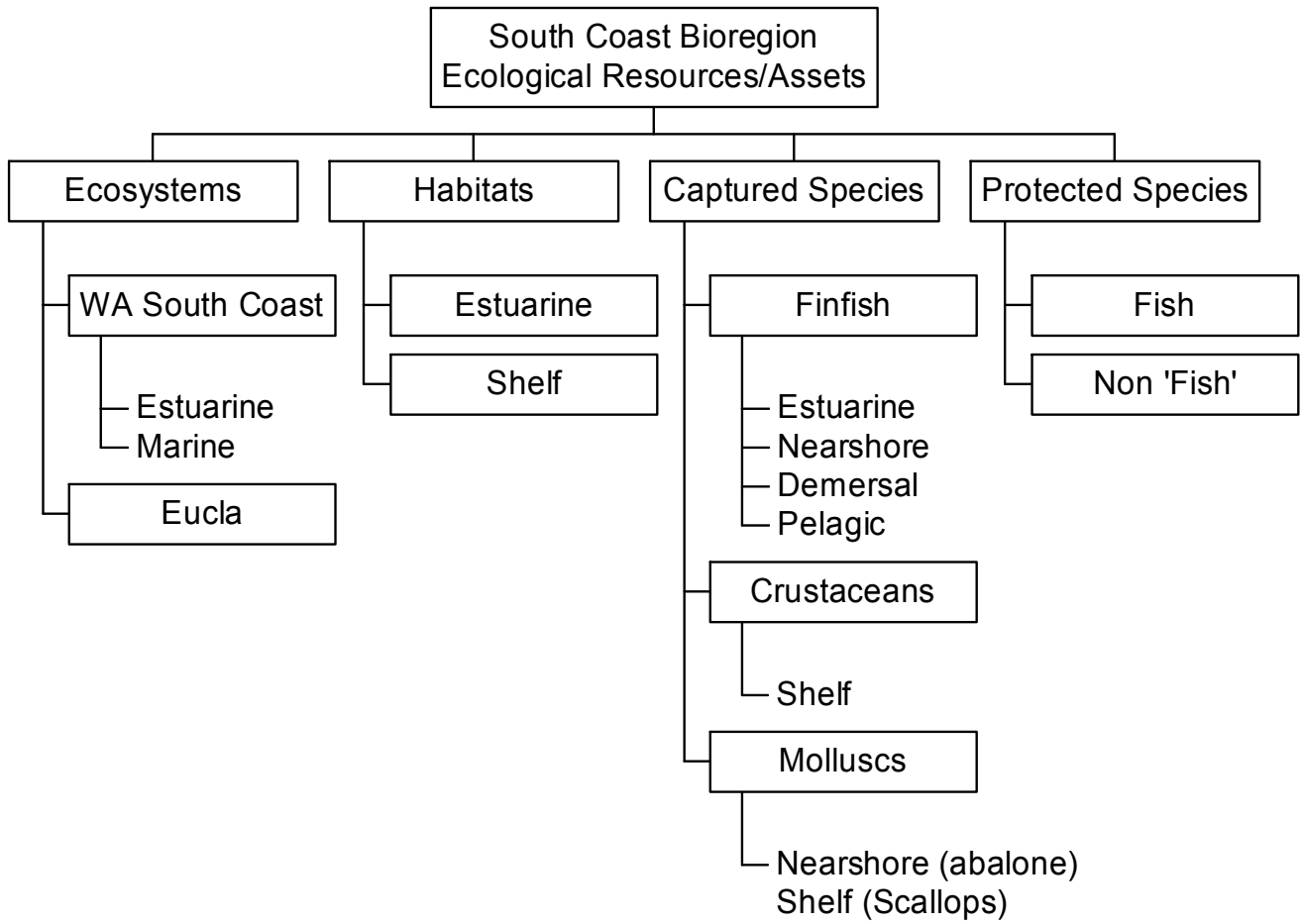
Protected fish species	Species	Risk	Status and Current Activities
Protected non 'Fish' species	Non fish (birds)	MODERATE	The capture of shearwaters in purse seine operations has been addressed by a code of conduct
	Mammals	MODERATE	The potential for the capture of sealions and seals by all fishing operations in this region, but especially gill nets has been the subject of a number of recent studies.
Protected 'Fish' Species	Fish	NEGLIGIBLE	There are few risks to the protected fish species in this region

**Benthic habitat**

Benthic Habitat	Risk	Status and Current Activities
Estuaries/ Nearshore	LOW (non fishing)	There are few fishing activities that would impact on nearshore or estuarine habitats. There may be risks at some locations due to coastal development activities.
Shelf	NEGLIGIBLE	The shelf region in this bioregion has very little habitat disturbance. Less than 3% of the area is trawled and there are no other activities that would materially impact on the habitats in these areas.

**External Drivers (Non Fishing)**

External Drivers	Risk	Status and Current Activities
Introduced Pests and Diseases	HIGH	The recent location of the pest algae <i>Codium fragile</i> in Albany highlights the issues that now face many ports in Australia
Climate	LOW	This area is not as likely to be impacted by climate change in the near future as West Coast and Gascoyne areas of WA.



**SOUTH COAST ECOSYSTEM MANAGEMENT FIGURE 1**

Component tree showing the ecological assets identified and separately assessed for the South Coast Bioregion

# FISHERIES

## South Coast Crustacean Fisheries Report: Statistics Only

*J. How and M. Stadler*

### Fishery Description

The 'south coast crustacean fisheries' comprise four pot-based fisheries, which operate from Augusta to the South Australian border. They include the Windy Harbour/Augusta Rock Lobster Managed Fishery, the Esperance Rock Lobster Managed Fishery (ERLF), the Southern Rock Lobster Pot Regulation Fishery operating in the Albany and Great Australian Bight sectors, and the South Coast deep-sea crab fishery (South Coast Crustacean Figure 1).

The fisheries are multi-species and take southern rock lobsters (*Jasus edwardsii*) and western rock lobsters (*Panulirus cygnus*) as well as deep-sea crab species including giant crabs (*Pseudocarcinus gigas*) crystal crabs (*Chaceon albus*) and champagne crabs (*Hypothalassia acerba*).

Southern rock lobsters comprise the majority of the catch in the eastern areas of the fishery, with crab species becoming more prevalent in the south-western region (South Coast Crustacean Figure 2). Western rock lobsters are a significant component of the catch in the Windy Harbour/Augusta Rock Lobster Managed Fishery (not reported here due to confidentiality provisions relating to the small number of licensees).

### Boundaries

Management boundaries for the south coast crustacean fisheries are shown in South Coast Crustacean Figure 1. The 'boundaries' of the deep sea crab component of the fishery (managed by Fishing Boat Licence Condition 105) include all the waters of these fisheries deeper than 200 metres, excluding those of the ERLF, where crabs may only be taken by licensees in the ERLF.

### Management arrangements

#### Commercial

These commercial fisheries are managed primarily through input controls in the form of limited entry, pot numbers, size limits and seasonal closures.

The season for fishing for rock lobsters throughout all south coast crustacean fisheries mirrors the previous West Coast Rock Lobster Managed Fishery season (prior to the 2010/11 season i.e. 15 November to 30 June). Fishing for deep-sea crabs can currently occur all year, but during the rock lobster season operators fishing under the authority of a Southern Rock Lobster Pot Regulation Licence must only use the number of pots endorsed on their authorisation. There is currently no limit on the number of deep sea crab pots that can be used by holders of Fishing Boat Licence Condition 105. Catch statistics for the fisheries are based on the period from 1 November to 31 October inclusive.

In 2010/11 there were two Windy Harbour/Augusta Rock Lobster Managed Fishery Licences; eight licences in the ERMF (6 vessels reported catch); 28 licences in the Southern

Rock Lobster Pot Regulation Fishery (15 vessels reported catch) and 23 holders of Fishing Boat Licence Condition 105 (seven vessels reported catch).

#### Recreational

Recreational fishers generally only target rock lobsters. They are restricted to the use of 2 pots per person and divers are only permitted to take rock lobster by hand, or with the use of a loop or other device that is not capable of piercing the rock lobster.

Size limits, bag limits and seasonal closures apply and all recreational fishers are required to hold a current recreational fishing licence authorising them to take rock lobster.

### Landings and Effort

#### Commercial

<b>Southern rock lobster</b>	<b>52.1 tonnes</b>
<b>Deep-sea crab</b>	<b>18.2 tonnes</b>
<b>Western rock lobster</b>	<b>not reported</b>
<b>due to confidentiality policy (too few operators)</b>	

The 2010/11 season total catch of southern rock lobsters was 52.1 t, an increase of 9% from the 2009/10 season. A catch of 28.2 t of southern rock lobsters was taken in the ERLF in 2010/11 – an increase of 18% on the catch taken in the 2009/10 season (23.8 t). This is showing an increasing trend over the last few seasons from low catches in 2008/09 (South Coast Crustacean Figure 2).

The combined catch for the Southern Rock Lobster Pot Regulation Fishery (Great Australian Bight (GAB) and Albany zones) in 2010/11 was 23.3 t, a 1% reduction in the catch taken in 2009/10. The catch in the Albany zone was 4.8 t, a reduction of 21% compared to the 2009/10 season, however, the catch in the GAB zone increased by 6% to 18.5 t (South Coast Crustacean Figure 2a). These catches have remained relatively stable since mid-2000, though there have been some fluctuations between the relative contribution from each region (South Coast Crustacean Figure 2a).

As a secondary target of the rock lobster fisheries, a total of 18.2 t of deep sea crabs was caught. The Albany zone is where the majority of crab catch is taken (South Coast Crustacean Figure 2b and 3) and included 3.9 t of giant crabs (a decrease of 0.8 t from the 2009/10 season) 5.1 t of champagne crabs (an increase of 1.4 t from the 2009/10 season) and 4 t of crystal crabs (a decrease of 11.3 t from the 2009/10 season). In the ERLF, 0.8 t of giant crabs were landed (a decrease of 1.6 t from the 2009/10 season).

The fishing effort in the ERLF increased by 8% in 2010/11 to 36,779 potlifts compared to the 33,952 potlifts in 2009/10. Conversely, the effort decreased by 15% in the Albany zone, however, it is not possible to split the effort of targeting lobsters from that of targeting deep-sea crabs.

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**Recreational Southern rock lobsters <5 tonnes**

Estimates from mail surveys sent to a randomly selected sample of rock lobster licence holders (approx 10%) suggests that the recreational catch of southern rock lobsters on the south coast is less than 5 t per year.

The number of recreational rock lobster licence holders that catch southern rock lobsters are small and estimating the recreational catch more accurately would require a dedicated survey or at least a different sampling strategy to the current mail survey. The small quantities taken on the south coast, provide a small risk to overall sustainability of the stock, and therefore do not make a more detailed survey a priority.

**Fishery Governance**

**Target commercial catch range:**

**Southern rock lobsters 50 – 80 tonnes**

In 2010/11, the south coast catch of 52.1 t was within the target range. However, this target catch range is currently being reviewed as a part of the overall review of the management for this fishery.

**Current Fishing (or Effort) Level Acceptable**

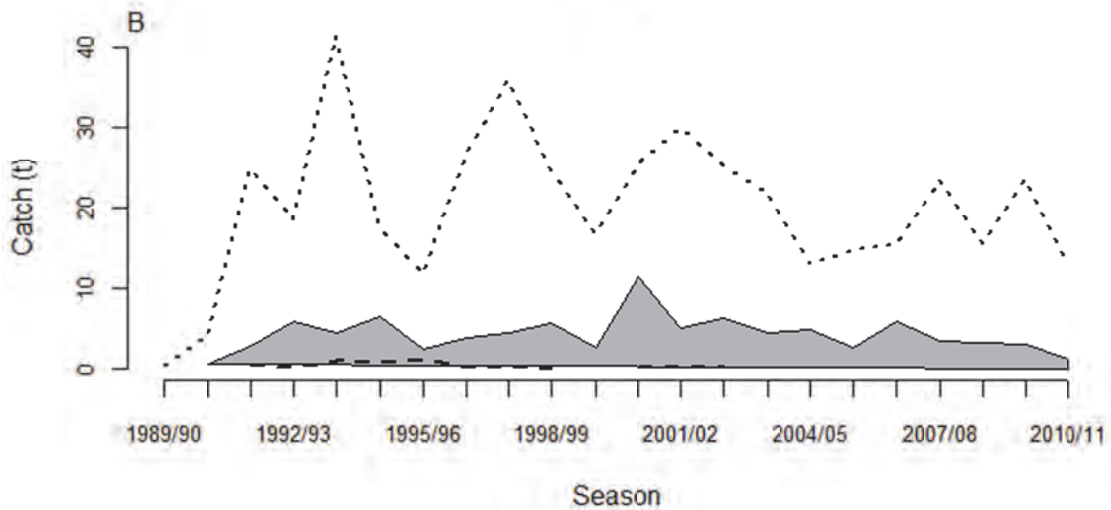
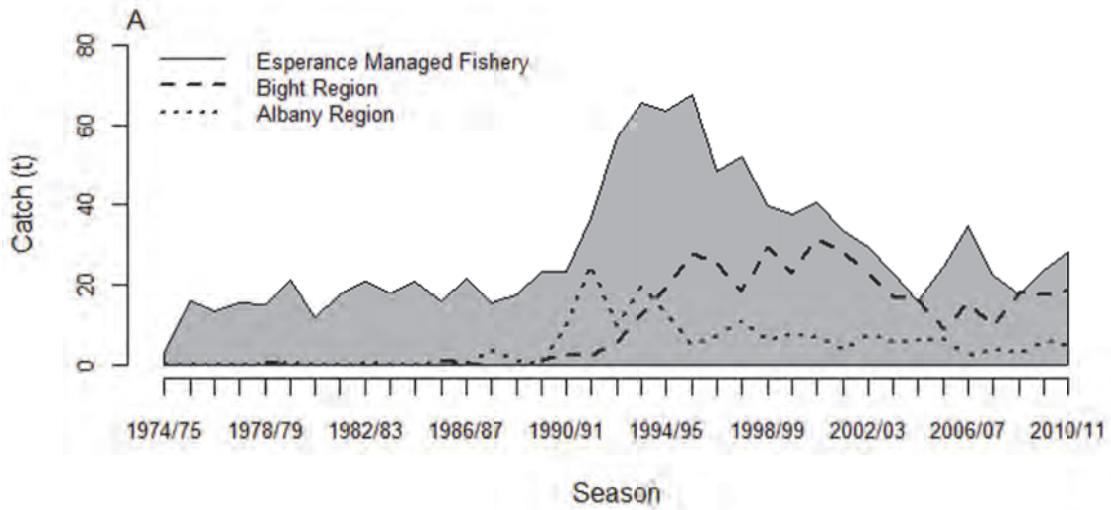
**New management initiatives (2011/12)**

In January 2009 the Department released Fisheries Management Paper 232 entitled, ‘The South Coast Crustacean Fishery: A Discussion Paper’. This public discussion paper provided a review of the management arrangements and history behind the four south coast crustacean fisheries, as well as making a number of recommendations on the future management of each fishery. Two key recommendations included that one management plan cover all four crustacean fisheries and that an independent panel make recommendations on access and allocation of entitlement in the new fishery. An independent access and allocation panel has recently been formed and the outcomes of this process will be reported in next seasons update.



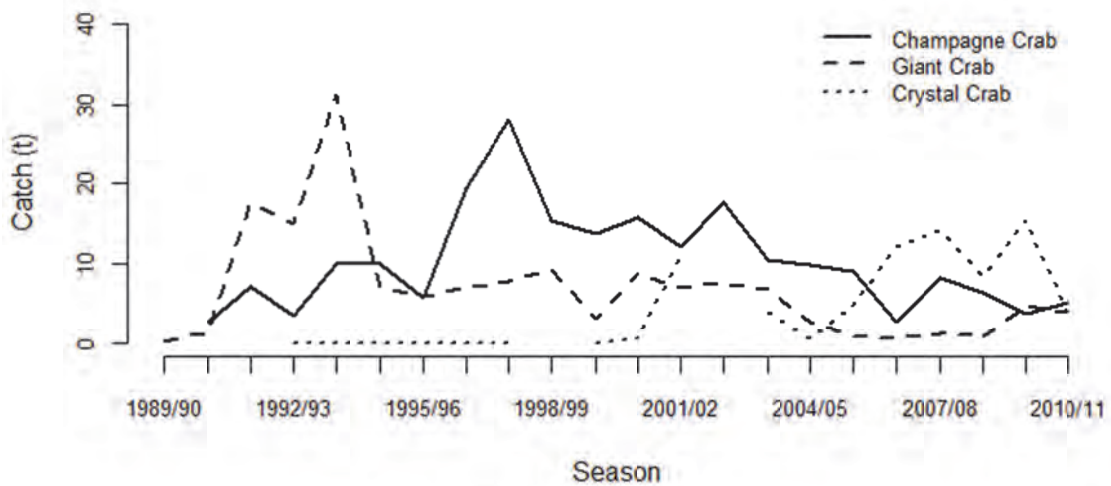
**SOUTH COAST CRUSTACEAN FIGURE 1**

Management boundaries in the South Coast crustacean fisheries.



**SOUTH COAST CRUSTACEAN FIGURE 2**

Seasonal catches of a) southern rock lobster and b) deep sea crab by management area.



**SOUTH COAST CRUSTACEAN FIGURE 3**

Seasonal catches of deep sea crab species since 1989/90 in the Albany region.



# Greenlip/Brownlip Abalone Fishery Status Report

A. Hart, F. Fabris and Kim Walshe

Main Features			
<b>Status</b>		<b>Current Landings</b>	
Stock level	Adequate	Commercial	
		Total	202 t
Fishing level	Acceptable	Greenlip	166 t
		Brownlip	36 t
		Recreational	3-4% of total catch

## Fishery Description

The Western Australian greenlip and brownlip abalone fishery is a dive fishery that operates in the shallow coastal waters off the south-west and south coasts of Western Australia. The fishery targets 2 large species of abalone: greenlip abalone (*Haliotis laevigata*), and brownlip abalone (*H. conicopora*), both of which can grow to approximately 200 mm shell length.

Abalone divers operate from small fishery vessels (generally less than 9 metres in length). The principal harvest method is a diver working off 'hookah' (surface supplied breathing apparatus) or SCUBA using an abalone 'iron' to prise the shellfish off rocks – both commercial and recreational divers employ this method.

### Governing legislation/fishing authority

#### Commercial

*Abalone Management Plan 1992*

Abalone Managed Fishery Licence

Commonwealth Government *Environment Protection and Biodiversity Conservation Act 1999* (Export Exemption)

#### Recreational

*Fish Resources Management Act 1994*; *Fish Resources Management Regulations 1995* and other subsidiary legislation.

Recreational Abalone Fishing Licence

### Consultation process

#### Commercial

The Department undertakes consultation directly with licensees on operational issues. Industry Annual General Meetings are convened by the West Australian Fishing Industry Council (WAFIC), who are also responsible for statutory management plan consultation under a Service Level Agreement with the Department.

#### Recreational

Consultation processes are now facilitated by Recfishwest under a Service Level Agreement although the Department undertakes direct consultation with the community on specific issues.

### Boundaries

#### Commercial

The Abalone Management Plan covers all Western Australian coastal waters, which are divided into eight management areas. Commercial fishing for greenlip/brownlip abalone is managed in three separate areas (Greenlip/Brownlip Abalone Figure 1).

#### Recreational

The recreational abalone fishery regulations relate to three zones: the Northern Zone (from Greenough River mouth to the Northern Territory border), the West Coast Zone (from Busselton Jetty to Greenough River mouth) and the Southern Zone (from Busselton Jetty to the South Australian border). Greenlip and brownlip abalone are only fished in the Southern Zone.

### Management arrangements

#### Commercial

The commercial greenlip/brownlip abalone fishery is part of the overall Abalone Managed Fishery which is managed primarily through output controls in the form of Total Allowable Commercial Catches (TACCs), set annually for each species in each area and allocated to licence holders as Individual Transferable Quotas (ITQs).

The overall TACC for 2011 was 213 t (whole weight). The TACC is administered through 16,100 ITQ units, with a minimum unit holding of 450 units. The licensing period runs from 1 April to 31 March of the following year.

The legal minimum length for greenlip and brownlip abalone is 140 mm shell length, although the commercial industry fishes to self-imposed size limits of 155 mm, 150 mm and 145 mm in various parts of the main stocks. In 'stunted stocks' areas, greenlip can be fished from 120 mm under special exemptions with such fishing strictly controlled to pre-arranged levels of catch and effort.

#### Recreational

The recreational component of the fishery for greenlip and brownlip abalone is managed under a mix of input and output controls and occurs primarily on the south and south-west coasts. Recreational fishers must purchase a dedicated abalone recreational fishing licence. Licences are not

restricted in number, but the recreational fishing season is limited to 7.5 months – from 1 October to 15 May.

The combined daily bag limit for greenlip and brownlip abalone is five per fisher, and the household possession limit (the maximum number that may be stored at a person's permanent place of residence) is 20.

### General

A comprehensive ESD assessment of this fishery has been undertaken to identify any potential sustainability risks requiring direct management. The only issues identified through this process were the breeding stock levels of greenlip and brownlip abalone. Boxed text in this status report provides the annual assessment of performance for these issues.

### Research summary

Current research is focused on stock assessment using catch and effort statistics, meat weight indices, and length-frequency sampling. Commercial abalone divers are required to provide daily catch information on the weight and number of abalone collected, the hours fished, the date and location of harvest and the name of the person(s) harvesting. The divers also supply a random selection of abalone shells from each fishing day, and these are measured and used to estimate fishing mortality.

An annual standardized catch per unit effort (CPUE) index was developed that takes into account diver, sub-area and month of fishing as well as technological improvements that aid fishing efficiency. This index forms the basis of the revised decision-rule framework for the quota setting in each area of the fishery.

Current research initiatives include the use of digital video imagery assessment by industry divers, who survey selected sites with an underwater video camera, fishery-independent survey data collected from 140 sites across the fishery, and mark-recapture analysis of growth and mortality in brownlip abalone.

The telephone diary survey estimates the statewide catch of greenlip and brownlip abalone at regular intervals. For the last survey, in 2007, around 500 licence holders were randomly selected from the licensing database, with selection stratified by licence type (abalone or umbrella) and respondent location (country or Perth metropolitan area). The licence holders were sent a diary to record their fishing activity and were contacted every 3 months by telephone for the duration of the abalone season.

Research on stock enhancement continued in 2011/12, under the externally funded Seafood CRC project titled "*Bioeconomic evaluation of commercial scale stock enhancement in abalone*". Results from this project will inform industry and management on the viability of stock enhancement as a management tool for this fishery.

## Retained Species

### Commercial landings (season 2011): 202 tonnes

In 2011 the greenlip/brownlip catch was 202 tonnes whole weight (Greenlip Brownlip Abalone Table 1), which was similar to the 2010 catch of 205 t. The Area 1 (Nullarbor fishery) exploratory quota remained at 1.2 t but was not fished in 2011.

The greenlip catch of 165.9 t whole weight from a total quota of 173.3 t, was very similar to the 2010 catch of 165.6 t. The brownlip catch of 36 t whole weight for the 2011 season was 8% lower than the 2010 catch of 39 t, and represents 91% of the quota of 39.9 t (Greenlip Brownlip Abalone Table 1).

### Recreational catch (season 2007): 8 tonnes

#### Recreational catch: 3 – 4% of total catch

The estimate of recreational catch of greenlip and brownlip abalone, based on the telephone diary survey of recreational licence holders in 2007, was 8 t (range: 0 – 16 t), which is similar to the 2006 estimate of 7 t. Given the catch estimates from 2004, 2006 and 2007, the recreational catch corresponds to approximately 3 – 4% of the total (commercial and recreational) catch (Greenlip Brownlip Abalone Table 2) and it is unlikely that this catch level would have differed greatly in 2011.

### Fishing effort/access level

#### Commercial

Total fishing effort on the main stocks in 2011 was 1,224 days. This was 2% higher than 2010 (1,196 days).

#### Recreational

For the 2011 season, 17,300 licences were issued allowing abalone fishing (Greenlip/Brownlip Abalone Figure 2). This was the first year in which only abalone specific licenses were available to those wishing to fish for abalone. Umbrella recreational licenses, which allow for the catch of multiple species, have been phased out (Greenlip/Brownlip Abalone Figure 2).

Effort estimates for recreational abalone fishing on the west coast (excluding the Perth metropolitan area), from the 2007 telephone diary survey, was 6,300 days (3,800 – 8,800 days), while the estimated effort on the south coast was 4,900 days (1,700 – 8,000 days) (Greenlip Brownlip Abalone Table 2).

## Stock Assessment

**Assessment complete:** Yes

**Assessment level and method:** Level 3

**Standardised catch rates / Fishing mortality**

**Breeding stock levels:** Adequate

A stock assessment of the greenlip/brownlip abalone fishery was undertaken for the 2011 fishing season, based on commercial catch and effort statistics, length-frequency and shell morphometry sampling, biological growth studies, and some fishery-independent surveys.

**Standardised catch per unit effort (SCPUE):** As a result of a recent review<sup>1</sup>, the SCPUE for the greenlip fishery is now used as the principal indicator of the abundance of

<sup>1</sup> Hart A, Fabris F, Caputi N (2009). Performance indicators, biological reference points and decision rules for Western Australian abalone fisheries (*Haliotis* sp.): (1) Standardised catch per unit effort. Fisheries Research Report No. 185. Department of Fisheries, Western Australia. 32p.

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legal-sized abalone and the basis for the decision-rule framework. Raw CPUE data (kg whole wt per diver per day) is also presented for comparative purposes.

In 2011, the SCPUE for the combined greenlip stocks was 35 kg whole weight per hour (Greenlip Brownlip Abalone Table 1). This was a slight decrease from the 2010 value of 37 kg per hour (Greenlip Brownlip Abalone Table 1).

**Fishing mortality (F):** This analysis determines the proportion of the available abalone stock that is being harvested. Fishing mortality of greenlip abalone increased between 2010 and 2011 for the Augusta region, declined on the South Coast of Area 3, and was stable in the Area 2 fishery (Greenlip Brownlip Abalone Figure 3a). Average *F*, based on a 3-yr running mean (2009-2011) was 0.44 (Augusta), 0.48 (Area 3 South Coast) and 0.50 (Area 2).

Fishing mortality of brownlip abalone in Area 3 decreased between 2010 and 2011, but no data were available from Area 2 (Greenlip Brownlip Abalone Figure 3b). Average *F*, based on a 3-yr running mean (2009-2011) was 0.31 (Area 3) and 0.30 (Area 2).

**Breeding stock:** Greenlip abalone mature between 80 and 110 mm shell length, and brownlip abalone mature between 90 and 130 mm shell length. These are both below the legal minimum size limit set across the fishery (140 mm shell length) with individual abalone expected to have spawned at least twice before reaching legal size.

Industry-imposed length limits that are larger than the minimum legal limits have been set in areas of fast-growing stocks. In Area 2, there is a general 145 mm minimum length across the fishing grounds. In Area 3, fishers have imposed a minimum size limit of 155 mm shell length for the faster-growing portions of the fishing grounds, and 150 mm for the remainder.

In 2011, the average sizes of greenlip and brownlip caught were 190 g and 242 g respectively which are both well above the minimum breeding sizes of 140 g for greenlip and 160 g for brownlip respectively.

For brownlip, the assessment showed that the TACC was being caught at a lower average meat weight (declined from 286 g in 2006 to 242 g in 2011). TACC was therefore reduced to 39.9 t in 2011 (Greenlip Brownlip Abalone Table 1).

*The main performance measures for the fishery relate to the maintenance of adequate breeding stocks in each area of the fishery. This is assessed using a combination of measures that reflect the average size of breeding individuals and the overall biomass of breeding stock.*

*In 2011, the average sizes of greenlip and brownlip caught were 190 g and 242 g respectively. These were well above the minimum breeding sizes of 140 g for greenlip and 160 g for brownlip. The effort (days fished) required to take the quota (1,224 days) was within the set range that indicates sufficient biomass of breeding stock for the fishery overall (907 – 1,339 days – see ‘Fishery Governance’ section).*

## 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 white shark (*Carcharodon carcharias*), which has been known to attack divers. Most divers now use diving cages or electronic shark deterrent devices for their personal protection. Divers are now recording their encounters with white sharks and these will be documented in future reports.

## 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 considered to result in little change in algal growth cover in areas fished.

## Social Effects

There are 14 vessels operating in the greenlip/brownlip commercial fishery, 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.

Recreational diving for greenlip and brownlip abalone is a small but active sector, with dive shops and vessel manufacturers' benefiting from this activity. The recreational fishery provides a major social benefit to those sectors of the community that appreciate the abalone as a delicacy. There were 17,300 licenses issued that would have allowed fishers to participate in the recreational abalone fishery, although most of these would have targeted the Roe's abalone fishery in the Perth metropolitan area.

## Economic Effects

**Estimated annual value (to fishers) for 2011:**

**Level 3 - \$5 - 10 million (\$8.3 million)**

The estimated average price received by commercial fishers was \$112/kg meat weight (\$42/kg whole weight) for greenlip and \$90/kg meat weight (\$36/kg whole weight) for brownlip

abalone, resulting in a fishery valued at \$8.3 million, compared to \$7.8 million in 2010 and \$7.7 million in 2009.

Greenlip prices in 2011 were higher than 2010 (\$103/kg), and were the highest since 2007, but still low compared to 10 years ago due to increasing value of the Australian dollar.

## Fishery Governance

**Target effort range:** 907 – 1,339 days

**Current effort level:** Acceptable

To assess whether the catch quota set is appropriate (sustainable) relative to the stock available, the effort required to take a full season's quota (213 t in 2011) from the main stocks should fall within the effort range (907 – 1,339 diver days) derived from the 5-year period 1994 – 1998. This range reflects the acceptable variation in catch rates for the main stocks due to weather and natural recruitment cycles.

The fishing effort in 2011 was 1,224 days (main stocks), which is within the governance range and indicates that the fishery as a whole is performing satisfactorily.

## New management initiatives (2010/11)

Consultation also took place with industry on relatively minor operational changes to the Abalone Management Plan 1992. These matters are currently being progressed.

## External Factors

In the last few years there have been a number of changes which impact on fishery governance, and particularly on catch rates. Lease divers are becoming more common and industry size limits have been varied substantially above the legal minimum sizes. The value of the abalone has decreased over the past few years, although increased for the first time in 2011

In addition, environmental effects, such as weather conditions, and the effect of technology changes, continue to have significant effects on diver efficiency.

**GREENLIP/BROWNLIP ABALONE TABLE 1**Greenlip and brownlip abalone catch and effort<sup>1</sup> by quota period.

Quota period <sup>2</sup>	Greenlip TAC kg whole weight	Greenlip caught kg whole weight (all stocks)	Brownlip TAC kg whole weight	Brownlip caught kg whole weight <sup>4</sup>	Combined catch kg whole weight	Diver days (main stocks only) <sup>3</sup>	Greenlip Raw CPUE kg whole (meat) <sup>4</sup> wt per diver day)	Greenlip standardised CPUE (kg whole weight) per diver hour
1989		229,619	–	36,977	266,596	1,324	158 (59)	
1990	126,500	118,395	–	19,118	137,514	696	164 (62)	
1991	148,500	132,194	–	14,658	146,852	816	158 (59)	
1992	192,500	170,608	–	30,404	201,012	1,120	152 (57)	37
1993	197,450	173,397	–	31,153	204,550	1,238	140 (53)	37
1994	200,750	171,820	–	32,222	204,042	1,337	129 (48)	36
1995	187,264	145,467	–	27,061	172,528	1,087	134 (50)	32
1996	189,750	171,337	–	21,932	193,269	904	177 (66)	40
1997	207,350	182,317	–	26,297	208,614	1,059	172 (65)	35
1998	200,750	181,810	–	22,197	204,006	1,031	166 (62)	36
1999	184,023	175,765	28,000 <sup>5</sup>	28,047	203,812	922	182 (68)	39
2000	194,691	189,511	34,875	34,179	223,690	1,029	178 (67)	41
2001	194,691	187,459	33,075	31,091	218,550	1,002	165 (62)	37
2002	194,691	166,828	33,075	27,458	194,286	1,027	134 (50)	34
2003	202,521	180,730	37,453	33,449	214,179	1,144 <sup>3</sup>	136 (51)	33
2004	190,520	170,385	35,000	34,196	204,581	1,154 <sup>3</sup>	129 (48)	34
2005	171,755	169,285	38,500	38,745	208,030	1,252	131 (49)	31
2006	171,755	168,752	39,750	37,265	206,017	1,161	133 (50)	31
2007	171,755	166,647	39,750	38,660	205,307	1,139	137 (51)	34
2008	163,220	157,224	41,900	39,515	196,739	1,144	135 (51)	34
2009	171,221	160,156	41,900	39,050	199,206	1,205	130 (49)	34
2010	171,221	165,558	41,900	39,006	204,564	1,196	138 (52)	37
2011	173,355	165,927	39,950	36,274	202,201	1,224	136 (51)	35

1. Data source: quota returns.

2. The length of quota period has varied with management changes, and for simplicity has been recorded against the nearest calendar years.

3. Effort (diver days): main stocks are separated from stunted stocks, which are subject to controlled fishing regimes and not directly comparable.

4. Greenlip conversion factor (meat weight to whole weight) is 2.667. Brownlip conversion factor for meat weight to whole weight is 2.5.

5. 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.

**GREENLIP/BROWNLIP ABALONE TABLE 2**

Summary of telephone diary surveys of recreational effort (fisher days), catch rate (abalone per fisher day) and catch (tonnes whole weight) for the greenlip and brownlip abalone fisheries in 2004, 2006, and 2007.

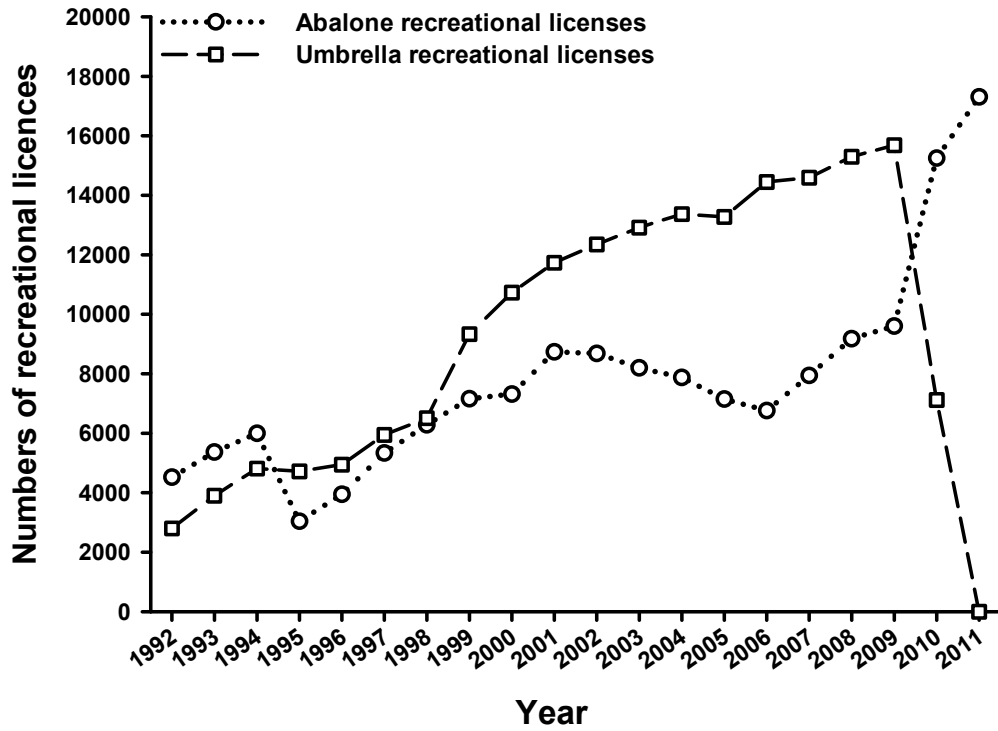
Location	Year	Effort	Greenlip		Brownlip	
			Catch Rate	Catch (tonnes)	Catch Rate	Catch (tonnes)
West Coast	2004	10,100 (6,500 – 13,600)	0.6	4 (2–6)	0.4	3 (1–5)
	2006	8,000 (4,700 – 11,300)	0.3	2 (0–3)	0.4	3 (0–5)
	2007	6,300 (3,800 – 8,800)	0.7	3 (0–6)	0.1	<1 (0–1)
South Coast <sup>1</sup>	2004	2,700 (1,700 – 3,700)	2.4	2 (1–5)	<0.1	<1 (0–1)
	2006	2,800 (1,600 – 3,900)	1.6	2 (0–4)	0.5	1 (0–2)
	2007	4,900 (1,700 – 8,000)	1.8	4 (0–8)	0.2	<1 (0–1)

1. Survey area is South Coast bioregion (i.e. east of Black Point).



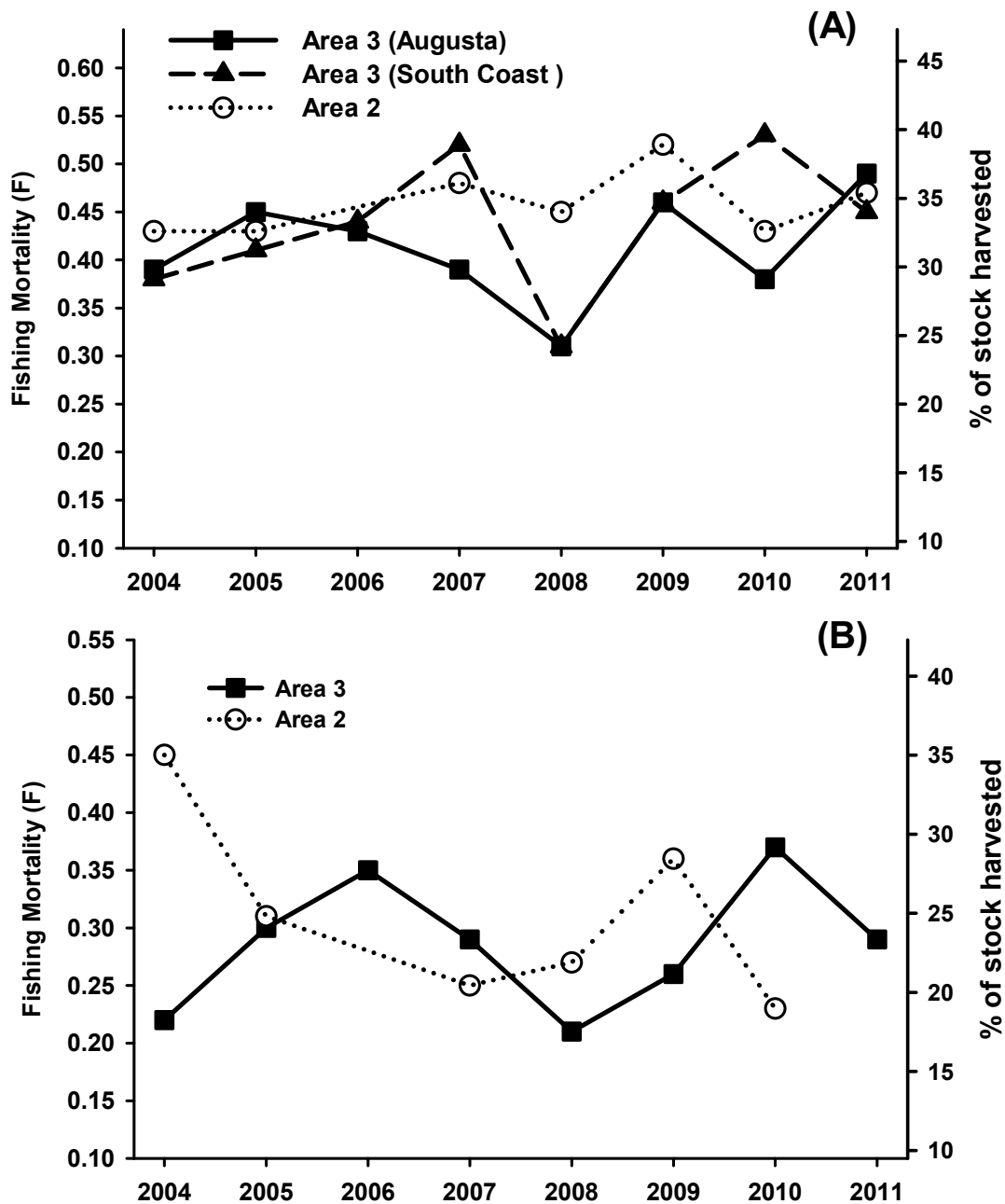
**GREENLIP/BROWNLIP ABALONE FIGURE 1**

Maps showing the distribution of (a) greenlip and (b) brownlip abalone in Western Australia, and (c) the management areas used to set quotas for the commercial fishery. Area 4 currently has no quota allocated.



**GREENLIP/BROWNLIP ABALONE FIGURE 2**

The number of licences issued in the recreational abalone fishery, by licence type, for the period since 1992. Data are license counts at the end of the Perth metro abalone season (mid-December). Note umbrella licences were discontinued in 2010.

**GREENLIP/BROWNLIP ABALONE FIGURE 3**

Fishing mortality for greenlip (A) and brownlip (B) abalone. Estimates of fishing mortality ( $F$ ) apply only to harvest-size animals, and are derived from catch-curve analysis using length-frequency data, and annualised growth increments based on following growth models. West Coast Greenlip:  $L_{\infty}=185$  mm,  $K = 0.30$ ; South Coast Greenlip:  $L_{\infty}=179$  mm,  $K = 0.30$ ; Brownlip:  $L_{\infty}=198$  mm,  $K = 0.32$ . Natural mortality ( $M$ ) is assumed to be 0.25.



# South Coast Nearshore and Estuarine Finfish Resources Status Report

K. Smith, J. Brown, A. Howard and M. Stadler

Main Features		Current Landings (2011)	
<b>Status</b>			
Stock levels:		Commercial total	466 t (finfish only)
Australian herring	Uncertain	South Coast Salmon Fishery	163 t (salmon only)
Western Australian salmon	Adequate	South Coast herring trap net fishery	84 t (herring only)
Black bream (Stokes Inlet)	Adequate	South Coast Estuarine Fishery	201 t (finfish only)
Black bream (Beaufort Inlet)	Adequate	Other commercial	18 t (finfish only)
Black bream (Wilson Inlet)	Adequate		
Black bream (Oyster Harbour)	Adequate	Recreational	not available for current year.
Black bream (Walpole-Nornalup Inlet)	Not assessed		Most recent survey was in 2000/01.
Cobbler (Wilson Inlet)	Adequate	2000/01 finfish catch	368 t (key species only)
Cobbler (Oyster Harbour)	Adequate		
Fishing Level (all stocks)	Acceptable		

## Fishery Description

### Commercial - Nearshore

Beach-based commercial fishers in nearshore waters of the South Coast Bioregion catch various finfish species, mainly using trap nets (herring only), beach seines, haul nets and gill nets. The main target species are western Australian salmon (*Arripis truttaceus*) and Australian herring (*Arripis georgianus*), with small quantities of southern sea garfish (*Hyporhamphus melanochir*) and sea mullet (*Mugil cephalus*) also taken.

Western Australian salmon form large migratory schools, particularly during the autumn spawning season, that move along the coast in nearshore waters between South Australia and Kalbarri (WA). The species is targeted in WA by two commercial fisheries – the South Coast Salmon Managed Fishery and the South-West Coast Salmon Managed Fishery (see later in this report). Fishers target schools of migrating fish mainly during late summer and autumn. Western Australian salmon fishing is conducted by teams of fishers setting beach seine nets using either row boats or small jet-powered boats.

Most of the commercial catch of Australian herring<sup>1</sup> in WA is taken on beaches along the South Coast using herring trap nets (also known as ‘G’ trap nets). Trap nets are used principally during the autumn migration of this species. Beach seine nets, gill nets and haul nets in the South Coast and West Coast Bioregions take the majority of the remaining commercial Australian herring landings.

<sup>1</sup> Note – The stock assessment for Australian Herring is presented in the West Coast Nearshore and Estuarine Fisheries Report

### Commercial - Estuarine

Approximately 25 major estuaries exist in the South Coast Bioregion, extending from Black Point in the west, to the WA/SA border to the east. Thirteen estuaries are conditionally open to commercial fishing as part of the South Coast Estuarine Managed Fishery (SCEMF). This is a multi-species fishery targeting many estuarine finfish species, with the main fishing methods being gill net and haul net. The main target species are cobbler (*Cnidoglanis macrocephalus*), black bream (*Acanthopagrus butcheri*), sea mullet and Australian herring.

### Recreational

Most finfish caught recreationally in South Coast Bioregion estuaries and nearshore waters are taken by line fishing. Shore and boat-based fishing are both popular. The most commonly captured recreational species include Australian herring, various species of whiting (Sillaginidae), trevally (*Pseudocaranx* spp.), black bream (estuaries only), western Australian salmon and southern sea garfish.

A relatively small amount of recreational net fishing occurs in the South Coast Bioregion, mainly targeting sea mullet.

### Governing legislation/fishing authority

#### Commercial

South Coast Estuarine Fishery Management Plan 2005

South Coast Estuarine Managed Fishery Licence

Fisheries Notice No. 478 of 1991 (Herring ‘G’ nets)

Fishing Boat Licence Condition 42 (Herring ‘G’ nets)

*South Coast Salmon Fishery Management Plan 1982*

South Coast Salmon Managed Fishery Licence

*Proclaimed Fishing Zone Notice (South Coast) 1975*

*Salmon Block Net Prohibition Notice 1996*

*Salmon and Snapper Purse Seining Prohibition Notice 1987*

Commonwealth Government *Environment Protection and Biodiversity Conservation Act 1999* (Export Exemption)

### **Recreational**

*Fish Resources Management Act 1994; Fish Resources Management Regulations 1995* and other subsidiary legislation

### **Consultation processes**

#### **Commercial**

The Department undertakes consultation directly with licensees on operational issues. Industry Annual General Meetings are convened by the West Australian Fishing Industry Council (WAFIC), who are also responsible for statutory management plan consultation under a Service Level Agreement with the Department.

#### **Recreational**

Consultation processes are now facilitated by Recfishwest under a Service Level Agreement although the Department undertakes direct consultation with the community on specific issues.

### **Boundaries**

#### **Commercial - Nearshore**

In the South Coast Bioregion, Australian herring can be taken commercially by holders of an unrestricted fishing boat licence. The use of trap nets is restricted to holders of fishing boat licences with Condition 42, who can only operate at 10 specific beaches along the south coast.

The South Coast Salmon Managed Fishery covers WA waters from Cape Beaufort to the eastern boundary of the State on the south coast of Western Australia.

#### **Commercial - Estuarine**

The South Coast Estuarine Managed Fishery encompasses 'the waters of all estuaries on the south coast of Western Australia between Cape Beaufort and 129° east longitude, including Princess Royal Harbour and Oyster Harbour, and all the rivers, streams and all the tributaries that flow into those estuaries.' The areas that are open to commercial fishing are (from west-to-east) Broke Inlet, Irwin Inlet, Wilson Inlet, Princess Royal Harbour, Oyster Harbour, Waychinicup Inlet, Beaufort Inlet, Gordon Inlet, Hamersley Inlet, Culham Inlet, Jerdacuttup Lakes, Oldfield Inlet and Stokes Inlet.

#### **Recreational**

Recreational line fishing is permitted in most areas within estuaries and nearshore waters of the South Coast Bioregion. Some spatial closures exist, including closures around dive wrecks.

A limited number of areas within certain estuaries and nearshore waters of the South Coast Bioregion are open to recreational netting. Recreational net fishers must hold a licence. Recreational set nets are prohibited in all ocean

waters of the South Coast at all times. Recreational net fishing regulations are complex – please refer to the 'Recreational Net Fishing Guide' for details.

### **Management arrangements**

#### **Commercial**

The South Coast nearshore and estuarine commercial fisheries are managed primarily through input controls in the form of limited entry and gear restrictions, as well as seasonal and time closures, area closures and size limits.

The South Coast Salmon Fishery Management Plan 1982 provides for licence holders to operate from assigned beaches between Shoal Cape and Cape Beaufort, with each fishing team having access to a single nominated beach only.

The Herring Trap Net Notice (Order 478 of 1991) prohibits the use of herring trap nets except by licensed commercial fishers using a fishing boat with the appropriate fishing boat licence condition (Condition 42). Holders of fishing boat licences with this condition may take Australian herring using 'G' trap nets on 10 separately nominated south coast beaches. There is a closed season for the use of 'G' trap nets (10 February to 25 March each year) that closely matches the peak western Australian salmon migration season along the south coast. Australian herring may also be commercially caught by beach seine, set net and line methods 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.

#### **Recreational**

Recreational fishers in South Coast Bioregion estuaries and nearshore waters take a diverse array of finfish species. South Coast Bioregion size and possession limits apply to these species. Refer to the 'Recreational Fishing Guide - South Coast Bioregion' for details. A State-wide Recreational Fishing from Boat Licence (RFBL) was introduced on 2 March 2010. A RFBL is required to undertake any general fishing activity (including crabbing) conducted with the use of a powered boat anywhere in the State.

As many of the recreationally targeted species are also targeted by the commercial sector, resource-sharing issues are a consideration in these fisheries.

#### **Indicator species**

The Department of Fisheries has selected indicator species for monitoring and assessing the status of the finfish resources in the South Coast Bioregion (DoF 2011<sup>1</sup>). Western Australian salmon, black bream and cobbler are indicators for this Bioregion's nearshore and estuarine finfish suites. Australian herring and sea mullet are also significant components of fishery landings in this Bioregion (see West Coast Nearshore and Estuarine Finfish Resources Report for the status of these stocks).

Australian herring and sea mullet are currently assigned to the 'low risk' category (mixed species daily bag limit of 40

<sup>1</sup> Department of Fisheries (DoF). 2011. Resource Assessment Framework (RAF) for Finfish Resources in Western Australia. Fisheries Occasional Publication No. 85. Department of Fisheries, Perth.

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applies to recreational fishers). Western Australian salmon and black bream are assigned to the 'medium risk' category (individual species bag limits of 8 and 4, respectively). Cobbler is assigned to the 'high risk' category (daily bag limit of 4).

### Research summary

Monitoring of fisheries and fish stocks in estuaries and nearshore waters of the South Coast Bioregion is based on commercial catch and effort statistics (CAES) from compulsory monthly returns, recreational catch and effort data from voluntary recreational fisher log books (Research Angler Program) and recreational fishing surveys and fishery-independent surveys to monitor annual juvenile recruitment of various fish species (including Australian herring, western Australian salmon, whiting, mullet and cobbler).

While commercial fishery catch levels are determined annually from data reported in compulsory monthly commercial returns, recreational catch levels are estimated only occasionally when recreational fishing surveys are conducted.

The interpretation of trends in recruitment, catch and catch rates is assisted by the substantial amount of biological information already available for key nearshore and estuarine species.

Regular monitoring of the age structure of fishery landings has recently been implemented for Australian herring, cobbler (Wilson Inlet only) and western Australian salmon. In future, this information will be used to monitor levels of fishing mortality in these stocks, which will be used in conjunction with trends in recruitment and catch rates to assess stock status.

## Retained Species

### Total commercial finfish landings (2011):

**265 tonnes in nearshore waters**

**201 tonnes in estuarine waters**

### Commercial landings by fishery (2011):

**South Coast Salmon 163 tonnes (salmon only)**

**Herring trap net 84 tonnes (herring only)**

**South Coast Estuarine 201 tonnes (finfish only)**

Commercial finfish catches (South Coast Nearshore and Estuarine Table 1) are taken by estuarine fisheries and beach-based nearshore fisheries using trap nets (herring only), gill nets, haul nets and beach seines. Minor quantities of the same species that are taken by other methods (e.g. fish traps and line) are generally not included in this report, although catches by all methods and all fisheries are included in the total catches reported for key species and are taken into account in stock assessments.

In 2011, the total commercial catch of finfish by estuarine and beach-based fisheries in the South Coast Bioregion was 467 t and included at least 38 species. The majority of the catch consisted of western Australian salmon (36% by weight) caught by the South Coast Salmon Managed Fishery,

Australian herring (24%) caught primarily by the trap net fishery, cobbler (14%) and black bream (9%) caught by the South Coast Estuarine Managed Fishery.

In 2011, the nearshore finfish catch was comprised predominantly of western Australian salmon (62% by weight) and Australian herring (35%). The estuarine finfish catch was comprised mainly of cobbler (33%), black bream (22%), sea mullet (15%) and Australian herring (9%).

Since 2000, 95% of landings by the South Coast Estuarine Managed Fishery have been finfish. The non-fish component is dominated by blue swimmer crabs (*Portunus pelagicus*), which ranged from 1 t in 2006 to 39 t in 2001. In 2011, 15 t of blue swimmer crab was reported by this fishery. The majority of estuarine finfish landings were taken by gill nets (91%), with smaller amounts taken by haul nets and fish traps.

### Key finfish species - nearshore

**Western Australian salmon:** This species is targeted commercially in Western Australia and South Australia. Since 2000, 68% of total commercial landings of western Australian salmon in WA have been taken in the South Coast Bioregion, with the remaining 32% taken in the West Coast Bioregion. Within the South Coast Bioregion, the South Coast Salmon Managed Fishery took almost 100% of landings.

Annual commercial landings of western Australian salmon in WA have been highly variable since the commercial fishery commenced in 1944. Peaks in total annual landings occurred in 1968 (4,223 t), 1984 (3,543 t) and 1995 (4,046 t) (South Coast Nearshore and Estuarine Figure 1). Total landings have been declining since 1995, with the decline becoming more pronounced after 2005. In 2011, the total WA catch was 171 t, which was the lowest since the 1940s. The decline since 1995 reflects the trend in the South Coast Bioregion, where the annual catch steadily declined from a peak of 2,728 t in 1995 to 165 t in 2011. Commercial fishery landings of western Australian salmon in South Australia have followed a similar trend since 1995<sup>1</sup>. The historically low catch levels in recent years are believed to be due to a combination of factors – lack of targeting in response to low market demand and reduced availability of fish in some years due to low recruitment and environmental factors affecting catchability.

In the West Coast Bioregion landings of salmon have been in the range 0-1363t. In 2011, 6 t of western Australian salmon was reported (South Coast Nearshore and Estuarine Figure 1). Landings of salmon in the West Coast Bioregion are strongly influenced by the Leeuwin Current and water temperature. Low or nil catches typically occur during years of strong Leeuwin Current (resulting in warmer water along the West Coast).

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<sup>1</sup> Knight MA and Tsolos A. 2012. South Australian Wild Fisheries Information and Statistics Report 2010/11. South Australian Research and Development Institute (Aquatic Sciences), Adelaide. SARDI Publication No. F2008/000804-4. SARDI Research Report Series No. 612. 57pp.

Unusual oceanographic conditions associated with a 'heatwave' event affected the distribution and catchability of salmon and limited the catch in both Bioregions in 2011 (Pearce *et al.* 2011<sup>1</sup>).

#### Key finfish species - estuarine

**Cobbler:** Commercial targeting of cobbler in WA is almost entirely restricted to estuaries. Each estuary hosts a discrete stock of cobbler, which is genetically distinct to other estuarine populations and also distinct to cobbler populations in adjacent ocean waters. From 2000 to 2011, 95% of commercial landings of cobbler were caught in estuaries of the South Coast Bioregion, with 5% taken from estuaries of the West Coast Bioregion. Less than 1% has been taken from ocean waters. Over this period, total annual landings in the South Coast Bioregion ranged from 40 t (in 2004) to 95 t (in 2003), with 79% of these landings caught in Wilson Inlet, 9% from Irwin Inlet, 8% from Oyster Harbour and 3% from Princess Royal Harbour.

In 2011, 65 t of cobbler was caught in the South Coast Estuarine Managed Fishery. The majority (50 t or 78%) of this catch was taken in Wilson Inlet. Wilson Inlet has historically produced the vast majority of South Coast Bioregion landings of cobbler.

In Wilson Inlet, annual cobbler landings steadily increased after the 1940s (minimal catch at this time) until the mid 1980s. Since 1985, annual landings have varied substantially but the overall trend has been stable. Annual landings reached an historical peak of 79 t in 1985 and again in 2003. Fluctuations in landings are believed to mainly reflect variations in the availability of cobbler due to variations in recruitment.

**Black bream:** Commercial targeting of black bream is restricted to estuaries. Each estuary hosts a different stock of black bream. From 2000 to 2011, 93% of commercial landings of black bream in WA were caught in the South Coast Bioregion, with the remaining 7% from the West Coast Bioregion. In the South Coast Bioregion, total landings over this period were mainly taken in Beaufort Inlet (34% of landings), Stokes Inlet (31%), Wilson (15%) and Oyster Harbour (11%). Minor black bream landings were reported in all other estuaries open to commercial fishing over this period.

Since 2000, total annual South Coast Bioregion landings of black bream have ranged from 30 t (in 2000) to 65 t (in 2010). The 2010 catch was the highest recorded in the South Coast Bioregion since 1993 (when the catch was 70 t), mainly due to high landings within Stokes Inlet. In 2011, a total of 44 t of black bream was landed in the South Coast Bioregion.

Since 1980, Stokes Inlet has contributed the greatest proportion of black bream landings of any single South Coast estuary and had the most stable trend in annual landings (average 12 t per year 1980-2011). In 2010, landings rose abruptly to an historical peak of 37 t. In 2011, the catch was

12 t.

Minimal landings of black bream were taken in Beaufort Inlet prior to 1993. From the late 1990s to 2005, landings gradually increased and have remained relatively high in subsequent years. Since 2005, annual landings have ranged from 10 to 26 t. Annual landings of black bream in Wilson Inlet and Oyster Harbour also followed an increasing trend after the late 1990s. Wilson Inlet landings peaked at 18 t in 2005 and Oyster Harbour landings peaked at 12 t in 2008. The catches in these estuaries then declined gradually, reaching 3 t and 5 t, respectively, in 2011. These catch trends appear to be the result of strong recruitment by black bream in Beaufort Inlet, Wilson Inlet and Oyster Harbour in the mid-1990s.

**Recreational catch estimate (2011):** NA

**Most recent catch estimate (2000/01)**

**Nearshore + estuarine:** 368 tonnes  
(key finfish species only)

**Most recent catch estimate (2002/03)**

**Estuarine only** 50 tonnes  
(key finfish species only)

Recreational catch levels of finfish in nearshore and estuarine waters of the South Coast Bioregion were not estimated in 2011. The most recent nearshore estimates are from the National Recreational and Indigenous Fishing Survey conducted in 2000/01 (South Coast Nearshore and Estuarine Table 2). The most recent estuarine estimates are from a creel survey in 2002/03 (South Coast Nearshore and Estuarine Table 3). While the dominant species in the catch are probably similar to those caught in recent surveys, the catch and effort levels by recreational fishers may have changed substantially. Therefore, the current total catch level cannot be estimated.

Overall, the most abundant species in the retained catch (nearshore and estuarine combined for the South Coast Bioregion) in 2000/01 were Australian herring (45% by number), King George whiting (*Sillaginodes punctata*) (12%), skipjack trevally (10%), whiting (various species, excluding King George) (8%), black bream (7%) and western Australian salmon (3%). The nearshore and estuarine waters in the region from Denmark to Esperance contributed 90% of all South Coast Bioregion catches. Shore fishers caught 73% of retained fish in nearshore waters and 28% in estuaries.

In nearshore waters, the most abundant species in the retained catch in 2000/01 were Australian herring (52% by number), skipjack trevally (11%), King George whiting (10%), whiting (various species, excluding King George) (9%) and western Australian salmon (3%). In estuarine waters, the most abundant species in the retained catch in 2000/01 were black bream (39% by number), King George whiting (23%), Australian herring (11%), mullet (*Mugilidae*) (6%) and skipjack trevally (4%).

The 2002/03 survey involved 17 estuaries, including 11 of the 13 estuaries open to commercial fishing (no commercial catches were taken in the remaining 2 estuaries during the study period). The most commonly reported species were King George whiting, black bream, Australian herring,

<sup>1</sup> Pearce, A., Lenanton, R., Jackson, G., Moore, J., Feng, M. and Gaughan, D. 2011. The "marine heat wave" off Western Australia during the summer of 2010/11. Fisheries Research Report No. 222. Department of Fisheries, Western Australia. 40pp.

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skipjack trevally (*Pseudocaranx georgianus*), pink snapper (*Pagrus auratus*), flathead (Platycephalidae), tarwhine (*Rhabdosargus sarba*) and garfish, comprising approximately 80% of all fish (by number) retained by recreational fishers during the survey.

In the commercially-fished estuaries, the recreational catch of these 8 species was estimated to be approximately 29% (by weight) of the combined recreational and commercial catch of these species during the survey period. A total of 48 species were reported in the recreational catch from south coast estuaries. However, the total recreational catch (by weight) of all species could not be estimated in 2002/03 due to uncertainties associated with small samples of less abundant species and limited data on the average size of fish in the catch.

With the inclusion of less abundant species and catches taken in estuaries closed to commercial fishing, the recreational catch share of recreationally-targeted finfish species in South Coast Bioregion estuaries is estimated to be 30-40%. If the landings of non-recreational species (cobbler, sea mullet and yellow-eye mullet) are also included, the recreational catch share of total finfish landings is estimated to be approximately 20%.

In 2002/03, the highest recreational fishing catch and effort of any south coast estuary was reported from the Walpole/Nornalup Inlet, which is closed to commercial fishing. The main species taken in this estuary was black bream, with an estimated recreational catch of 15 t during the survey period.

A comprehensive Statewide Recreational Fishing from Boat survey was undertaken in 2011. Analyses of the survey results from up to 23,000 interviews of recreational boat fishers are due to be completed by the end of 2012. However, catch and effort data from shore-based fishers, who are believed to take the majority of the recreational nearshore and estuarine finfish catch, will not be estimated by this survey. The Department of Fisheries recently conducted a pilot study of shore-based fishers in the Perth Metropolitan area in an attempt to determine the best method to quantify recreational fishing catch and effort from this sector (Smallwood *et al.* 2011<sup>1</sup>).

### Recreational catch share

The recreational catch share of total finfish landings in nearshore and estuarine waters of the South Coast Bioregion cannot be determined for the current year and given there has been no survey for over five years it is not appropriate to estimate the current catch share.

### Fishing effort/access level

#### Commercial

Since 1990, the number of licences in nearshore and estuarine commercial fisheries has been substantially reduced via a Voluntary Fishery Adjustment Scheme (VFAS) (i.e. licence

buy-backs). The removal of licences has eliminated a significant amount of latent effort (inactive licences) that previously existed in these fisheries.

Fishing effort in nearshore and estuarine fisheries is sometimes reported as the number of units of access (vessels, teams, licensees, etc). These measures of effort provide a general indication of effort changes over time and are often the only types of effort data available throughout the history of each fishery. Where possible, effort is also calculated as the number of days fished by each method. It is considered that 'method days fished' generally provides a more accurate measure of the effort undertaken in each fishery.

The commercial method of fishing for western Australian salmon and Australian herring (i.e. beach-based netting) includes a considerable amount of time spent observing or searching for fish ('spotting'). Hence effort in these fisheries is difficult to accurately quantify. The number of licensed teams that operate during each fishing season provides an approximate measure of effort in these fisheries.

**South Coast Estuarine Fishery:** Declines in total fishery effort over the past decade reflect a reduction in the number of licensees in the fishery due to a VFAS. This resulted in the number of licensees being reduced from 66 in 1987 to 25 in 2002.

The total annual reported fishing days peaked at 6,747 days in 1992 and then steadily declined until about 2004. Similarly, the average number of boats fishing per month peaked at 42.9 in 1992 and then declined. Total effort assessed as both the number of fishing days and the average number of boats fishing per month has followed a stable trend in recent years. In 2011, the fishery reported a total of 3,320 fishing days and an average of 18 boats fished per month.

In 2011, 48% of effort (method days) occurred in Wilson Inlet, 16% in Oyster Harbour, 14% in Princess Royal Harbour, 8% in Irwin Inlet, 5% in Broke Inlet, 5% in Beaufort Inlet and 4% in Stokes Inlet. The remaining effort (<1%) occurred in Oldfield River, Jerdacuttup Lakes and Culham Inlet. Three estuaries (Gordon Inlet, Hamersley River and Waychinicup Inlet) were not fished during 2011.

**Herring trap net fishery:** The total number of licensed teams reached a peak of 30 in 1984, and has since been reduced by a VFAS to the current level of 11 (operating from 10 beaches). In 2011, only 2 teams recorded effort during the season. This is a continuation of the low participation level in this fishery in recent times. Commercial fishers report that these historically low effort levels are in response to the lack of markets and low wholesale prices paid for Australian herring.

**South Coast Salmon Fishery:** Since 1999, there have been 18 licensed teams in this fishery. Some teams are inactive each year. Effort (number of active teams) has followed a declining trend since 2002. In 2011, western Australian salmon landings were reported by 5 of the 18 licensed teams.

#### Recreational

Current estimates of recreational effort for the South Coast Bioregion are unavailable.

The 2000/01 National Recreational and Indigenous Fishing Survey, which included all methods and Bioregions, provided the most recent information on total recreational fishing

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<sup>1</sup> Smallwood CB, Pollock KH, Wise BS, Hall NG and Gaughan DJ. 2011. Quantifying recreational fishing catch and effort: a pilot study of shore-based fishers in the Perth Metropolitan area. Fisheries Research Report 216. Department of Fisheries, Perth.

effort in the South Coast Bioregion. About 90% of the nearshore and estuarine 'fishing events' that were targeting finfish during the survey used line fishing (bait or lure). About 85% of all line fishing events occurred in nearshore waters. The estimated nearshore line fishing effort in 2000/01 comprised 223,158 shore-based and 50,368 boat-based fishing events during the 12-month survey period. In estuaries, the line fishing effort comprised 21,800 shore-based and 30,087 boat-based fishing events.

Recreational fishing effort in 17 south coast estuaries was estimated by a creel survey conducted in 2002/03. Total effort during the survey period was estimated at 254,171 fisher hours or 86,482 fisher days. This total included boat-based (202,658 hours), shore-based (47,816 hours) and house boat (3,698 hours) fishing. Recreational netting and charter boat effort was not quantified in this survey, but was considered to have been negligible (less than 2% of total effort).

In the 2002/03 survey, recreational fishing effort was estimated to have occurred mainly in Walpole/Nornalup Inlet (33% of total effort), Oyster Harbour (29%), Princess Royal Harbour (12%), Wilson Inlet (12%) and Wellstead Estuary (6%).

The 2011 Statewide Recreational Boat Fishing Survey will provide recreational boat fishing effort data for the South Coast Bioregion in 2012.

## Stock Assessment

**Assessment complete:** Yes

<b>Assessment level and method:</b>	<b>Level 2 - Catch rates</b>
<b>Breeding stock levels:</b>	
<b>Australian herring<sup>1</sup></b>	<b>Uncertain</b>
<b>Western Australian salmon</b>	<b>Adequate</b>
<b>Black bream (Stokes Inlet)</b>	<b>Adequate</b>
<b>Black bream (Beaufort Inlet)</b>	<b>Adequate</b>
<b>Black bream (Wilson Inlet)</b>	<b>Adequate</b>
<b>Black bream (Oyster Harbour)</b>	<b>Adequate</b>
<b>Black bream (Walpole-Nornalup Inlet)</b>	<b>Not assessed</b>
<b>Cobbler (Wilson Inlet)</b>	<b>Adequate</b>
<b>Cobbler (Oyster Harbour)</b>	<b>Adequate</b>

### Indicator species - nearshore

**Western Australian salmon:** Western Australian salmon form a single breeding stock across southern Australia. Spawning occurs mainly along the lower west coast of WA. The Leeuwin Current disperses eggs and larvae to coastal nurseries distributed from the West Coast Bioregion to Victoria. Adult western Australian salmon undertake a westward migration along the southern coast of Australia to

the West Coast Bioregion, where they spawn during autumn. Western Australian salmon then migrate back to the South Coast Bioregion (but not to South Australia or Victoria) after spawning. Traditionally, commercial fishers in WA have targeted western Australian salmon during the autumn (mainly March/April) pre-spawning migration, with approximately 95% of South Coast landings and 100% of West Coast landings taken during the January-June period each year. On the South Coast, this percentage has been declining since 1995, reaching a historical minimum of 46% in 2011. The temporal shift in the distribution of South Coast landings appears to be due to the combined effects of market demand (declining demand during January-June) and changes in fish behaviour due to environmental factors. In 2011, a 'heatwave' event in coastal waters reduced the catchability of fish during January-June (Pearce *et al.* 2011<sup>2</sup>).

Total landings of western Australian salmon in WA have been declining since 1995, with the decline becoming more pronounced after 2005. This trend has been primarily driven by declining landings in the South Coast Bioregion, where the majority of the annual catch is traditionally taken. The South Coast Bioregion commercial catch and catch rate have been declining since 1995 (South Coast Nearshore and Estuarine Figures 1 and 2). In 2011, the catch (165 t) and catch rate (8 t per team) reached their lowest levels since the commencement of the South Coast fishery in the 1940s. Reduced targeting of western Australian salmon by commercial fishers is believed to be the main reason for declining South Coast catches and catch rates, due to the lack of markets and low wholesale prices paid for this species. Reduced availability of fish due to low recruitment and environmental factors may have also contributed to low catches in some years.

In contrast to the South Coast, catches and catch rates of western Australian salmon on the West Coast have followed a more stable trend and have remained within their historical ranges in recent years. In 2011, a relatively low catch (6 t) and catch rate (<1 t per team) was reported. However, low annual catches and catch rates have occurred several times in the past in the West Coast Bioregion, and so 2011 levels were not exceptional (South Coast Nearshore and Estuarine Figure 1).

Low catches of salmon in the West Coast Bioregion typically occur during years of strong Leeuwin Current (resulting in warmer water along the West Coast). The low catch in 2011 was likely due to a 'heatwave' event during the spawning period, when a strong Leeuwin Current and unusually high water temperatures discouraged the northward migration of western Australian salmon. This behavioural response, resulting in low catches, was also observed in 2000 when a strong Leeuwin Current resulted in above average water temperatures on the West Coast.

Annual recruitment by juvenile (less than 1 year old) western Australian salmon has been variable since recruitment surveys commenced in 1994 but the long-term trend has been

<sup>1</sup> The stock assessment for Australian Herring is presented in the West Coast Nearshore and Estuarine Fisheries Report

<sup>2</sup> Pearce, A., Lenanton, R., Jackson, G., Moore, J., Feng, M. and Gaughan, D. 2011. The "marine heat wave" off Western Australia during the summer of 2010/11. Fisheries Research Report No. 222. Department of Fisheries, Western Australia. 40pp.

## SOUTH COAST BIOREGION

stable. Relatively high recruitment in 2008 and 2009 was followed by relatively low recruitment in 2010 and 2011 (South Coast Nearshore and Estuarine Figure 3). Low recruitment in 2011 is attributed to the effects of the 'heatwave' event. Levels of annual recruitment provide an indication of future breeding stock level and are likely to influence catch rates 3-4 years later when each year class recruits to the fishery.

### Indicator species - estuarine

**Cobbler:** Commercial targeting of cobbler in WA is restricted to estuaries. Each estuary hosts a discrete stock of cobbler, which is genetically distinct to other estuarine populations and also distinct to cobbler populations in adjacent ocean waters. Historically, commercial targeting of cobbler in the South Coast Bioregion has mainly occurred in Wilson Inlet and in the estuaries around Albany (Oyster Harbour, Princess Royal Harbour).

Commercial catch rates suggest a stable long-term trend in the availability of cobbler in Wilson Inlet and Oyster Harbour since 1980 (South Coast Nearshore and Estuarine Figure 4). Catch rates suggest a slight increase in availability in these estuaries after 2000. The Department of Fisheries has conducted annual fishery-independent surveys of juvenile recruitment of cobbler in Wilson Inlet since 2006. Information from these surveys will assist in interpreting variations in catch and catch rates. Regular monitoring of the age structure of fishery landings was recently implemented in Wilson Inlet. In future, this information will be used to monitor levels of fishing mortality in this stock, which will be used in conjunction with trends in recruitment and catch rates to assess stock status.

**Black bream:** Black bream are restricted to estuaries. Each estuary hosts a discrete stock of black bream, which is genetically distinct to other estuarine populations.

The majority of commercial black bream landings in the South Coast Bioregion are taken in four main estuaries - Stokes Inlet, Beaufort Inlet, Wilson Inlet and Oyster Harbour. From 1980 to 1995, commercial catch rates in these estuaries were relatively low and followed a stable trend, then steadily increased until about 2005 (South Coast Nearshore and Estuarine Figure 5). Since 2005, catch rates have remained relatively high in Beaufort Inlet, Oyster Harbour and Stokes Inlet. The catch rate has been declining since 2005 in Wilson Inlet, although recent levels are still high relative to historical levels.

Black bream landings vary in response to environmental factors in individual estuaries. The simultaneous increases in catch rates in numerous South Coast Bioregion estuaries from 1995 to 2005 suggest that a widespread factor, such as rainfall, has influenced black bream availability and recruitment across the region.

The current status of black bream in Walpole-Nornalup Inlet (closed to commercial fishing) cannot be assessed due to lack of recent data.

## Non-Retained Species

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

The small-scale commercial fisheries in nearshore and estuarine waters mainly use gill, seine and haul nets that are deployed in a targeted manner. Few non-target species are

taken. Mesh size regulations ensure that target species caught by these methods are within an appropriate size range. Minimal discarding occurs because virtually all fish taken can be retained and marketed.

Recreational fishers mainly use line-based methods in nearshore and estuarine waters. This method can result in the capture and release of a significant number of non-target species and undersized fish. The risks associated with post-release mortality vary considerably among species. In general, fish in nearshore and estuarine waters are captured from shallow depths and suffer less barotrauma-related injuries than deep water species.

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

It is compulsory for commercial fishers to report all interactions with protected listed marine species. New Zealand fur seals and Australian sea lions are occasionally surrounded by beach seine nets used in the South Coast nearshore and estuarine fisheries, but are released immediately by the fishers. This is possible because seine netting is a labour-intensive operation and the fishing team will immediately notice a seal in the net. Fishers are able to release a seal from their seine net without injury to the animal.

The abundance of fur seals on the south coast has steadily increased over the last 15 years, resulting in an increasing level of interaction with fishers, especially in estuaries of the Albany region (R. Campbell, pers. comm.). There have been no reports of incidental mortalities of seals in these fisheries and it is believed that the present level of interaction (direct and indirect) is not a significant threat to the populations of fur seals and sea lions. An assessment of the impact of interactions is performed on an annual basis and, if required, appropriate management plans will be devised to mitigate these interactions.

Very low numbers of estuarine birds sometimes interact with fishing nets but the risks to these populations are negligible. One duck was reported in 2011 and this was released alive.

Recreational fishers using line-fishing methods are unlikely to capture protected species. Interactions are expected to be insignificant or nil.

## Ecosystem Effects

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

Excessive removal by commercial and recreational fisheries of certain species, such as Australian herring or western Australian salmon, from the food chain could potentially impact on prey and predator species including larger fish, cetaceans and seabirds. However, commercial fishing effort directed towards these species in recent years has been relatively low and declining. Recreational fishing effort directed towards Australian herring is relatively high.

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

The operation of gill nets and haul nets over predominantly sand and mud bottoms is unlikely to have any impact on these habitats in estuaries and nearshore waters. Similarly, the line fishing methods used by recreational fishers have a

negligible impact on the bottom substrates. Anchoring by recreational fishing vessels may have localised impacts on habitats such as seagrass.

Haul nets may be deployed over low or medium density seagrass. This type of net tends to 'roll' over the surface of seagrass beds without removing attached leaves or uprooting plants. At times, haul nets may collect floating vegetation including seagrass leaves or algae.

## Social Effects

### Commercial

In 2011, there were approximately 18 commercial fishers involved in the South Coast Salmon Fishery and approximately 8 commercial fishers involved in the South Coast herring trap net fishery. In 2011, the South Coast Estuarine Managed Fishery employed an average of 22 fishers per month. Additional employment is created by these fisheries in the processing and distribution networks and retail fish sales sectors.

Australian herring and western Australian salmon fisheries in the South Coast Bioregion supply WA bait and human consumption markets. The South Coast Estuarine Fishery is an important source of fresh local fish to regional centres. Additionally, a small proportion of estuarine landings are sold to zoos across Australia as animal food.

The use of trap nets and seine nets by Australian herring and western Australian salmon fishers may temporarily impact on beach access by members of the public.

### Recreational

The 2000/01 National Recreational and Indigenous Fishing Survey estimated that approximately 12% of the State's total recreational fishing effort occurred in the South Coast Bioregion (Henry and Lyle 2003<sup>1</sup>, Barharthah 2006<sup>2</sup>). Fish resources in estuaries and nearshore waters of the Bioregion are a focus for recreational fishers and have a high social value in the region.

Within the South Coast Bioregion, approximately 21% of the recreational fishing effort is estimated to occur in estuaries and rivers. A high proportion of people who fish in each South Coast estuary are non-residents, travelling from Perth, other WA regions or interstate. Consequently, fishing in South Coast estuaries has a great benefit to local tourism.

Australian herring is the most common finfish species retained by recreational fishers in the South Coast Bioregion (and in WA) and therefore has high social value. In 2000/01 Australian herring were estimated to comprise 15% of all finfish retained by South Coast recreational fishers.

Interviews conducted during the 2011/12 Statewide Recreational Boat Fishing Survey will provide important new data on the social aspects of boat-based fisheries in the South Coast Bioregion (results due in late 2012).

<sup>1</sup> Henry GW and Lyle JM. 2003. The National Recreational and Indigenous Fishing Survey. FRDC Project No. 99/158. NSW Fisheries Final Report Series No. 48.

<sup>2</sup> Barharthah T. 2006. Department of Fisheries community survey 2005. Fisheries Occasional Paper No. 33. Department of Fisheries, Perth.

## Economic Effects

**Estimated annual value (to fishers) for 2010/11:**

**South Coast Estuarine Fishery**

(finfish landings only) **Level 1 - < \$1 million**

**South Coast Salmon + Herring trap net fisheries**

**Level 1 - < \$1 million**

## Fishery Governance

### Commercial

#### Current Fishing (or Effort) Level

**South Coast Estuarine Fishery** **Acceptable**

**Herring trap net fishery** **Under Review**

**South Coast Salmon Fishery** **Under Review**

#### Target commercial catch range:

**South Coast Estuarine Fishery** **200 – 500 tonnes**

**South Coast herring** **475 – 1,200 tonnes**

**Salmon (South Coast + South West Fisheries)**

**1,200 – 2,800 tonnes**

The 2011 South Coast Estuarine Managed Fishery total catch of finfish (201 t) was within the target range of 200-500 t.

The 2011 South Coast Bioregion commercial catch of Australian herring (84 t) was below the target range. Low catches in 2011 are due to the combined effects of low availability of fish in the South Coast Bioregion due to ongoing low recruitment and lack of targeting due to weak market demand. The South Coast herring catch has now been below the target range for 8 consecutive years.

The total catch of western Australian salmon (West Coast and South Coast landings combined) in 2011 (171 t) was below the target range. The salmon catch has now been below the target range for 5 consecutive years. Low catches are believed to be due to the combined effects of lack of targeting due to weak market demand, low catchability due to environmental factors (relatively high water temperatures) and low availability of fish due to recruitment variation (South Coast Nearshore and Estuarine Figure 4).

*The performance measure for the South Coast Salmon Fishery relates to annual salmon commercial catch, which is taken predominantly during the spawning season and is therefore an indicator of breeding stock levels. In 2011, the catch was below the target range. However, the low catch was primarily due to limited targeting due to weak market demand, low recruitment and low catchability due to environmental factors. Collectively, all available information suggests that the total breeding stock level was adequate in 2011.*

### Recreational

**Current Fishing (or Effort) Level:** **Not available**

**Target catch range:** **Not developed**



## SOUTH COAST BIOREGION

### New management initiatives (for the next year)

The Department has no new management initiatives planned for the South Coast Bioregion nearshore or estuarine fisheries. Should the research projects mentioned in this section provide information suggesting an increased risk to sustainability, the Department will consult with the fishing sectors and introduce the appropriate arrangements as required.

### External Factors

Climate change is expected to have impacts on nearshore and estuarine ecosystems. Changes in environmental variables such as ocean temperature, currents, winds, nutrient supply, rainfall, ocean chemistry and extreme weather conditions are expected to have major impacts on marine ecosystems (Hobday *et al.* 2008<sup>1</sup>). These impacts are expected to create both difficulties and opportunities for fisheries.

In 2011, a very strong Leeuwin Current resulted in unusually warm ocean temperatures in coastal waters of the southern West Coast Bioregion and the western South Coast Bioregion (Pearce *et al.* 2011<sup>2</sup>). This 'heatwave' event resulted in atypical distributions of various species (e.g. tropical species occurring in temperate waters) and unusual fish behaviour. The event altered the distribution and behaviour (eg. spawning activity, migration) of western Australian salmon and Australian herring, which reduced catch levels of these species in 2011 and may continue to affect them in subsequent years (due to effects on recruitment).

It is likely that annual variation in coastal currents (particularly the Leeuwin and Capes Currents) influences the recruitment patterns of larvae of nearshore species such as Australian herring and western Australian salmon and thus their subsequent recruitment into each region. Coastal currents also influence the distribution and catchability of adult fish. For example, warmer beach water temperatures are associated with lower catchability of western Australian salmon.

On the south coast, an increased abundance of fur seals (R. Campbell, pers. comm.), which consume Australian herring and western Australian salmon, could have impacted on stock levels in recent years. Western Australian salmon also consume Australian herring.

Fluctuating market demand is a significant factor affecting the annual commercial catch level of many species. Limited demand and low wholesale prices paid for Australian herring and western Australian salmon in recent years have limited commercial catch and effort levels. By purchasing only a limited quantity of Australian herring and western Australian salmon each year, fish processors effectively restrict catch levels. Commercial fishers sometimes elect not to capture a school of fish, or release part of their catch, when a market is not available.

Variations in the abundance of target species in South Coast Bioregion estuaries are largely driven by environmental factors, independent of fishing. These factors, which are outside the control of the Department of Fisheries, often have a dominant influence on the commercial catch and effort from year-to-year. For example, high rainfall may contribute to higher catches of black bream.

Catchment processes, such as clearing of vegetation, flow regulation and nutrient input, can have major downstream effects on estuary condition and on fishery production. Attempts to quantify the influence of these complex, interacting factors on fishery production are difficult with the limited biological and environmental monitoring data that are available from South Coast Bioregion estuaries.

The influence of environmental factors on recruitment to estuaries is further complicated by the practice of human intervention to breach estuarine sandbars, mostly for reasons related to estuarine amenity coupled with ecosystem 'health'.

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<sup>1</sup> Hobday, AJ, Poloczanska, ES and Matear, RJ (eds) (2008). Implications of Climate Change for Australian Fisheries and Aquaculture: a preliminary assessment. Report to the Department of Climate Change, Canberra, Australia. August 2008.

<sup>2</sup> Pearce, A., Lenanton, R., Jackson, G., Moore, J., Feng, M. and Gaughan, D. 2011. The "marine heat wave" off Western Australia during the summer of 2010/11. Fisheries Research Report No. 222. Department of Fisheries, Western Australia. 40pp.

**SOUTH COAST NEARSHORE AND ESTUARINE TABLE 1**

Total annual catches of finfish (except sharks and rays) from the estuarine and beach-based nearshore commercial fisheries in the South Coast Bioregion, 2007 to 2011.

Species	Scientific name	Catch (tonnes)				
		2007	2008	2009	2010	2011
Western Australian salmon	<i>Arripis truttaceus</i>	246.2	545.1	258.0	291.3	164.9
Australian herring	<i>Arripis georgianus</i>	192.2	236.3	151.3	182.7	110.1
Cobbler	<i>Cnidoglanis macrocephalus</i>	68.1	77.4	86.6	69.8	64.9
Black bream	<i>Acanthopagrus butcheri</i>	46.2	37.8	50.0	65.5	43.8
Sea mullet	<i>Mugil cephalus</i>	52.9	21.8	26.3	32.2	29.6
Southern sea garfish	<i>Hyporhamphus melanochir</i>	18.0	16.8	7.6	13.7	10.8
King George whiting	<i>Sillaginodes punctata</i>	8.0	9.1	6.8	7.0	7.8
Flathead	Platycephalidae	9.1	9.2	5.2	3.0	3.6
Leatherjacket	Monocathidae	6.7	5.5	2.9	5.6	4.8
Silver bream (Tarwhine)	<i>Rhabdosargus sarba</i>	3.1	5.3	2.7	2.8	6.1
Yellow-eye mullet	<i>Aldrichetta forsteri</i>	3.0	4.6	3.4	2.6	3.7
Trevally	Carangidae	3.1	2.4	2.9	2.1	2.0
Snapper	<i>Pagrus auratus</i>	3.2	3.6	1.9	0.9	1.3
Snook	<i>Sphyraena novaehollandiae</i>	2.4	2.9	2.4	1.3	1.7
Grunter (Trumpeter)	Teraponidae	2.5	0.3	1.7	0.3	1.6
Flounder	Pleuronectidae	1.7	1.1	0.2	1.5	1.3
Scaly Mackerel	<i>Sardinella lemuru</i>	1.1	0.5	0.9	0.4	0.3
Yellowtail scad	<i>Trachurus novaezelandiae</i>	1.1	0.3	0.2	0.6	0.8
Mulloway	<i>Argyrosomus japonicus</i>	0.2	0.5	0.3	0.4	0.7
Yellow fin whiting	<i>Sillago schombergkii</i>	0.1	1.1	0.2	0.2	0.2
Other finfish	Teleostei	3.7	3.7	3.5	3.9	6.2
<b>TOTAL</b>		<b>672.7</b>	<b>985.4</b>	<b>615.3</b>	<b>687.8</b>	<b>466.2</b>

**SOUTH COAST NEARSHORE AND ESTUARINE TABLE 2**

Estimated total recreational catches of key species in nearshore and estuarine waters in the South Coast Bioregion in 2000/01 (Henry and Lyle 2003<sup>1</sup>).

Species	Scientific name	2000/01 Catch (tonnes)
Western Australian salmon	<i>Arripis truttaceus</i>	117
Trevally	<i>Pseudocaranx</i> spp.	93
Australian herring	<i>Arripis georgianus</i>	79
King George whiting	<i>Sillaginodes punctata</i>	40
Black bream	<i>Acanthopagrus butcheri</i>	28
Whiting	<i>Sillago</i> spp.	11
TOTAL		368

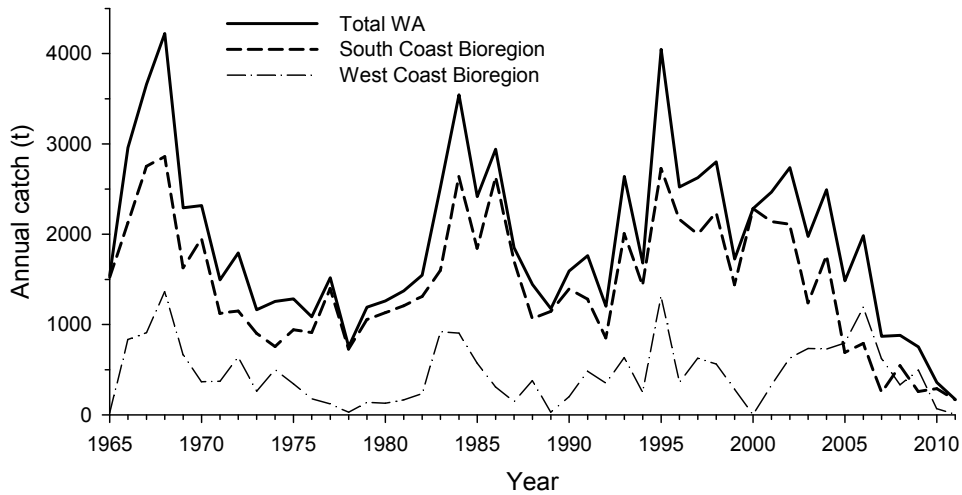
**SOUTH COAST NEARSHORE AND ESTUARINE TABLE 3**

Estimated total recreational catches of key species in estuaries in the South Coast Bioregion in 2002/03 (Smallwood and Sumner 2007<sup>2</sup>).

Species	Scientific name	2002/03 Catch (tonnes)
Black bream	<i>Acanthopagrus butcheri</i>	23.3
King George whiting	<i>Sillaginodes punctata</i>	10.9
Trevally	<i>Pseudocaranx</i> spp.	6.1
Australian herring	<i>Arripis georgianus</i>	4.1
Southern blue-spotted flathead	<i>Platycephalus speculator</i>	2.6
Pink snapper	<i>Pagrus auratus</i>	2.6
Tarwhine	<i>Rhabdosargus sarba</i>	0.5
Southern sea garfish	<i>Hyporhamphus melanochir</i>	0.2
TOTAL		50.3

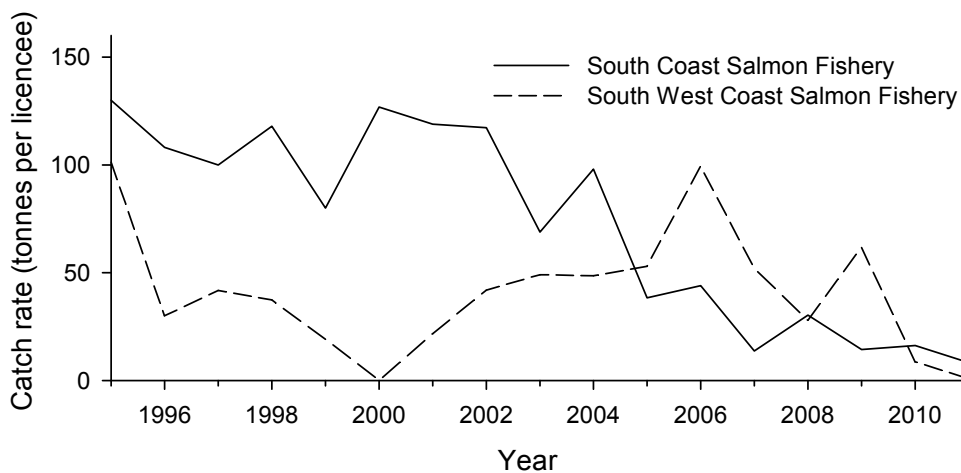
<sup>1</sup> Henry GW and Lyle JM. 2003. The National Recreational and Indigenous Fishing Survey. FRDC Project No. 99/158. NSW Fisheries Final Report Series No. 48.

<sup>2</sup> Smallwood CB and Sumner NR. 2007. A 12-month survey of recreational estuarine fishing in the South Coast bioregion of Western Australia during 2002/03. Fisheries Research Report 159. Department of Fisheries, Perth.



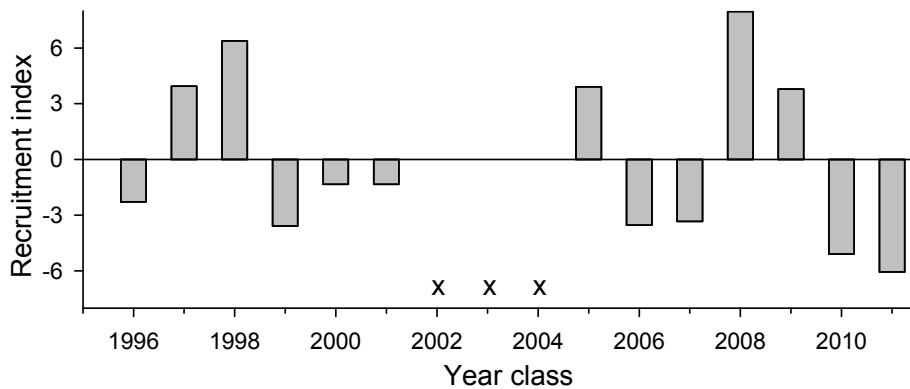
**SOUTH COAST NEARSHORE AND ESTUARINE FIGURE 1**

Total annual commercial catches of western Australian salmon in the South Coast and West Coast Bioregions, 1965 – 2011.



**SOUTH COAST NEARSHORE AND ESTUARINE FIGURE 2**

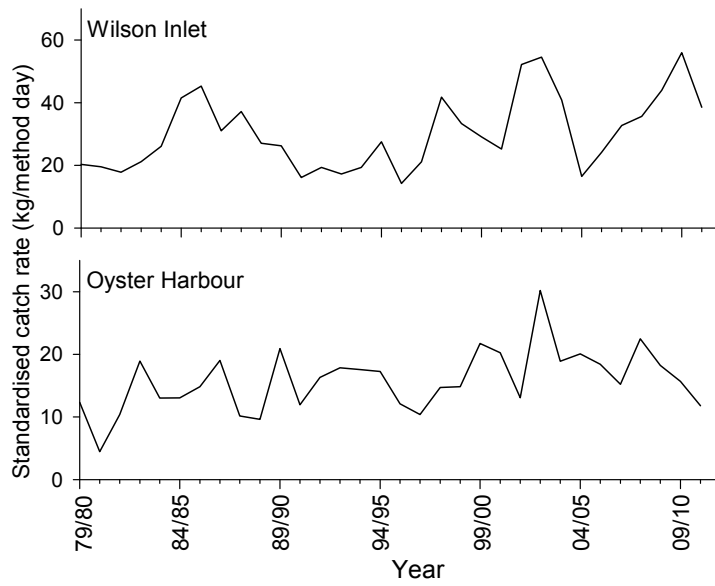
Total annual commercial catch rate (tonnes per licensee per year) of western Australian salmon in the South Coast Salmon Fishery (South Coast Bioregion) and the South West Coast Salmon Fishery (West Coast Bioregion), 1995 – 2011.



**SOUTH COAST NEARSHORE AND ESTUARINE FIGURE 3**

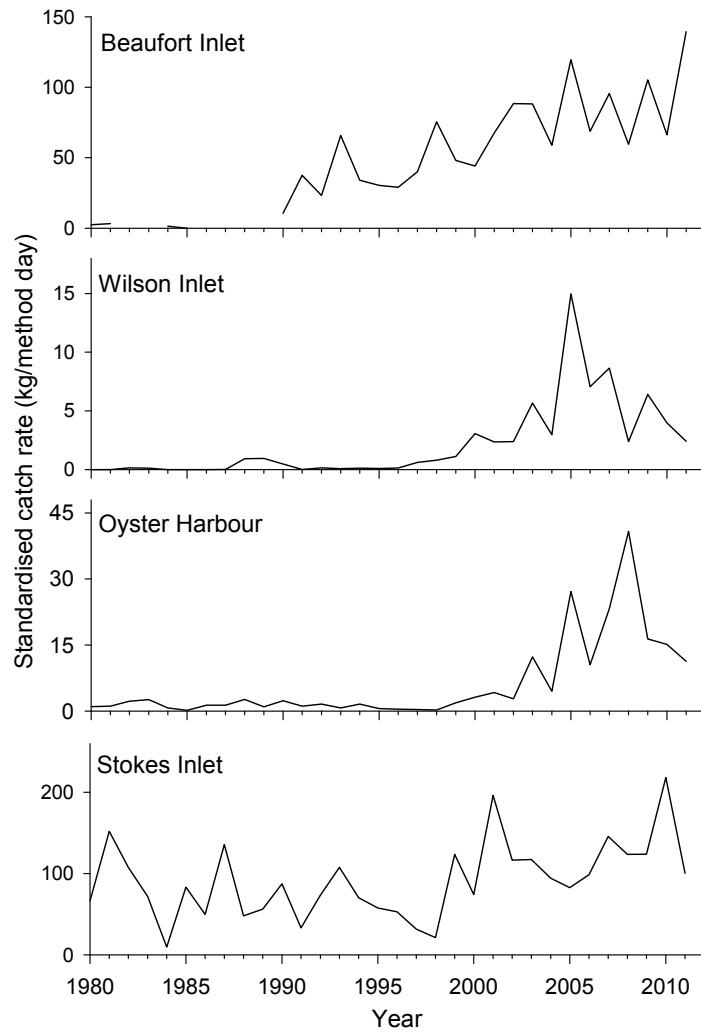
Annual fishery-independent relative recruitment index for western Australian salmon in the South Coast Bioregion, 1996 – 2011. (x – no sampling conducted in that year). Bars above the line reflect better than average number of recruits.

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**SOUTH COAST NEARSHORE AND ESTUARINE FIGURE 4**

Annual commercial catch rates of cobble in Wilson Inlet and Oyster Harbour, 1979/80 – 2010/11.



**SOUTH COAST NEARSHORE AND ESTUARINE FIGURE 5**

Annual commercial catch rates of black bream in Beaufort Inlet, Wilson Inlet, Oyster Harbour and Stokes Inlet, 1980 – 2011.

# South Coast Purse Seine Fishery Report: Statistics Only

B. Molony, E. Lai and M. Stadler

## Fishery Description

The South Coast Purse Seine Managed Fishery (SCPSF) is based on the capture of pilchards (*Sardinops sagax*) by purse seine nets in the waters between Cape Leeuwin and the Western Australia/South Australia border. The South Coast Purse Seine Management Plan 1994 also covers the take of yellowtail scad (*Trachurus novaezelandiae*), Australian anchovy (*Engraulis australis*), scaly mackerel (*Sardinella lemuru*), sandy sprat (*Hyperlophus vittatus*) blue sprat (*Spratelloides robustus*) and maray (*Etrumeus teres*).

### Boundaries

The SCPSF consists of five Management Zones (South Coast Purse Seine Fishery Figure 1). Zone 1 extends from Peak Head to Vancouver Peninsula (the waters in and around King George Sound, Albany). Zone 2 extends from Point D'Entrecasteaux to Cape Knob. The Bremer Bay Zone (Zone 3) extends from Cape Knob to longitude 120°E. The large Esperance Zone (Zone 4) extends from 120°E to the WA/SA border. An additional zone (Zone 5) exists between Cape Leeuwin and Point D'Entrecasteaux but has not been significantly fished to date. The Zones are broken down into finer spatial scale blocks for reporting of catch and effort in the mandatory Catch and Effort Disposal forms but for this report catches are reported for the major zones (Zones 1 and 2 combined; Zone 3 and Zone 4 separately) plus the total catches (South Coast Purse Seine Fishery Figure 2).

### Management arrangements

This SCPSF is primarily managed through output controls in the form of individual transferable quota (ITQ) units. Four of the five zones in the fishery (i.e. zones 1 – 4) have been allocated a set amount of ITQ units whose values are determined by dividing the total allowable catch (TAC) for that zone by the total number of units allocated to that zone. The TAC has been relatively stable over the past 10 years and will be reviewed on an as needs basis but is primarily dependant on the status of fish stocks. The total number of units allocated across each of the four zones in the fishery amount to 890 and remained unchanged from the previous season. The quota season for the SCPSF runs from 1 July to 30 June each year. The Albany zone has an annual TAC of 2683 tonnes, while both the Bremer Bay and Esperance zones each have an annual TAC of 1500 tonnes. Zone 5 of the fishery is considered a development zone and can only be fished by a licence holder in the SCPSF with a minimum holding in another zone, it has no specific TAC or units and has not been fished for a number of years.

### Landings and Effort

Effort in the SCPSF was lower in 2010/11, with a total of 1,186 days of fishing (2009/10: 1,450 days). Effort was lower in Albany Zones (Zones 1 and 2), similar in the Esperance Zone (Zone 4), with an increase in effort reported from the Bremer Bay Zone (Zone 3).

Commercial pilchard catches during the 2010/11 was 2,272 t, lower than in 2009/10 (2,647 t) but still trending upward

since the late 1990s (South Coast Purse Seine Figure 2), further underlining the recovery in biomass since the pilchard virus. The 2010/11 catch was the second highest since 1998. Less than 5 t of other pelagic species were also landed, dominated by yellowtail scad.

Most of the commercial catches were reported from the Albany Zones (1,241 t). However, overall effort and catches remain below those recorded during the late 1980s and 1990s.

## Fishery Governance

**Target commercial effort range: Not available**

For the 2010/11 season, the total pilchard catch (2,272 t) was well below the total TAC for the entire fishery (5,683 t) (South Coast Purse Seine Fishery Table 1) with catches from each of the Management Zones remaining well below their respective TACs. The fleet and infrastructure for this fishery continues to rebuild but reports of below market size fish (i.e. small fish) in Bremer Bay and Esperance influence how much of the TAC is caught. These factors, combined with the variability in unit holdings within the fishery and resultant variability in fishing behaviour by different operators, mean that it is not possible to estimate a target effort range for the fishery.

**Current Fishing (or Effort) Level: Acceptable**

Based on the most recent assessment (completed in 2006) and the recent history of the fishery, the level of spawning biomass in each Management Zone is likely to be appropriate and the current level of fishing is acceptable. Further, catches in other jurisdictions are also increasing further supporting the continued increase and recovery of the biomass of pilchards across southern Australia.

### New management initiatives (2011/12)

In 2006 the SCPSF industry met to develop a strategy to manage bycatch of flesh-footed shearwaters (*Puffinus carneipes*) in the Fishery, focussing on Zone 1 (King George Sound, Albany) where interactions with these birds was occurring. A bycatch committee, with representation from the Conservation Council of WA, Department of Environment and Conservation, the WA Fishing Industry Council, SeaNet, Department of Fisheries and operators in the SCPSF was formed to address the issue. This led to the establishment of the SCPSF protected species bycatch mitigation program.

From the 2006 /07 season to present, the SCPSF protected species bycatch mitigation program has undertaken a range of measures to monitor and mitigate shearwater bycatch during the peak interaction period between 1 March to April 30. Bycatch mitigation measures are reviewed annually and continually being refined and improved.

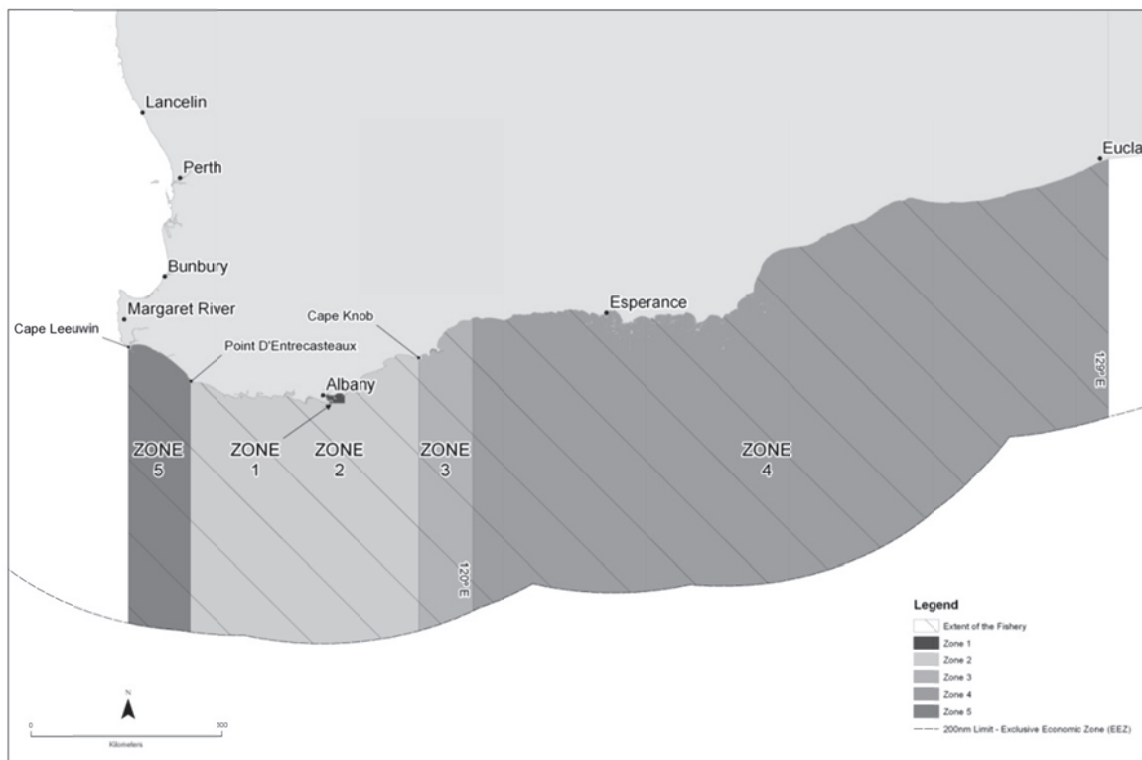
There are no significant legislative management changes planned for this fishery.

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**SOUTH COAST PURSE SEINE FISHERY TABLE 1**

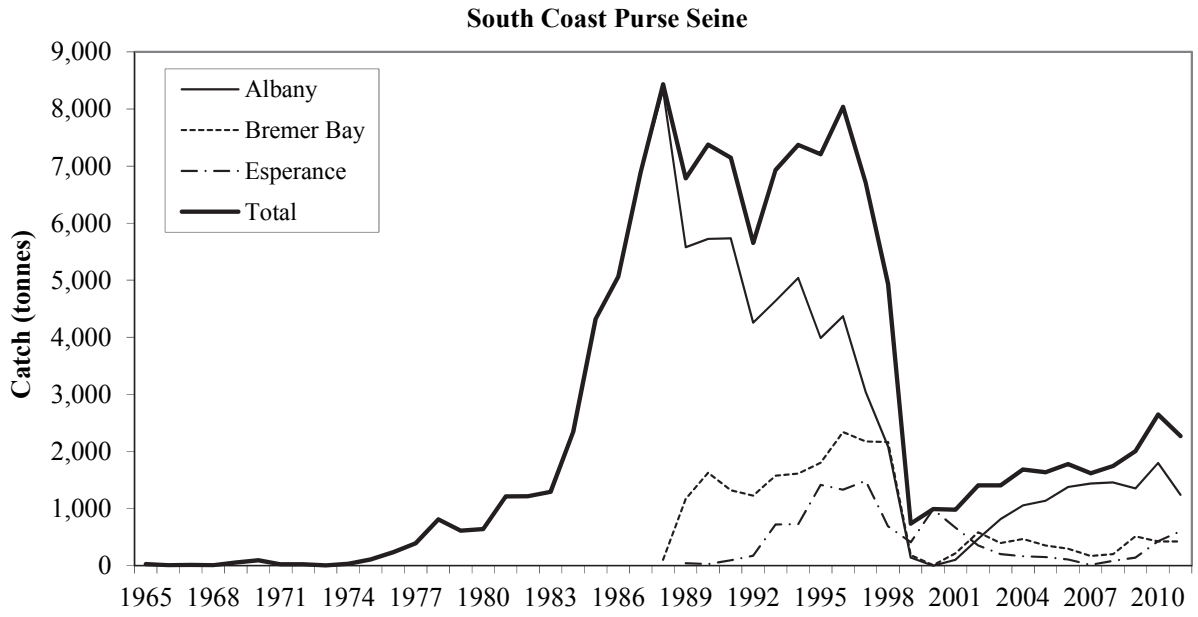
2010/11 pilchard catches and TACs in tonnes (t) for each of the major Management Zones. \* less than 5 vessels operated in each of these zones in 2010/11 and cannot be reported.

Management Zone	TAC (t)	2009/10 catch (t)	2009/10 catch as percent of TAC
Albany (Zones 1 and 2)	2,683	1,241	46.3%
Bremer Bay (Zone 3)	1,500	*	-
Esperance (Zone 4)	1,500	*	-
Total for Fishery	5,683	2,272	40.0 %



**SOUTH COAST PURSE SEINE FISHERY FIGURE 1**

Map of the extent of the Mackerel Managed Fishery.



**SOUTH COAST PURSE SEINE FISHERY FIGURE 2**

Annual catches of pilchards along the south coast, by major fishing zone, 1965 – 2010/11.



# Temperate Demersal Gillnet and Demersal Longline Fisheries Status Report

R. McAuley and F. Rowland

Main Features			
<b>Status</b>		<b>Current Landings (2010/11)</b>	
Stock level		Demersal Gillnet and Demersal Longline Fishery	
Gummy shark	Adequate	Total sharks and rays	1,031 t
Dusky shark	Recovering	Scalefish	175 t
Sandbar shark	Inadequate		
Whiskery shark	Adequate	Indicator species	
		Gummy shark	375 t
Fishing Level		Dusky shark	255 t
JASDGDLF Zone 1	Acceptable	Sandbar shark	71 t
JASDGDLF Zone 2	Acceptable	Whiskery shark	127t
WCDGDLF	Acceptable		
		Catch of sharks and rays by other commercial fisheries (2010/11)	3 t
		Recreational catch (2005/06)	<5% of commercial catch

## Fishery Description

The Temperate Demersal Gillnet and Demersal Longline Fishery (TDGDLF) is comprised of the Joint Authority Southern Demersal Gillnet and Demersal Longline Managed Fishery (JASDGDLF) and the West Coast Demersal Gillnet and Demersal Longline (Interim) Managed Fishery (WCDGDLF). These fisheries operate in continental shelf waters along the south and lower west coasts respectively. The majority of operators employ demersal gillnets and power-hauled reels to target sharks, with scalefish also being a legitimate component of the catch. Demersal longline is also a permitted method of fishing, but is not widely used.

The main shark species targeted in the TDGDLF are gummy shark (*Mustelus antarcticus*), dusky shark (*Carcharhinus obscurus*), sandbar shark (*Carcharhinus plumbeus*) and whiskery shark (*Furgaleus macki*). On the south coast operators primarily target gummy and dusky sharks, while dusky and sandbar sharks are targeted on the west coast. Whiskery sharks are an important component of both fisheries catch. These four species have been selected as indicators for the status of the temperate shark 'suite' as they account for approximately 80% of the fisheries' shark catch and represent the range of life history strategies of the other shark species caught by these fisheries.

As their stocks span multiple bioregional boundaries, dusky, sandbar and whiskery sharks are assessed and monitored as indicators of the Statewide inshore demersal suite of shark species. Gummy sharks, however, have a more limited southern range and are an indicator species of the South Coast Bioregion inshore demersal shark species suite. The two fisheries are reported together here because extensive research has demonstrated that they share these key unit

stocks.

## 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 Licences

### West Coast

*West Coast Demersal Gillnet and Demersal Longline (Interim) Management Plan 1997*

West Coast Demersal Gillnet and Demersal Longline (Interim) Managed Fishery Permits

## Consultation processes

The Department undertakes consultation directly with licensees on operational issues. Industry Annual General Meetings are convened by the West Australian Fishing Industry Council (WAFIC), who are also responsible for statutory management plan consultation under a Service Level Agreement with the Department.

## Boundaries

The Joint Authority Southern Demersal Gillnet and Demersal Longline Managed Fishery spans the waters from 33° S latitude to the WA/SA border and comprises three management zones (Demersal Gillnet and Longline Figure

1). Zone 1 extends southwards from 33° S to 116° 30' E longitude off the south coast. Zone 2 extends from 116°30' E to the WA/SA border (129° E). A small number of Zone 3 units permit fishing throughout Zone 1 and eastwards to 116° 55'40" E. For the purposes of this report, Zone 3 catch and effort data are amalgamated into Zone 1 or Zone 2 as appropriate.

The West Coast Demersal Gillnet and Demersal Longline (Interim) Managed Fishery technically extends northwards from 33° S latitude to 26° S longitude (Demersal Gillnet and Longline Figure 1). However, the use of shark fishing gear has been prohibited north of 26° 30' S (Steep Point) since 1993. Demersal gillnet and longline fishing inside the 250 metre depth contour has been prohibited off the Metropolitan coast (between latitudes 31° S and 33° S) since November 2007.

### Management arrangements

The Southern and West Coast fisheries are regulated through two complementary management plans. The JASDGLF (Joint Authority jurisdiction fishery) became managed under WA state law in 1988 and since then the fishery has been managed by the Western Commonwealth Government on behalf of a Joint Authority comprising the Western Australian and Commonwealth Governments. The WCDGDLF (a state jurisdiction fishery) is managed by the Western Commonwealth Government under an interim management plan introduced in 1997.

Both fisheries are managed via input controls in the form of transferable time/gear effort units, with additional restrictions on mesh and hook sizes, net height ('drop') and maximum net length. Historically, each unit has permitted the use of a specified length of net or an equivalent number of hooks for one month. However, in 2009, the Department transitioned the fishery to a more explicit hourly effort management system, with the objectives of removing excessive latent effort capacity and restricting effort within each management zone to 2001/02 levels. All units now permit the use of 27 m of gillnet or 9 longline hooks for 288 hours in the WCDGDLF, 264 hours in Zones 1 and 3 of the JASDGLF or 380 hours in Zone 2 of the JASDGLF. In addition to these effort controls all boats operating in the TDGDLF are closely monitored by the Department's satellite-based Vessel Monitoring System.

- A suite of shark management arrangements in target and non-target fisheries have been in effect since the 2006/07 season to ensure sustainable catches of target, byproduct and bycatch species, to assist in the recovery of historically over-exploited whiskery, dusky and sandbar shark stocks and to maintain acceptably low risks to threatened, endangered and protected (TEP) species. These include: the State-wide commercial protection of all sharks and rays;
- a general prohibition of metal trace wire and large hooks (except in the Northern Shark and Mackerel Fisheries), which had previously been used to target large whaler sharks;
- a significant increase in penalties for illegally possessing sharks or rays; and
- a two month closure (16 August to 15 October), during the main whiskery shark pupping season, of inshore

waters to 200m depth throughout all of the WCDGDLF and the waters of the South Coast west of 118° E (in the JASDGLF) to assist in the recovery of the over-exploited whiskery shark stock.

In addition, to further assist in the protection of medium-high risk dusky stocks, a 70 cm maximum (inter-dorsal fin) size limit for all whaler sharks taken by recreational fishers within the waters of the South Coast and West Coast Bioregions, was introduced in February 2009.

The metropolitan zone between latitudes 31° S and 33° S (inshore of 250 metres depth) was closed to most commercial fishing activities, including those of the WCDGDLF, in November 2007. To offset the Metropolitan Area Closure and mitigate potential impacts of effort displacement to northern grounds of the fishery, the Government established a Voluntary Fisheries Adjustment Scheme that bought back 36% of WCDGDLF entitlement.

The TDGDLF was first declared as an approved Wildlife Trade Operations (WTO) in February 2006. The fishery was reassessed in 2008 and re-accredited in April 2009, under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. The accreditation allows continued export of product from these fisheries for a period of three years. The current WTO expires on 31 March 2012 and the Department is in the process of applying for reassessment of TDGDLF.

Following the outcomes of the Wetline Review, the Government made a commitment to address the long-term sustainability of demersal scalefish on the West Coast by reducing both commercial and recreational demersal scalefish catches by at least 50% of 2005/06 levels. Demersal scalefish are an important component of the TDGDLF catch and the fisheries are being closely monitored to ensure the combined catch of demersal scalefish taken from the commercial sector does not exceed the target (see West Coast Demersal Scalefish Fishery Status Report).

### Research summary

Major FRDC-funded studies of the shark fishery on the south and west coasts of Western Australia, undertaken over the period 1993–2004, have provided a detailed basis for monitoring and assessing the fisheries. The extensive biological and fishery information gained from these studies have been reported in three FRDC final reports, numerous international journal publications and have been used to develop stock assessment models for the fisheries' key target stocks to determine their likely responses to current levels of exploitation and to test alternative harvest regimes. A new three year FRDC-funded study of the movements of the fisheries' four indicator shark stocks commenced in 2011. Results from that study will be used to reassess the status of these stocks with greater reference to their spatial and temporal dynamics.

Current research monitoring involves analysis of fishing returns data and periodic biological sampling of commercial and fishery-independent catches. To support the fishery management arrangements introduced from 2006 and to, improve assessments of key stocks and facilitate the more detailed reporting requirements of the fisheries' export accreditation under the Commonwealths Environment Protection and Biodiversity Conservation (EPBC) Act, new

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statutory daily/trip catch and effort logbooks were introduced in 2006/07. To resolve initial instances of missing, misreported and confounded catches in the logbook data, an extensive data recovery and correction exercise was undertaken between 2009 and 2010. As well as rectifying previously misreported fishing returns data, this exercise generally improved reporting standards and has provided the basis for development and implementation of new catch and effort data validation protocols.

In addition to research on the fisheries' target stocks, some tactical research has been completed on Threatened Endangered and Protected (TEP) species bycatch. Two National Heritage Trust funded projects investigated movements and aggregation locations of grey nurse sharks (*Carcharias taurus*) and a recent FRDC-funded project examined the relative spatial risks of Australian sea lion (*Neophoca cinerea*) interactions with demersal gillnets. A further FRDC-funded study to estimate quantitative rates of sea lion encounters with demersal gillnets was undertaken in 2010-11. WA Government funded research into white shark (*Carcharodon carcharias*) movements around the south-west of Western Australia may also yield information on the ecology and population structure of this protected species.

### Retained Species

#### Commercial landings (seasons 20010/11)<sup>1</sup>:

<b>All sharks (and rays):</b>	<b>1,031 tonnes</b>
<b>Indicator shark species:</b>	<b>828 tonnes</b>
<b>Gummy:</b>	<b>375 tonnes</b>
<b>Dusky<sup>2</sup>:</b>	<b>255 tonnes</b>
<b>Whiskery:</b>	<b>127 tonnes</b>
<b>Sandbar:</b>	<b>71 tonnes</b>

**Other finfish (i.e. non shark) catch:** In addition to their primary catch of sharks, the JASDGLF and WCDGDLF land a variety of scalefish species, which totalled 175 t in 2010/11 (Demersal Gillnet and Longline Figure 3). This catch included 53 t of demersal scalefish species taken in the West Coast Bioregion and 99 t of demersal scalefish taken in the South Coast Bioregion and a total of 24 t of non-demersal scalefish species (Demersal Gillnet and Longline Table 1). For details of other fisheries' demersal scalefish catches in those bioregions, see Demersal Scalefish Fishery Status Report and South Coast Wetline Fishery Report.

**Shark catches in other fisheries:** Sharks were also historically caught off the south and west coasts in a variety of other commercial fisheries. However, due to the very poor standard of reported species identification of non-targeted shark catches and those catches' contribution to identified sustainability risks to some stocks (eg. dusky shark), the retention of sharks and rays was prohibited in most non-target fisheries throughout the State by commercially protecting all sharks and rays (elasmobranchs) in November

2006. Reported elasmobranch catches by vessels operating in other managed fisheries between North West Cape and the South Australian border subsequently declined to less than 5 t per year (2.7 t in 2010/11).

#### Recreational catch estimate (season 2005/06):

**< 5% of total catch**

The recreational catch of sharks by fishers operating from trailer-boats between Augusta and Kalbarri was estimated from two Department of Fisheries surveys conducted in 1996/97 and 2005/06. The total recreational shark catch was estimated to have declined from ca. 7,000 sharks per year in 1996/97 to ca. 5,500 sharks per year in 2005/06, although only about half of these were reported to have been retained. The reported species composition of the retained catch in 2005/06 was similar to that of the Demersal Gillnet and Demersal Longline fisheries. Whaler shark species were the most commonly retained group (31%), followed by hound sharks (gummy, whiskery, etc.; 28%), wobbegongs (14%) and hammerheads (10%). Assuming an average weight of 5 kg per shark, then the recreational take of sharks in the west coast bioregion would have been about 13.5 t or approximately 3% of the bioregion's commercial shark catch in 2005/06. A new State-wide recreational fishing boat survey that commenced in 2011 will provide updated estimates of the recreational take of sharks across the State in 2012.

#### Fishing effort/access level

There are 57 licences in the JASDGLF (24 in Zone 1 and 33 in Zone 2) and 20 WCDGDLF permits, which can be used collectively in conjunction with a fishing boat licence. Only 7 Zone 1, 14 Zone 2 and 4-6 WCDGDLF vessels reported active fishing returns during 20010/11, similar to the levels of participation in the fisheries over the last four years.

As gillnetting is by far the dominant method employed in the fisheries, the historically small amount of longline fishing effort is standardised as equivalent gillnet effort by transforming longline shark catches by gillnet Catch Per Unit Effort (CPUE). Although standardised fishing effort has previously been reported in units of kilometre gillnet hours (km gn.hr), the hourly component of effort reported in monthly fishing returns prior to 2006/07 is known to be a poor indication of the time nets actually spend fishing (i.e. 'soak time'). With the transition from monthly to hourly effort entitlement units and the introduction of a daily catch and effort logbooks in 2006/07, actual soak times have been more accurately reported over the last five years. Thus, the hourly components of fishing effort reported in monthly and daily fishing returns are not directly comparable. To allow for historical comparison and assessment of effort and CPUE trends in the fisheries, the entire 35 year time series of effort data have been recalculated in comparable units of kilometre gillnet days (km gn.d; Demersal Gillnet and Longline Figure 4). For these same reasons, fishing effort is also monitored against 2001/02 target levels in units of km.gn.d.

Fishery and zone-specific limits on demersal gillnet and demersal longline fishing effort, equivalent to their 2001/02 levels, were agreed for the start of the 2006/07 season by specifying the number of days that monthly units could be

<sup>1</sup> All reported weights are live weight

<sup>2</sup> Dusky shark catches include catches of bronze whaler (*Carcharhinus brachyurus*), which cannot be accurately separated in catch returns data prior to 2006/07.

fished in each management zone. These (daily) effort limits are considered likely to deliver sustainable catches of target, byproduct and bycatch species and acceptably low risks to TEP species. Effort limits were subsequently re-defined and legislated as hourly units of entitlement using conversion rates of 24 hours day<sup>-1</sup> in Zones 1 and 3 of the JASDGDLF, 20 hours day<sup>-1</sup> in Zone 2 and 24 hours day<sup>-1</sup> in the WCDGDLF. Thus, specified fishing effort limits for each management zone of the fishery are:

JASDGDLF Zones 1 and 3:	84,075 km gn.hr (3,503 km gn.d)
JASDGDLF Zone 2:	144,102 km gn.hr (7,205 km gn.d)
WCDGDLF <sup>1</sup> :	67,692 km gn.hr (2,832 km gn.d)

Expended effort in 20010/11 was 62,817 km gn.hr (3,464 km gn.d) in Zone 1; 109,806 km gn.hr (6,126 km gn.d) in Zone 2 and 25,522 km gn.hr (1,117 km gn.d) in the WCDGDLF. Overall, 67% of the fisheries' effort capacity was utilised in 20010/11 (75% in Zone 1, 76% in Zone 2 and 38% in the WCDGDLF).

## Stock Assessment

**Assessment complete:** Yes

**Assessment level and method:**

**Gummy shark** Level 2 - CPUE  
(annual -relative to previous Level 5 assessment)

**Dusky shark** Level 2 - CPUE  
(annual -relative to previous Level 4 assessment)

**Sandbar shark** Level 2 - CPUE  
(annual -relative to previous Level 4 assessment)

**Whiskery shark** Level 5 - Age Structured Model

**Breeding stock levels:**

**Gummy shark** Adequate

**Dusky shark** Recovering

**Sandbar shark** Inadequate

**Whiskery shark** Adequate

Stock assessments are carried out for the four indicator shark species caught by the fishery using a combination of catch and effort data, periodic empirical estimates of fishing mortality rates, biological information and dynamic biomass and demographic simulation models. For assessment purposes, monthly catch and effort data are corrected to account for missing fishing returns prior to 1989/90, inaccurately reported species compositions and an increasing

effort efficiency of 2% yr<sup>-1</sup> prior to 1995/96, to account for major advances in gear technology (eg. monofilament nets and GPS) and vessel development (i.e. introduction of larger vessels). Missing, misreported and confounded catches submitted in daily/trip logbook returns between 2006/07 and 2008/09 were recovered or corrected using fishers' personal records, fish processor returns, face to face and phone interviews with fishers or were derived from average fish weights in accurately-reported logbook records or from previously observed size frequency data and available length weight relationships.

Trends in the relative abundance of the fisheries' four indicator species are inferred from each species' annual 'effective' Catch Per Unit Effort (CPUE) data. Effective CPUE is calculated by dividing the corrected gillnet-only catch by the equivalent gillnet effort from the regions of the fisheries that overlap each species' primary distribution (as defined below). Due to the introduction in 2006 of an annual two month closure to protect near-term pregnant whiskery sharks and the prohibition of demersal gillnet fishing in the metropolitan region in November 2007, catch and effort data reported from west of 118°E during August, September and October and between latitudes 31°S and 33°S in all months are excluded from the effective CPUE time series.

**Gummy shark:** The best (median) estimate from age-structured modelling indicated that in 1997/98 the Western Australian gummy shark stock was 42.7% of its virgin biomass, slightly above its minimum acceptable level of 40% of its virgin level. As gummy shark catches are almost exclusively comprised of adults, the upward trend in effective CPUE from the area off the south coast between longitudes 116°E and 129°E between the mid 1990s and 2005/06, suggested that breeding biomass steadily increased following reductions in demersal gillnet fishing effort commencing in 1992 (Demersal Gillnet and Longline Figure 5). Although recent CPUE estimates have been higher than at any time since records began, the unprecedented spike and subsequent decline in effective CPUE over the last five years is inconsistent with previous estimates and will be considered in more detail during development of a new stock assessment model that incorporates contemporary catch, effort, size and movement information that is due to be developed over the next three years.

**Dusky shark:** Due to the size selectivity characteristics of the mesh sizes permitted in the fishery and its area of operation, dusky shark catches have historically consisted of neonate (young of the year) and one to two year old fish, which collectively accounted for 89% of the observed catch during the 1990s. Due to the age-selective nature of the fishery and longevity of the species, which takes about 30 years to reach maturity and may live for more than 50 years, the available time series of catch and effort data are insufficient for developing a dynamic population simulation model for this stock (as has been used for gummy and whiskery sharks). The status of the Western Australian dusky shark stock was therefore assessed using stochastic demographic modelling techniques to evaluate the sustainability of empirically-estimated fishing mortality rates of sharks born between 1994 and 1996.

The most recent demographic assessment for this stock was conducted in 2005 and subsequent assessments have relied on analyses of catch and CPUE data from south of 28°S latitude to 120°E longitude off the south coast, in relation to the

<sup>1</sup> The WCDGDLF limit is adjusted to 64% of the 2001/02 effort level to account for the reduction in entitlement units arising from the 2008 Voluntary Fishery Adjustment Scheme.

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demographic rates estimated by that model. This analysis confirmed that demersal gillnet and longline fishing mortality rates were likely to have been sustainable for the cohorts of sharks born in 1994/95 and 1995/96. However, the model also predicted that very low levels of fishing mortality (1–2% yr<sup>-1</sup>) applied to sharks older than 10 years of age would result in negative rates of population growth. Although the area of the WCDGDLF between 26° 30' S and North West Cape was closed in 1993 to protect adult dusky sharks, they are known to have been caught by various fisheries operating within and outside WA jurisdiction. Previous assessments therefore concluded that the declining trend observed in the effective CPUE series between the mid 1990s and 2004/05 (Demersal Gillnet and Longline Figure 6) could indicate that breeding biomass had been gradually depleted by these poorly-quantified sources of fishing mortality.

There has been an increasing trend in the effective CPUE over the past six years. While the effects of reduced gear competition in the WCDGDLF resulting from the reduction in fishing units due to the VFAS and a general reduction in fishing effort could have contributed to the increasing trend, the average effective CPUE for the past five years has been higher than any time since 1984–1985. This suggests that recruitment has been increasing strongly since measures were introduced to protect adult sharks and constrain effort in the TDGDLF. Combined with the recent catches of juvenile sharks of this species having been reduced to approximately half of the quantity determined to be sustainable in 1994/95 and 1995/96, along with the comprehensive measures to mitigate cryptic mortality of older dusky sharks that have been introduced from 2006<sup>1</sup>, the current management arrangements are considered suitably precautionary to ensure that fishing mortality is now at a level such that recovery of this stock is occurring.

**Whiskery shark:** Previous age structured modelling of the whiskery shark stock (based on hourly CPUE data) concluded that total biomass was depleted to less than 40% of its virgin level by the early 1990s but the stock had shown preliminary signs of recovery to slightly above 40% of virgin biomass by the late 2000s. Using the new series of daily effective CPUE data from south of 28°S latitude to 129°E longitude off the south coast (Demersal Gillnet and Longline Figure 8) in the model, results support the conclusion that total biomass was heavily depleted during the 1980s. However, this model implementation indicates that total biomass at the commencement of mandatory catch and effort reporting in 1975/76 was less certain than previous assessments suggested (95% confidence intervals that biomass was between 69% and 100%). Significantly, the model also suggests (with 95% confidence) that biomass may only have fallen as low as 45.4% in 1995/96. The best (median) estimates of total biomass have indicated only very modest increases and that current biomass was 52.1% of B<sub>0</sub> it's virgin level in 2009/10 (95% confidence intervals of 46.4

to 56.8%). Further analyses of CPUE data are currently being undertaken in conjunction with exploration of alternative model assumptions, in an attempt to better understand these model results. Nevertheless, as these and previous model outputs suggest that whiskery shark biomass currently exceeds the minimum acceptable level and all recent modelling indicates that total and mature female biomass trends are increasing, the status of the WA whiskery shark stock is now considered to be acceptable.

Furthermore, accelerated rates of whiskery stock recovery are expected to become evident in catch and CPUE data when sharks born since the introduction of the annual closed season (see management arrangements above) begin recruiting to the fishery (around 2012/13).

**Sandbar shark:** Due to the sandbar shark's longevity and age-specific nature of fishing mortality in the target fisheries, stock assessment was undertaken using empirically-derived estimates of fishing mortality and demographic modelling techniques, similar to those used for dusky shark. FRDC-funded research undertaken between 2000 and 2005 confirmed that sandbar sharks taken in the TDGDLF were the same unit stock as was being targeted in the Northern Shark Fisheries. The model indicated that combined levels of fishing mortality in the target TDGDLF and Northern Shark Fisheries, as well as in non-target commercial fisheries and the recreational fishing sector were increasingly unsustainable between 2001 and 2004 and had probably been so since at least 1997/98. As those mortality rates corresponded to combined reported catches of 250–440 tonnes year<sup>-1</sup>, the combined catch of 918 tonnes reported by the target sector in 2004/05 (762 tonnes of which was reported by the northern shark fisheries) is considered to have been highly unsustainable. This conclusion is supported by fishery-independent survey data collected from the area between northern Shark Bay and Eighty Mile Beach where mature sandbar sharks are prevalent, which indicate there was a significant decline in breeding stock abundance between 2002 and 2005.

Subsequent assessments of stock status have used analyses of the combined catches by the TDGDLF and northern shark fisheries (see Northern Shark Fisheries Status Report), relative to those fisheries' catches during the assessment period. Although an effective CPUE region has been identified as south of 26°S latitude to 118°E longitude off the south coast (Demersal Gillnet and Longline Figure 9), the full extent of expected reductions in recruitment caused by previous excessive catches of breeding stock, are unlikely to be reflected in CPUE data until cohorts born since 2004/05 enter the fishery between 6 and 9 years of age (i.e. over the coming three years). Although the significant declines in WCDGDLF fishing effort may mask the magnitude of reductions in those cohorts' abundance, TDGDLF sandbar shark catches since 2008/09 have been at levels that should allow a gradual recovery of the breeding stock. With the breeding stock likely to be close to the minimum acceptable limit (40% of virgin biomass), the WCDGDLF will need to be carefully monitored over coming years to ensure that catch levels of sandbar sharks are maintained consistent with continued stock recovery.

**Other sharks:** The four indicator species of the temperate shark 'suite' account for approximately 80% of the fisheries' and bioregional shark catch and represent the range of life history strategies of other shark species caught by the

<sup>1</sup> i.e. commercial protection of sharks in most non-target fisheries, total protection of all whaler sharks with an inter-dorsal fin length greater than 70 cm in the South and West Coast Bioregions, 70 cm maximum (inter-dorsal fin) size limit for dusky sharks in the TDGDLF, implementation of bycatch reduction devices in trawl fisheries, prohibition of metal snoods in most commercial fisheries.

fisheries. Thus, the status of indicator stocks is believed to generally reflect the status of other sharks in the South and West Coast bioregion.

## Non-Retained Species

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

The catch composition of the fishery was examined in detail for the period 1994 to 1999. There is some discarded bycatch of unsaleable species of sharks, rays and scalefish. During ESD risk assessment of these fisheries in 2002, all impacts on stocks of bycatch species were determined to be low risk. As maximum potential fishing effort is now explicitly capped at less than 70% of the mid to late 1990s levels, bycatch in all management zones is expected to have been proportionally reduced. Recent multi-fisheries bycatch risk assessment has identified the Port Jackson shark among the higher risk bycatch species in the West Coast Bioregion. Although this species is one of the largest components of the demersal gillnet and demersal longline fisheries bycatch and is recorded as bycatch in other commercial fisheries, cumulative risks were assessed as low-moderate.

### Protected species interaction: **Negligible-Low**

Historical on-board observer programs have shown that protected species interactions were very low throughout the fishery. The Demersal Gillnet and Longline Table 2 details individual interactions between the fishery and all protected species since 2006/07.

Recently completed analyses of potential encounter rates of sea lions with demersal gillnet gear and interpretation of those rates in the light of historical observer data have supported Department's Negligible-Low risk rating and suggested that sea lion captures in these fisheries are likely to be extremely low frequency events.

It should also be noted that demersal gillnet and longline fishing is 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, where populations of turtles and sea lions are present.

## Ecosystem Effects

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

The recent analysis of potential changes in ecosystem structure of finfish on the south and west coast bioregions (Hall & Wise, 2011)<sup>1</sup> found no evidence of any systematic change in species diversity, richness or trophic index indicating that this fishery is not having a material impact on food chain or trophic structure.

<sup>1</sup> Hall, N.G. and Wise, B.S. 2011. Development of an ecosystem approach to the monitoring and management of Western Australian fisheries. FRDC Report – Project 2005/063. Fisheries Research Report No. 215. Department of Fisheries, Western Australia. 112pp.

### Habitat effects: **Negligible**

The level of effort is such that the gear is deployed infrequently over approximately 40% of the fisheries' operational area (Demersal Gillnet and Longline Figure 1) and under normal circumstances the physical impact of the gear on the bottom is minimal. Moreover the very small footprint of each net would combine to make a very small percentage (<< 5%) of the area that would be contacted by this gear on an annual basis.

## Social Effects

**Direct:** Fishing returns reported that between 80 and 100 skippers and crew were employed in the JASDGDLF and over 20 were employed in the WCDGDLF during 2010/11. As sharks are generally not targeted by recreational fishers in Western Australia, their direct social importance to this group is negligible.

**Indirect:** Sharks are viewed as a menace by some members of the community due to their perceived danger to humans and their predation of recreationally caught fish. However, others consider them to be important components of marine ecosystems that need to be conserved.

## Economic Effects

### Estimated annual value (to fishers) for 2010/11:

**JASDGDLF: Level 2 - \$1 - 5 million**

**WCDGDLF: Level 2 - \$1 - 5 million**

\* As fishers do not specify the value of fins on their catch returns, fin values were calculated at an average of 3% of sharks' whole weight and value was conservatively estimated using a price of \$35/kg. Categories of shark which do not have saleable fins were excluded from fin valuation.

## Fishery Governance

### Target commercial catch range:

**Key shark species 725–1,095 tonnes**

**Individual target catch ranges for the key shark species in 2010/11 were as follows:**

**Gummy shark 350–450 tonnes**

**Dusky shark 200–300 tonnes**

**Sandbar shark < 120 tonnes**

**Whiskery shark 175–225 tonnes**

### Current Fishing Level

**JASDGDLF Zone 1 Acceptable**

**JASDGDLF Zone 2 Acceptable**

**WCDGDLF Acceptable**

Maximum acceptable effort levels for each management zone have been based on their respective 2001/02 (daily) levels. These levels are considered likely to deliver sustainable harvests of the fisheries' target and byproduct species and acceptably low levels of bycatch and protected species

## SOUTH COAST BIOREGION

interactions. Under explicit hourly-gear input control arrangements, effort should not exceed these limits.

**Gummy shark** catches exceeded the upper limit of their acceptable range between 2003-04 and 2009-10, and reached a historically high level in 2007-08 (755 t). As the steadily increasing CPUE trend observed between the early-mid 1990s and 2005/06 is believed to have been a result of increasing stock abundance, the consistently high catches reported in recent years are not of concern. However, until the implications of the unprecedented recent spike in effective CPUE can be ascertained and a new stock assessment model developed, CPUE will be closely monitored to ensure that it remains at expected levels and the downwards trajectory of the last three years does not continue.

**Dusky shark** catches have been within their acceptable range since 20004-05, except for 2006/07 when they were 5 tonnes below the minimum limit. The dusky shark catch in 2010/11 was 255t which is within the target range of 200-300t. However, the fishery has not utilised its full entitlement during 2010/11 and as such the Department will carefully monitor the catch levels to ensure they do not increase above sustainable levels. The acceptable catch range will require re-evaluation if catches increase in coming years.

**Whiskery shark** Total catches of whiskery shark have steadily declined since the mid-1990s although, until 2010/11 had been maintained slightly above or below the minimum acceptable level. The 127t catch in 2010/11 was nearly 50t less than that minimum level and was the fisheries' lowest annual catch since 1975/76. The low catches of recent years mostly reflect the outcomes of management measures to recover this stock, in particular, the introduction of the seasonal 'pupping' closure. As these measures are intended to increase catch rates in coming years the acceptable catch range will need to be adjusted upwards as the magnitude and rate of stock recovery can be determined.

**Sandbar shark** catches exceeded their maximum acceptable level until effort declined dramatically in the WCDGDLF in 2008/09 and catches declined to more sustainable levels of 81 t in 2008/09, 107 t in 2009/10 and 71t in 2010/11. At these levels, recruitment to the breeding stock should improve in coming years and gradually allow the mature biomass to recover from more than a decade of excessive catches in the northern shark fisheries (see Northern Shark Fisheries Status Report).

### **New management initiatives (for 2011/12)**

The review of the whiskery shark 'pupping' closure will commence in late 2011 with a view to making a determination by mid year for the 2012 arrangements. At this time the Department will assess the status of the whiskery shark in relation to the long-term sustainability of the species. Since 2009, the whiskery shark pupping closure has been reviewed on an annual basis and at this stage it is still too early to determine if pre-natal survival resulting from the previous 5 years of seasonal closure has delivered full benefits to the recovery of the whiskery shark stock. Evidence to determine the measure of the benefit to whiskery

shark stock will not be available in catch data until cohorts born since 2006 recruit to the fisheries in around 2012/13 (at approximately 5-6 years of age). With the long term sustainability of the species in mind the closure into the 2010 and 2011 fishing seasons has been maintained (with majority industry support).

The FRDC funded desktop study that began in August 2010 to estimate potential interaction rates of Australian sea lions with demersal gillnets in the TDGDLF is expected to be completed and accepted by FRDC in early 2012. The model developed as part of the project will be used to conduct a (partial) reanalysis of existing independent observer data from the TDGDLF to assist in evaluating management options to ensure interactions with Australian sea lions are maintained with acceptable levels.

The current WTO for the TDGDLF expires on 31 March 2012. The Department is currently preparing for reassessment of the TDGDLF and expects to submit the application in early 2012. It is intended that the above mentioned model will assist in addressing Condition 5 of the current WTO export approval which directly relates to estimating the risk of interactions between fishers in the TDGLF and Australian sea lions.

The release of the Commonwealth Southwest Marine Bioregional Plan (SWMBP) (including a proposed marine reserve zoning scheme) originally expected to be release in 2010/11 has been delayed. It is now expected that this Bioregional Plan which has significant potential to impact on the operation of the TDGDLF, will be announced in early 2012. It is likely that the announcement of the SWMBP will coincide with the release of the Commonwealth North West Marine Bioregional Plan. It is expected that the State Ngari Capes Marine Park, which is likely to have some impact on Zone 1 of the JASDGDLF, will also be announced in early 2012.

## **External Factors**

As the TDGDLF key target species span multiple regional boundaries there are a number of factors outside of the control of the fishery which can negatively impact the performance of key temperate shark stocks. In particular, the potential for ongoing catches of breeding stock of sandbar sharks across the northern shark fisheries (from Western Australia, Northern Territory and northern Queensland and Commonwealth managed fisheries) remains cause for concern. Other potential factors affecting key temperate shark stocks include targeted fishing for gummy shark by Commonwealth managed vessels that occurs to the east of Zone 2 of the JASDGDLF (although the fishery is tightly managed via quota controls) and incidental catches of dusky and gummy sharks in other State and Commonwealth Government-managed fisheries. While the risks associated with these outside influences are largely unqualified they must be taken into account in the stock assessment for individual species (and the TDGDLF 'suite') to ensure appropriate management strategies are implemented that address the long-term sustainability of the shark stocks.

**DEMERSAL GILLNET AND LONGLINE TABLE 1**

Summary of 2010/11 catch (t live wt.) by the WA temperate Demersal Gillnet and Demersal Longline Fisheries. Data are given by management zone and also by Bioregion (*italicised*). Indicator species and catches are highlighted in **bold**.

Name	Species or taxon	JASDGLF		WCDGDLF	Bioregion		Total
		Zone 1	Zone 2		South Coast	West Coast	
Sharks and rays							
<b>Gummy</b>	<b><i>Mustelus antarcticus</i></b>	<b>25.1</b>	<b>348.7</b>	<b>1.0</b>	<b>354.4</b>	<b>20.4</b>	<b>374.8</b>
<b>Dusky whaler</b>	<b><i>Carcharhinus obscurus</i></b>	<b>125.1</b>	<b>97.7</b>	<b>32.5</b>	<b>121.0</b>	<b>134.3</b>	<b>255.2</b>
<b>Whiskery</b>	<b><i>Furgaleus macki</i></b>	<b>30.5</b>	<b>90.6</b>	<b>5.6</b>	<b>100.0</b>	<b>26.6</b>	<b>126.7</b>
<b>Sandbar</b>	<b><i>Carcharhinus plumbeus</i></b>	<b>22.2</b>	<b>2.7</b>	<b>46.2</b>	<b>12.7</b>	<b>58.3</b>	<b>71.0</b>
Hammerheads	F. Sphyrnidae	25.2	36.4	6.0	42.6	25.0	67.6
Spinner (long nose grey)	<i>Carcharhinus brevipinna</i>	35.9	12.1	12.4	14.6	45.7	60.4
Wobbegongs	F. Orectolobidae	16.3	9.0	5.0	14.5	15.8	30.3
Rays	Batoidea	4.6	1.0	4.3	2.1	7.9	10.0
Common saw shark	<i>Pristiophorus cirratus</i>	0.4	9.5		9.5	0.4	9.9
School	<i>Galeorhinus galeus</i>		9.2	<0.1	9.2	0.1	9.3
Other elasmobranchs		6.2	3.5	6.2	4.5	11.4	15.9
<b>Total elasmobranchs</b>		<b>291.5</b>	<b>620.3</b>	<b>119.2</b>	<b>685.2</b>	<b>345.9</b>	<b>1,031.1</b>
Scalefish							
Queen Snapper	<i>Nemadactylus valenciennesi</i>	18.7	32.2	0.2	41.7	9.4	51.1
<b>Blue Groper</b>	<b><i>Achoerodus gouldii</i></b>	<b>24.5</b>	<b>22.3</b>	<b>0.7</b>	<b>30.9</b>	<b>16.6</b>	<b>47.5</b>
<b>Dhufish</b>	<b><i>Glaucosoma hebraicum</i></b>	<b>12.2</b>	<b>1.0</b>	<b>3.3</b>	<b>3.7</b>	<b>12.7</b>	<b>16.4</b>
<b>Pink snapper</b>	<b><i>Pagrus auratus</i></b>	<b>5.2</b>	<b>7.2</b>	<b>3.6</b>	<b>8.9</b>	<b>7.1</b>	<b>16.0</b>
Boarfishes	F. Pentacerotidae	2.2	5.4	<0.1	6.1	1.6	7.7
Samsonfish	<i>Seriola hippos</i>	1.6	3.0	2.3	3.5	3.3	6.9
<b>Redfishes</b>	<b><i>Centroberyx spp.</i></b>	<b>0.7</b>	<b>5.7</b>	<b>&lt;0.1</b>	<b>6.2</b>	<b>0.2</b>	<b>6.4</b>
Mulloway	<i>Argyrosomus hololepidotus</i>	2.9	2.0	0.9	2.0	3.7	5.8
Sweetlips	F. Haemulidae			2.5		2.5	2.5
<b>Baldchin groper</b>	<b><i>Choerodon rubescens</i></b>	<b>&lt;0.1</b>		<b>1.3</b>	<b>&lt;0.1</b>	<b>1.3</b>	<b>1.3</b>
Other scalefish		8.4	3.3	2.0	5.9	7.8	13.7



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Name	Species or taxon	JASDGLF		WCDGDLF	Bioregion		Total
		Zone 1	Zone 2		South Coast	West Coast	
Total scalefish		76.3	82.1	16.8	109.0	66.3	175.2
<hr/>							
<i>'Demersal scalefish suite' component</i>		63.9	74.8	12.7	98.7	52.6	151.4
<hr/>							
<b>Fishing effort (km gn d)</b>		3,464 (99) <sup>1</sup>	6,126 (85) <sup>1</sup>	1,117 (39) <sup>2</sup>			10,706 (79) <sup>2</sup>
<hr/>							
<b>Fishing effort (1000 km gn hr)</b>		62.8 (75) <sup>3</sup>	109.8 (76) <sup>3</sup>	25.5 (38) <sup>3</sup>			198.1 (67) <sup>3</sup>

<sup>1</sup> Percentage of respective 2001/02 levels

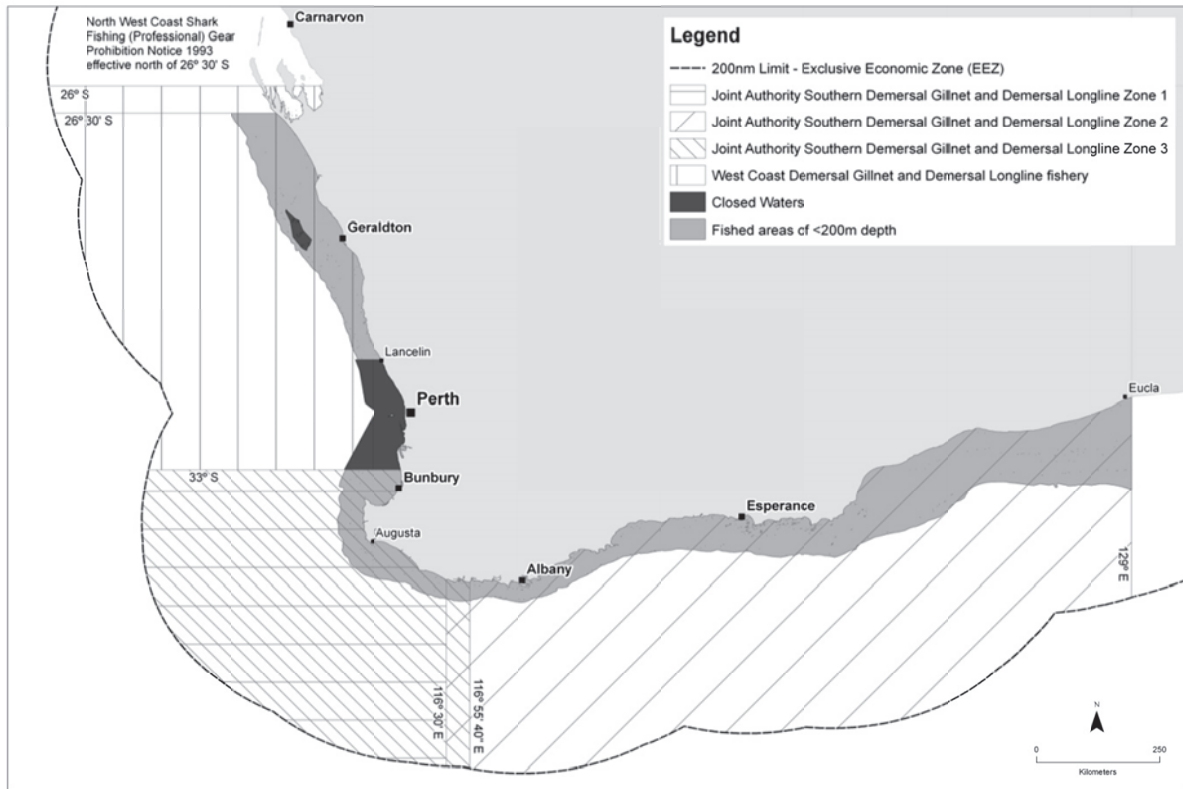
<sup>2</sup> Percentage of VFAS adjusted 2001/02 levels

<sup>3</sup> Values in parentheses are percentages of each management zone's maximum hourly effort capacity

**DEMERSAL GILLNET AND LONGLINE TABLE 2**

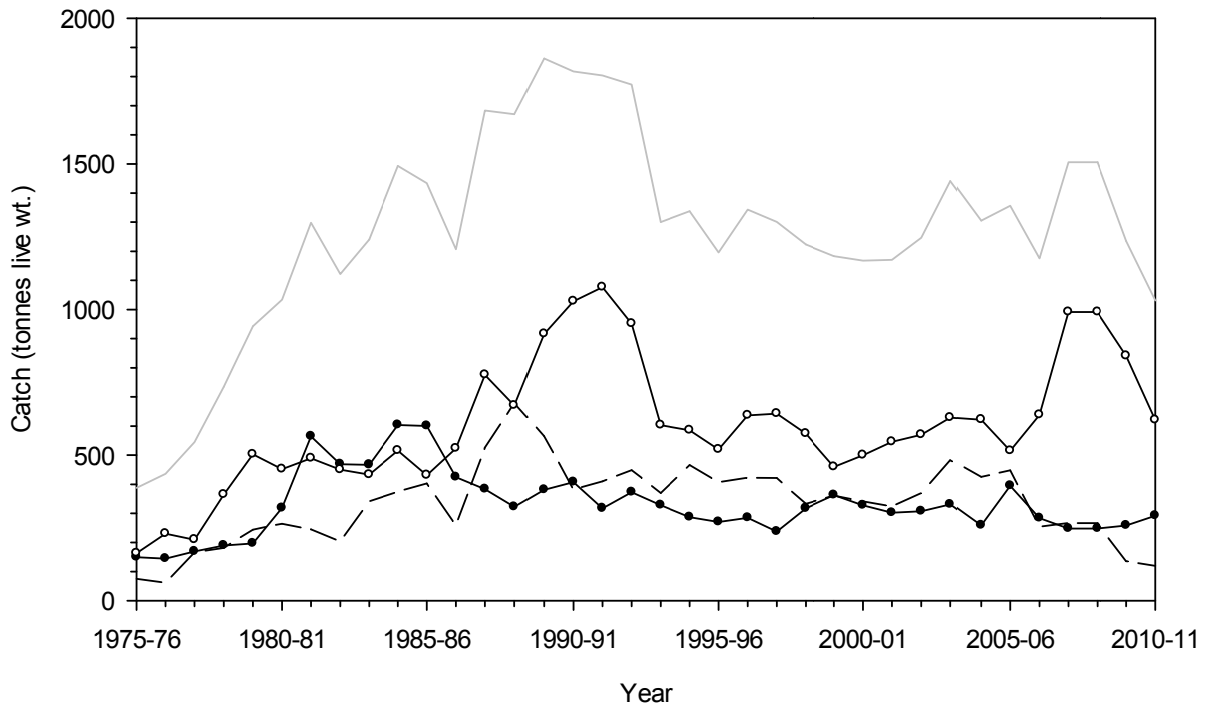
Recorded interactions with Threatened, Endangered, Protected (TEP) species.

TEP SPECIES	2006/07		2007/08		2008/09		2009/10		2010/11	
	A	D	A	D	A	D	A	D	A	D
Alive(A)/Dead(D)	A	D	A	D	A	D	A	D	A	D
Dolphins		6	1		1	2		2		3
Manta Rays	2									2
Muttonbird, General							7		4	
Sawfish, General			1							1
Sea Birds	1	3		2	2	1				
Sea Lions						2				
Seal, NZ Fur	1	1		2	1	5		7		1
Shark, Grey Nurse	61	18	38	16	63	18	59	27	53	19
Shearwater, Fleshfooted								2		
Snake, Sea				2						
Turtle, General	4	3	5		2	2	2	1	1	
Whales					1					
White Pointer	10	3	10	3	14	2	2	1	3	5



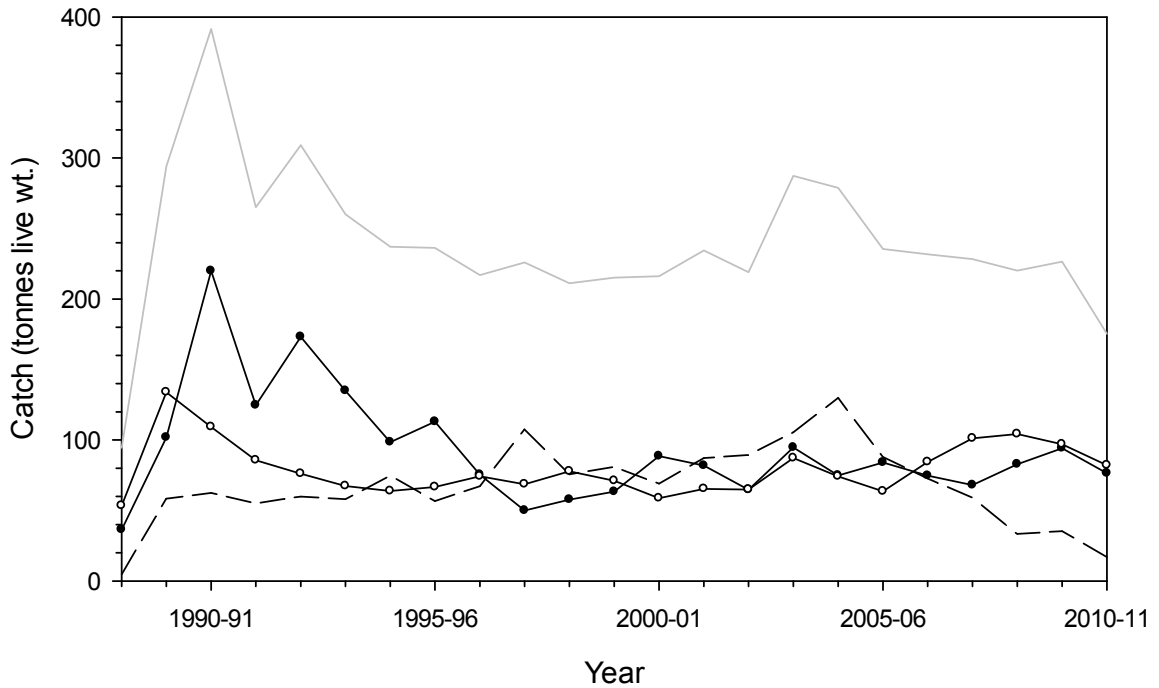
**DEMERSAL GILLNET AND LONGLINE FIGURE 1**

Management boundaries of the WA temperate Demersal Gillnet and Demersal Longline Fisheries. Black shading represents fished areas of less than 200m depth.



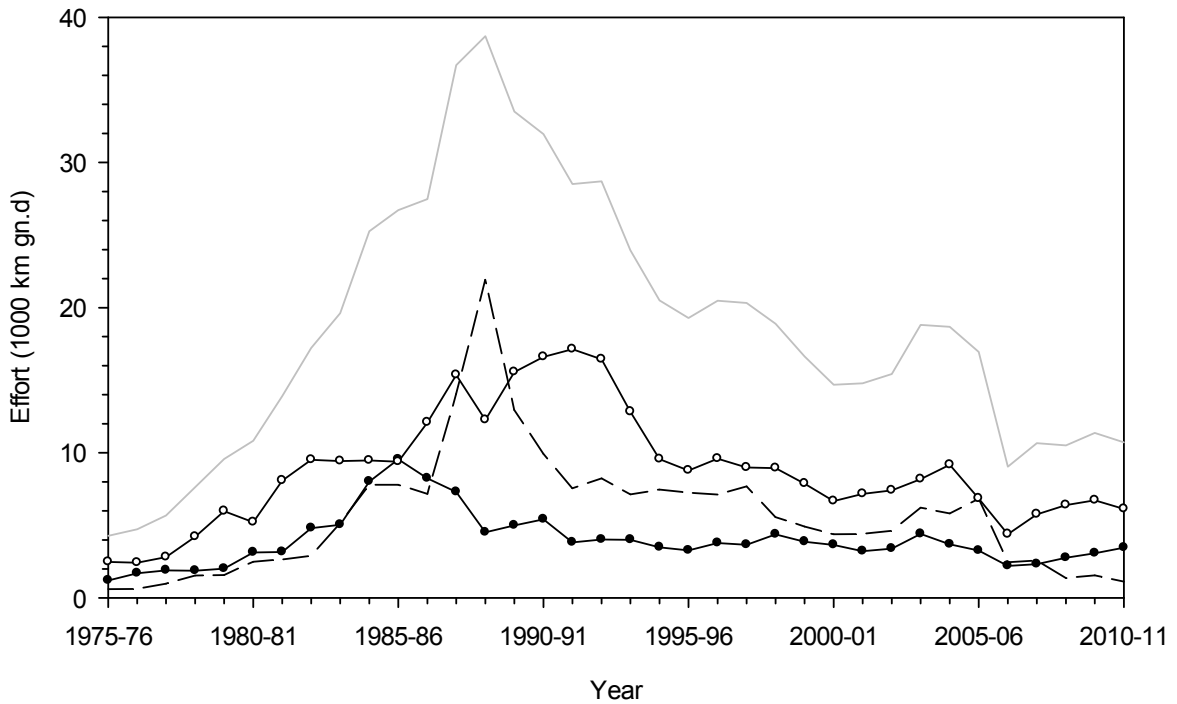
**DEMERSAL GILLNET AND LONGLINE FIGURE 2**

Total elasmobranch catches. Black circles = JASDGLF Zone 1; white circles = JASDGLF Zone 2; dashed black line = WCDGDLF; plain grey line = total from the three management zones.



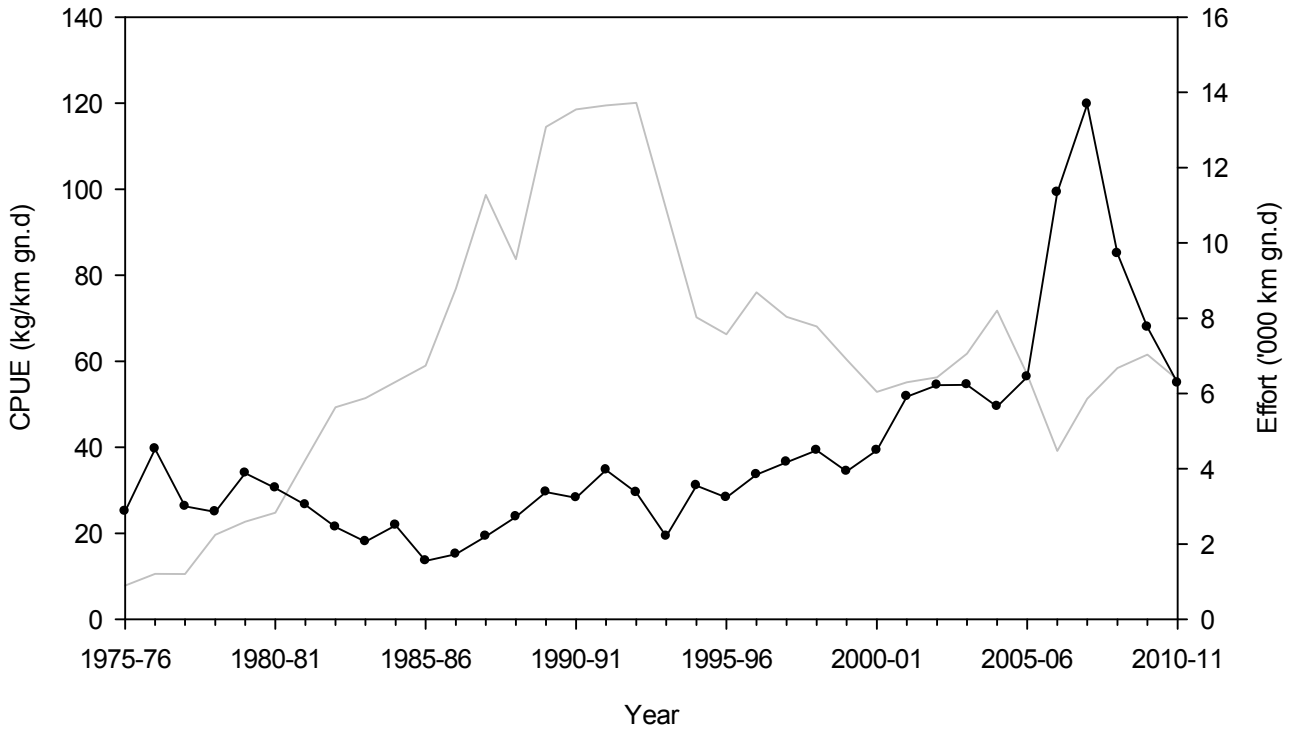
**DEMERSAL GILLNET AND LONGLINE FIGURE 3**

Total scalefish catch. Black circles = JASDGDLF Zone 1; white circles = JASDGDLF Zone 2; dashed black line = WCDGDLF; plain grey line = total from the three management zones. Catches prior to 1988/89 cannot be distinguished from other fisheries' gillnet and longline catches and are omitted.



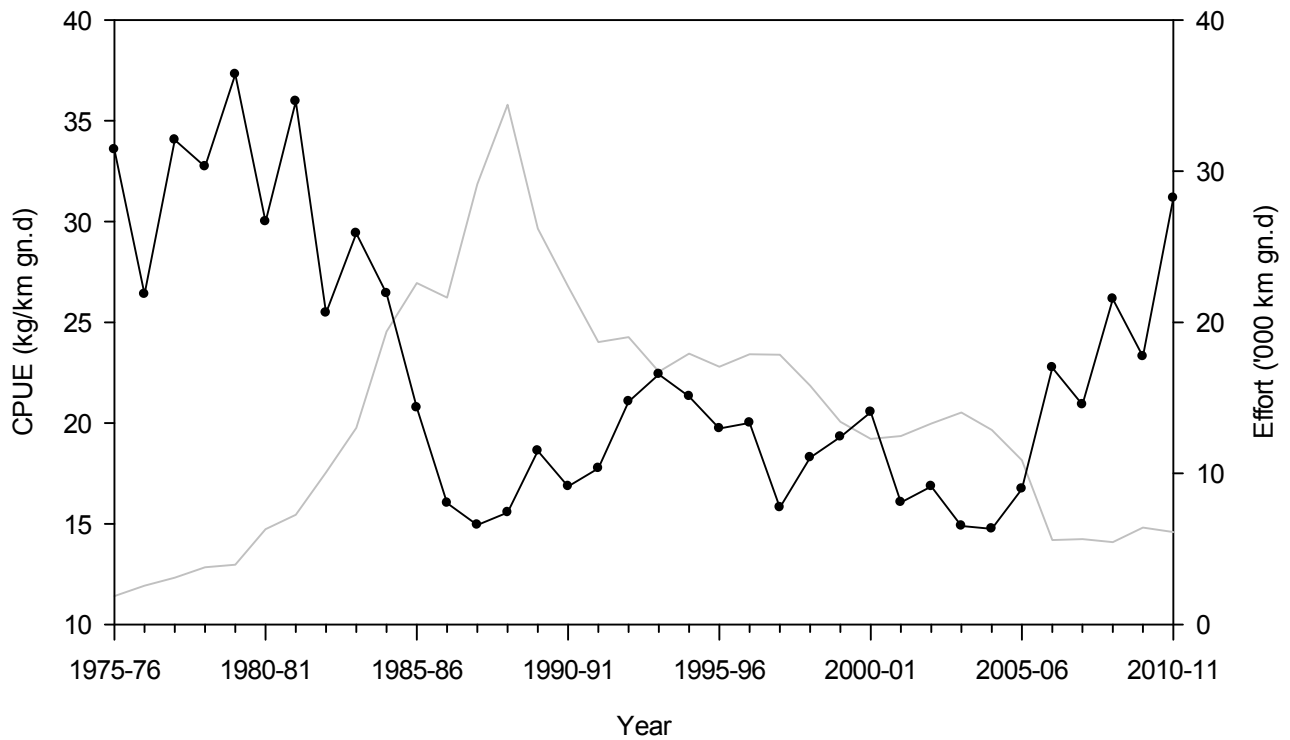
**DEMERSAL GILLNET AND LONGLINE FIGURE 4**

Standardised demersal gillnet and demersal longline effort. Black circles = JASDGDLF Zone 1; white circles = JASDGDLF Zone 2; dashed black line = WCDGDLF; plain grey line = total from the three management zones.



**DEMERSAL GILLNET AND LONGLINE FIGURE 5**

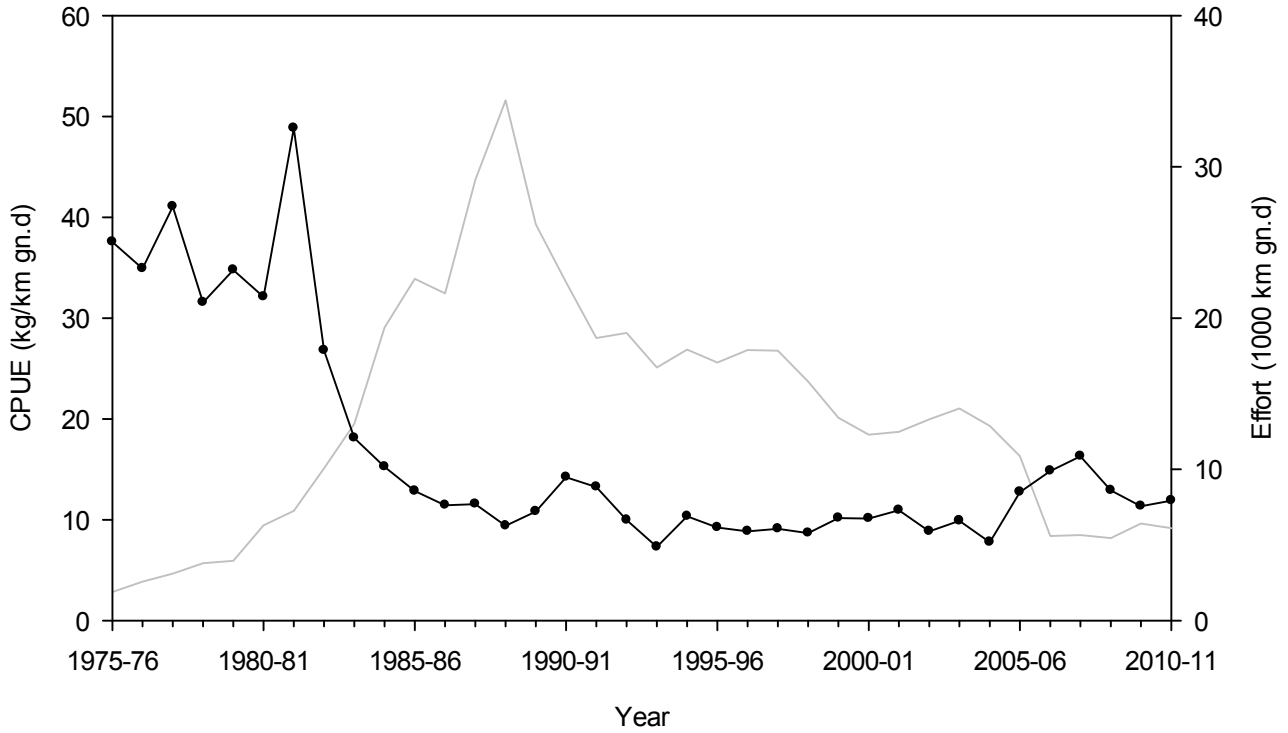
Gummy shark effective effort (grey line) and CPUE (black circles).



**DEMERSAL GILLNET AND LONGLINE FIGURE 6**

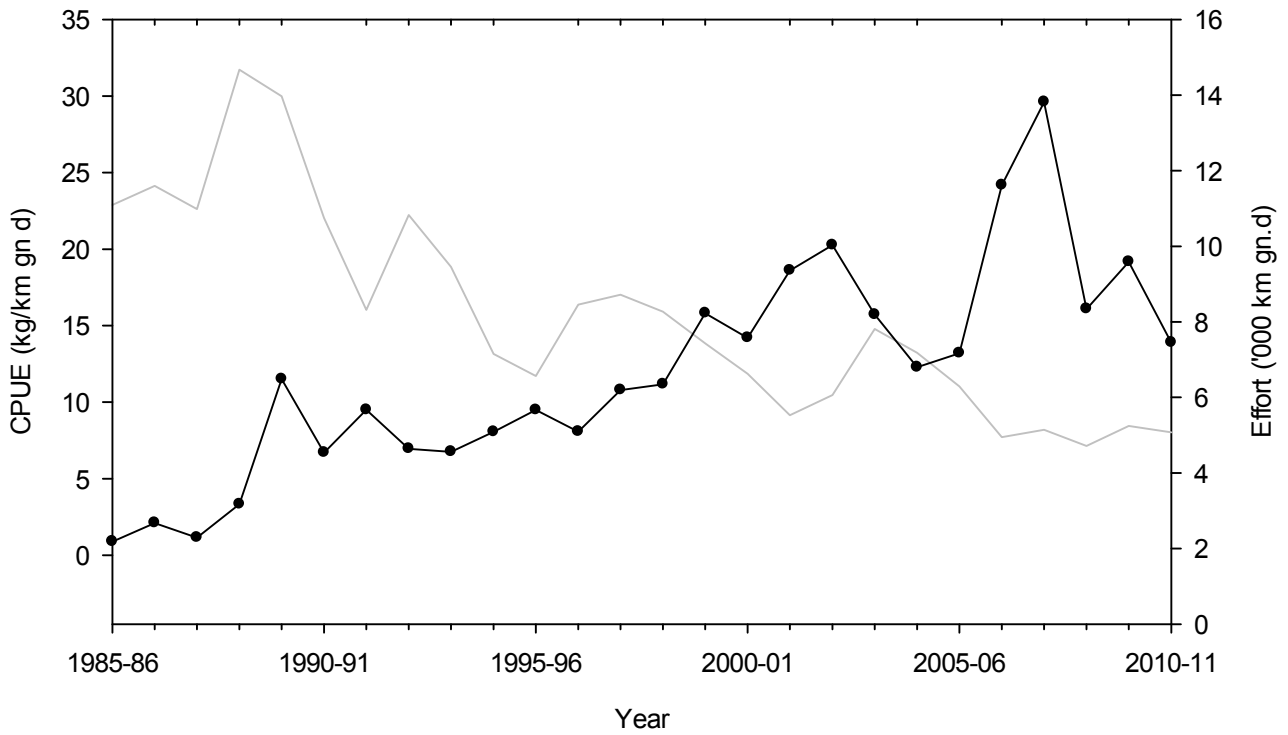
Dusky shark effective effort (grey line) and CPUE (black circles),

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**DEMERSAL GILLNET AND LONGLINE FIGURE 7**

Whiskery shark effective effort (grey line) and CPUE (black circles),



**DEMERSAL GILLNET AND LONGLINE FIGURE 8**

Sandbar shark effective effort (grey line) and CPUE (black circles),

# South Coast Demersal Scalefish Resource Report: Statistics Only

*B. Molony, E. Lai and M. Holtz*

## Fishery Description

### Commercial

Operators in this fishery target scalefish stocks in oceanic waters of the South Coast Bioregion, primarily using wetline methods such as droplines, handlines and trolling to take both offshore and inshore demersal scalefish species such as pink snapper, Bight redfish and queen snapper. Haul nets and set nets are also used to take nearshore scalefish species such as herring, whiting and mullet.

The take of scalefish by trap and trawl methods, salmon by line and beach netting and pilchards by purse seine in the South Coast Bioregion are separately managed fishery activities. The capture of demersal species by the Joint Authority Southern Demersal Gillnet and Demersal Longline Fishery operating in the South Coast Bioregion is also managed separately (see Demersal Gillnet and Longline Fisheries Status Report).

### Recreational

Recreational fishers, mostly using line based methods from boats target this suite of species.

### Boundaries

The fishery operates in the South Coast Bioregion, from 115° 30' to the WA/SA border (South Coast Wetline Figure 1).

### Management arrangements

#### Commercial

*Fish Resources Management Act 1994, Fish Resources Management Regulations 1995* and other subsidiary legislation

The commercial 'wet line' fishery is currently 'open access' for the holder of a valid Fishing Boat Licence (for the boat) and a Commercial Fishing Licence (for the fisher).

#### Recreational

*Fish Resources Management Act 1994, Fish Resources Management Regulations 1995* and other subsidiary legislation

### Total Landings (Season 2011):

**90.5 tonnes (demersal scalefish only)**

#### Commercial

Estimates of catches are monitored through the mandatory CAES logbook system. Bight redfish, blue groper, blue morwong and pink snapper have been identified as indicator species of the inshore demersal suite of finfish for the South Coast Bioregion. These indicator species are used to monitor the status of the resource and fishery and make up a bulk of the catches from this suite by the commercial fishery. In addition, Hapuku, blue-eye trevalla and eightbar grouper have been identified as indicator species for the offshore

demersal suite of finfish in the South Coast Bioregion.

The catch of 90.5 t of demersal scalefish during 2011 is the second lowest since 2000, but remains within the range of catches since 2000 (80–140 t, South Coast Demersal Line Fishery Figure 2). The slightly lower catches reported since 2007 are mainly due to the ability to now better allocate catches east and west of 115° 30' to the South Coast Demersal and West Coast Demersal Scalefish fisheries respectively. The decline in demersal scalefish catch in 2011 (90.5 t) compared with 2010 (98.3 t) is mainly due to a lower catch of pink snapper in 2011.

In addition, 31 t of non-demersal scalefish were reported in 2011. The non-demersal catches were dominated by Samson fish (18.6 t, pelagic suite) and skippy (4.0 t, nearshore suite).

### Recreational

Estimates of the recreational catch levels of this suite are not available. A State-wide recreational survey is currently underway and will result in estimates of recreational boat-based catches from this fishery being available in late 2012.

## Fishery Governance

**Target commercial catch range: Not available**

A formal catch range has not been developed for this fishery. However, the 2011 catch levels of the inshore demersal suite falls within the 80 t -140 t range of catches reported since 2000 and is likely to be sustainable. Catch levels will be more closely monitored in future and additional monitoring of the resources and fishery is proposed; funding applications are pending a decision.

**Current Fishing (or Effort) Level: Not available**

This fishery is likely to undergo review in the near future. Development of an interim catch range will be considered during this review.

### New management initiatives (2011/2012)

Following the introduction of the *West Coast Demersal Scalefish (Interim) Management Plan 2007* and reductions in effort applied to the West Coast Rock Lobster Managed Fishery, there have been concerns about a shift in effort to the South Coast and resultant increase in catches of scalefish off the south coast. This situation does not seem to have occurred at this stage.

In the absence of assessments of demersal scalefish stocks off the south coast such as pink snapper, queen snapper and Bight redfish, a potential increase in fishing mortality may increase the risks to unacceptable levels. Furthermore, recent data suggests that hapuku (an indicator species of the offshore demersal suite) of the south coast are possibly being

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overfished. A research project to undertake formal stock assessment of the key species is now planned to commence in late 2012.

The nearshore species targeted by open access inshore (oceanic) netters are also vulnerable and the recent increase in this activity has led to reports of resource sharing and user group conflict.

The Department will continue to monitor the fishery and may develop more formal management arrangements for wetline fishing off the south coast should a significant increase in effort and catch occur. These arrangements will aim to restrict effort and catches of demersal scalefish and may help to address social issues such as easing the conflict between users that share the inshore scalefish resource.

### SOUTH COAST DEMERSAL SCALEFISH RESOURCE TABLE 1

Catches (t) of indicator species, demersal species and total scalefish catches by the commercial sector of the South Coast Demersal Line Fishery, 2007–2011.

Species	2007	2008	2009	2010	2011
Bight Redfish*	37.0	47.2	33.5	26.8	23.9
Blue groper	1.1	1.1	1.2	0.4	1.3
Blue Morwong	5.1	5.2	8.0	4.4	8.1
Pink Snapper	37.3	37.9	44.9	38.8	28.9
Hapuku	14.2	13.1	18.5	11.5	14.8
Blue-eye trevalla	4.9	5.5	2.4	3.2	3.4
Eightbar grouper	2.5	0.6	0.7	0.5	1.4
Other demersal scalefish	15.0	15.6	12.5	12.7	23.4
Total demersal scalefish	117.1	126.4	121.9	98.3	90.5
Total non-demersal scalefish**	20.6	27.6	26.5	21.3	31.0
Total Scalefish	137.7	153.9	148.4	119.6	121.5

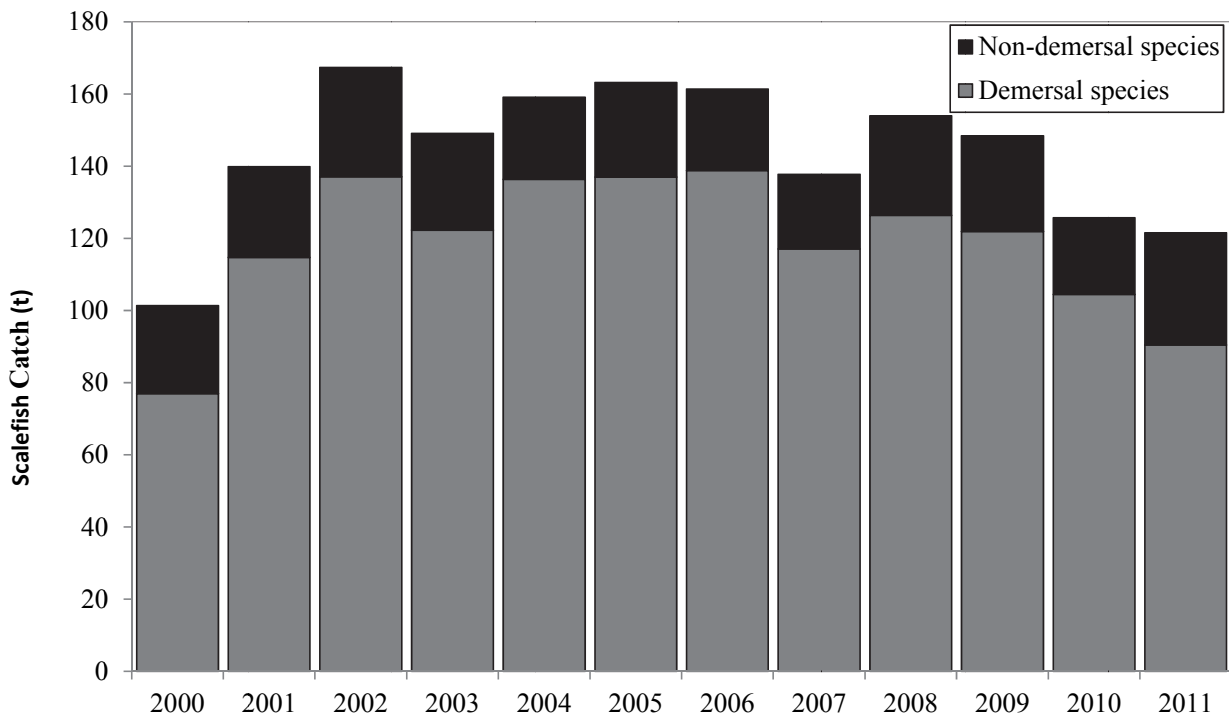
\* Estimates of bight redfish catches represent catches by this fishery of fishes reported as 'Bight redfish', 'yelloweye redfish' and 'redfish'. Line catches of redfish from the south-west zones of the West Coast Demersal Scalefish Fishery are almost exclusively Bight redfish. In addition, the Commonwealth Great Australian Bight trawl fishery operating in the South Coast Bioregion only reports catches of Bight redfish. It is likely that catches of 'redfish' by the South Coast Demersal Line Fishery are likely to be of Bight redfish. This may be confirmed in the near future via catch or market sampling.

\*\* Non demersal scalefish includes fishes from the pelagic suite (mainly Samson fish) and nearshore suite (mainly skippy).



**SOUTH COAST DEMERSAL SCALEFISH RESOURCE FIGURE 1**

Map of the extent of the South Coast Demersal Line Fishery.



**SOUTH COAST DEMERSAL SCALEFISH RESOURCE FIGURE 2**

Catches (t) of demersal and non demersal scalefish in the South Coast Demersal Line Fishery, 2000—2011.



## AQUACULTURE

### Regional Research and Development Overview

Greenlip abalone is considered a key species for aquaculture development on the south coast of WA.

An abalone farm and associated hatchery near Bremer Bay has been upgraded and modified to cater for planned growth in production and to accommodate biosecurity requirements. The land-based farm and hatchery are being operated according to a Biosecurity Plan, developed with input from the Department of Fisheries. Independent audits are undertaken to ensure compliance with the Biosecurity Plan.

An offshore abalone farm near Augusta is achieving encouraging early results for abalone grown out using purpose-built concrete structures located on the sea bed. The operator is testing two new sites under an Exemption issued by the Department of Fisheries.

The abalone aquaculture industry sector currently operates under the policy entitled *Abalone Aquaculture in Western Australia*. The Policy was developed in 2010, in consultation with the wild-capture and aquaculture industry sectors. An outbreak of abalone viral ganglioneuritis (AVG) in Victorian abalone farms in 2005, the spread of the disease to the wild-capture fishery in Victorian waters and the subsequent outbreak of AVG at an abalone processor in Tasmania caused significant mortalities and raised the matter of AVG preparedness in Western Australian waters. As a result, the 2010 Policy is being reviewed and expected to be completed in September 2012. The revised Abalone Aquaculture Policy will provide greater certainty to all sectors of the abalone industry, including aquaculture, stock enhancement, the wild fishery and the recreational sector.

## COMPLIANCE AND COMMUNITY EDUCATION

Commercial and recreational fisheries compliance in the South Coast bioregion is undertaken by Fisheries and Marine Officers (FMOs) based at Albany, Esperance and Mobile 2 (occasional recreational patrols). Officers undertake a variety of compliance activities including land, at-sea, inspection of vessels, catches, fishing gear, marine safety equipment, covert investigations and verification of licenses for both the commercial and recreational fisheries.

There are two part-time South Coast Marine Education Officers who deliver the Education program for the South Coast.

### Activities during 2010/2011

#### Compliance

Due to the variety of commercial and recreational fisheries, expanse of coastline and variable and seasonal weather conditions, Fisheries and Marine Officers employ a risk management driven approach to prioritise and plan compliance activities.

Overall, Fisheries and Marine Officers delivered a total of 3322 hours of "field" compliance activity during 2010/2011.

South Coast Compliance Table 1 represents an increase from the previous year (South Coast Compliance Figure 1).

Officers made contact with a total of 308 commercial fishers in the field, across the south coast. Generally only minor breaches were detected, mainly in terms of licensing issues, quota management and breaches of individual fisheries management arrangements. Illegal (unlicensed) commercial abalone operations continue to be a major concern in the South Coast bioregion threatening the sustainability of the commercial and recreational abalone fishery. Officers from the southern region conducted joint investigations with other compliance units into organized unlicensed illegal fishing operations.

The remainder of the commercial fishery compliance effort was directed to the wide range of minor commercial fisheries operating in the bioregion. There was an increase in Catch Inspections of the Estuarine fisheries and Commercial Licence Inspections. A review was made of the SOP for Joint Authority (Shark) Catch Inspections and improvements were made to the process of investigating VMS reports.

A dedicated effort was applied to the Abalone 'black market' trade with a substantial prosecution resulting in four people being prosecuted and convicted.

During the year, 6 infringement warnings, 11 infringement notices were issued and a further 2 cases resulted in prosecution action being instigated against commercial fishers. In addition to 'black market' abalone operations, illegal sale of other fish by unlicensed individuals or groups continues to be an issue of concern in the region.

Recreational compliance activities concentrated mainly on checking shore and boat based anglers, net fishers and shellfish collectors. Fisheries and Marine Officers (FMOs) made contact with a total of 5764 recreational fishers. During 2010/2011, 80 infringement warnings, 37 infringement notices were issued and 6 prosecutions were instigated against recreational fishers.

Compliance patrols in recreational fisheries principally involve checks to ensure that fishers are adhering to size and bag limits and complying with restrictions that apply in the recreational net fishery. The areas of highest risk of non-compliance with the management arrangements were considered to be abalone, marron, marine finfish and estuarine netting. There continues to be a growing awareness of the open season and availability of abalone on the south coast.

#### Education

Community and school education programs in the bioregion were conducted by the Marine Education Officer. Activities

included the delivery of school incursions and excursions to 1185 primary and secondary students across the region in 44 structured sessions. A further 258 people took part in structured community education activities such as school holiday programs, presentations and Teacher Professional Development sessions. Six regional events were also attended with around 1012 contacts made. These included agricultural shows, regional festivals, and fishing competitions. Where possible, education initiatives were delivered in collaboration with other environmental education providers. Partnerships included the Department of Environment and Conservation, South Coast Natural Resource Management, the Albany Museum and the Fishers with Disabilities Association.

## Initiatives in 2011/2012

### Compliance

Compliance and management personnel continue to refine compliance planning to deliver greater efficiencies and outcomes through the use of risk assessments and intelligence processes. This has resulted in greater capacity to target specific offence types, utilising risk analysis to deploy resources more efficiently.

Renewed focus on complaints and investigations with a view towards improving the keeping of records, gathering and managing evidence and delivering outcomes of those matters in a more timely fashion – with feedback (where appropriate) to the complainants.

Biosecurity is a strategic focus for the region with the complimentary efforts between compliance staff and the Biosecurity Unit.

Physical resourcing initiatives undertaken in the 2011/2012 year are expected to eventuate in the 2012/2013 year to enable better compliance initiatives.

Training and development of staff has been a focus which continues into the new financial year with four staff currently

attending the Frontline Managers Course, improvements to Warrant Execution refresher training, in the field mentoring, delegation of projects to junior staff to develop 'Operational Orders' and lead the operations.

FMO'S will structure recreational fishing compliance programs to address a growing concern of increased catches of demersal scalefish by recreational fishers due to the additional effort from fishers relocating from the West Coast as a result of the new West Coast rules and license fees. The program will include operations aimed at ensuring compliance with possession limits as well as investigations into suspected illegal fish sales.

The recent development of the Walpole – Nornalup Inlets Marine Park will see the personnel in the southern bioregion engaged in a range of tasks including delivery of marine park compliance services and education programs. Operational plans have been developed with the Department of Environment and Conservation with a focus on joint operations to maximize the management presence in the marine park.

The 2011/2012 year has delivered a total of 933 contacts made in this marine park and has included joint operations with the Department of Environment and Conservation (a partner of the marine park).

### Education

The education program for the south coast will continue to focus on school-based incursions and excursions working on sustainability and education themes developed as part of the state-wide education plan. Education staff will continue to deliver community activities such as holiday programs, workshops and regional events, in partnership with other agencies where possible. Education for the Walpole-Nornalup Inlets Marine Park will continue to be delivered in collaboration with the Department of Environment and Conservation. The Marine Education Officer will also support community participation initiatives such as 'fish frame' collections.

SOUTH COAST BIOREGION

**SOUTH COAST COMPLIANCE TABLE 1**

Summary of compliance and educative contacts and detected offences within the South Coast bioregion during the 2010/11 financial year.

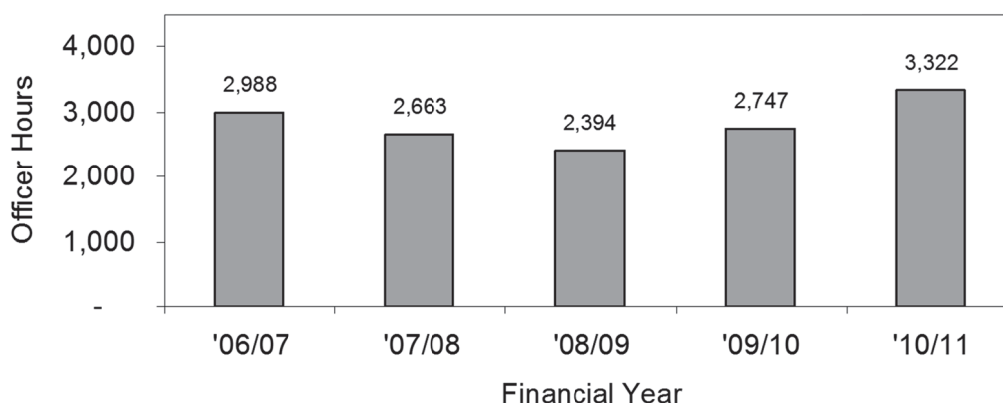
PATROL HOURS DELIVERED TO THE BIOREGION	3,322 Officer Hours
CONTACT WITH THE COMMERCIAL FISHING COMMUNITY	
Field Contacts by Fisheries & Marine Officers	308
Infringement warnings	6
Infringement notices	11
Prosecutions	2
CONTACT WITH THE RECREATIONAL FISHING COMMUNITY	
Field Contacts by Fisheries & Marine Officers	5,764
Infringement warnings	80
Infringement notices	37
Prosecutions	6
OTHER FISHING-RELATED CONTACTS WITH THE COMMUNITY*	
Field Contacts by Fisheries & Marine Officers	335
Fishwatch reports**	28
VMS (Vessel Days)****	2,114

\*Contacts are classified according to the specific fishery, which is usually clearly delineated as being either commercial or recreational. The “Other” category is used where multiple fisheries are contacted and it is not possible to accurately classify the contacts into one specific fishery – typically, the majority of these contacts are recreational in nature (e.g. personal contacts in Marine Protected Areas), but contacts made in relation to fish kills, shark patrols and inspections of commercial fish wholesale and retail premises etc. are also included in this category.

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

\*\*\*\* VMS (Vessel Days) represents the number of vessel days recorded in this bioregion. That is, a count for each day that each vessel was polled within the bioregion.

**South Coast Bioregion Compliance Patrol Hours**



**SOUTH COAST COMPLIANCE FIGURE 1**

“On Patrol” Officer Hours showing the level of compliance patrol activity delivered to the South Coast bioregion over the previous 5 years. The 2010/11 total gives the patrol hours in the bioregion that resulted in the contacts detailed in Table 1. (The totals exclude time spent on other compliance related tasks e.g. travel time between patrol areas, preparation and planning time etc.)