



West coast demersal scalefish fishery status report. In: State of the fisheries report 2007/08. Eds W. J. Fletcher and K. Santoro.

Fairclough, D.; Keay, I.; Johnson, C.; et.al.

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WEST COAST BIOREGION

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PV Waterman. Photo: Henrique Kwong



WEST COAST BIOREGION

ABOUT THE BIOREGION

The marine environment of the West Coast bioregion between Kalbarri and Augusta is predominantly a temperate oceanic zone, and is heavily influenced by the Leeuwin Current, which transports warm tropical water down the continental shelf. Under the Interim Marine and Coastal Regionalisation for Australia (IMCRA) scheme, published in 1998 by the Australian and New Zealand Environment and Conservation Council, the bioregion has been divided into 3 meso-scale regions: the Abrolhos Islands, the Central West Coast and the Leeuwin–Naturaliste.

The fish stocks of the region are typically temperate, in keeping with the coastal water temperatures that range from 18°C to about 24°C. The Leeuwin Current is also responsible for the existence of the unusual Abrolhos Islands coral reefs at latitude 29° S and the extended southward distribution of many tropical species along the west and south coasts.

The Leeuwin Current system, up to several hundred kilometres-wide along the west coast, flows most strongly in autumn/winter (April to September) and has its origins in ocean flows from the Pacific through the Indonesian archipelago. The current is variable in strength from year-to-year, flowing at speeds typically around 1 knot, but has been recorded at 3 knots on occasions. The annual variability in current strength is reflected in variations in Fremantle sea levels, and is related to El Niño or Southern Oscillation events in the Pacific Ocean.

Weaker counter-currents on the continental shelf, such as the Capes Current that flows northward from Cape Leeuwin as far as Shark Bay, occur during summer and influence the distribution of many of the coastal finfish species.

The most significant impact of the clear, warm, low-nutrient waters of the Leeuwin Current is on the growth and distribution of the temperate seagrasses. These form extensive meadows in all protected coastal waters of the West Coast bioregion, in depths of up to 30 m, and act as major nursery areas for many fish species and particularly for the large western rock lobster stock.

The west coast is characterised by exposed sandy beaches and a limestone reef system that creates surface reef lines, often about 5 kilometres off the coast. Sea floors further offshore on the continental shelf are typically composed of coarse sand interspersed with low limestone reef associated with old shorelines. There are few areas of protected water along the west coast, the exceptions being in the Abrolhos Islands, in the lee of some small islands off the mid-west coast, and behind Rottnest and Garden Islands off the Perth metropolitan area.

The major significant marine embayments of the west coast are Cockburn Sound and Geographe Bay. Beyond Cape Naturaliste, the coastline changes from limestone to predominantly granite and becomes more exposed to the influences of the Southern Ocean. Along the west coast, there are 4 significant estuarine systems – the Swan/Canning, Peel/Harvey and Leschenault estuaries and Hardy Inlet (Blackwood estuary). All of these are permanently open to the sea and form an extension of the marine environment except when freshwater run-off displaces the oceanic water for a short period in winter and spring.



Abrolhos Islands. Photo: Shannon Conway

The principal commercial fishery in this region targets the western rock lobster. The West Coast Rock Lobster Fishery is Australia's most valuable single-species fishery, producing an average catch of 11,000 t valued at around \$300 million annually. There are also significant fisheries for scallops, abalone, blue swimmer crabs, sharks, pilchards, and coastal and estuarine finfish. Many of these inshore fish resources are shared with the recreational sector.

The West Coast bioregion is also home to an active wetline fishery, for which specific management arrangements have recently been developed. Demersal line fishers take a range of species including dhufish, snapper, baldchin groper and emperors from boats operating purely as 'wetliners'. There is also an important take of fish by beach seining and near-shore gillnetting using hand-hauled nets, for species including whitebait, mullet and whiting.

In the West Coast bioregion more than any other in the State, population growth poses specific challenges for fisheries management. Increased recreational fishing pressure, and the setting of catch shares for commercial and recreational users, is a major focus of the Department of Fisheries' management activity.

The West Coast bioregion is the most heavily used one for recreational fishing, owing to its accessibility to the main population centres. The bioregion provides a range of recreational fishing opportunities – from estuarine fishing to beach fishing and boat angling in embayments. Offshore boat angling includes both demersal and pelagic/game fishing opportunities around islands and on the edge of the continental shelf.

Species targeted in estuaries include black bream, flatfish and blue swimmer crabs, whilst herring, whiting (including King George whiting), tailor, mulloway and abalone are targeted from beaches. Boat-based fishers target herring, whiting, rock lobsters, pink snapper, dhufish, baldchin groper and a number of larger pelagic and game species.

The principal aquaculture development activities in the West Coast bioregion are the production of blue mussels (*Mytilus edulis*) and

marine algae (*Dunaliella salina*) for beta-carotene production, and the emerging black pearl industry based on the production of *Pinctada margaritifera* at the Abrolhos Islands.

The main mussel farming area is in southern Cockburn Sound, where conditions are sheltered and the nutrient and planktonic food levels are sufficient to promote good growth rates. Owing to the generally low productivity of the Western Australian coastline under the influence of the Leeuwin Current, areas outside embayments (where nutrient levels are enhanced) are unsuitable for bivalve aquaculture.

The Department of Fisheries' Research Division's Biodiversity and Biosecurity Branch has a number of important research initiatives underway. Ecological risk assessments undertaken on the western rock lobster fishery identified lobster fishing pressure in the deep water as being a moderate risk to communities in those depths. In addressing this concern, a recently completed Fisheries Research and Development Corporation (FRDC)-funded project provided critical information on the relationships between rock lobster abundance, size distributions and benthic habitat characteristics in deep water. That project also provided preliminary data on the trophic role of rock lobster in deep water ecosystems.

Further ecological research in deep waters, supported by funding from the Western Australian Marine Science Institution (WAMSI) and the FRDC, will compare fished and unfished areas using a deep water reference area. A key objective of this project will be to enable potential ecosystem impacts of lobster fishing to be quantified. Negotiation of a suitable reference area is underway, as is the development of sampling methodologies to effectively monitor benthic habitats in fished and unfished areas.

Further research into monitoring fished and unfished (sanctuary) areas was the basis of a recently completed project supported by the Swan Catchment Council (SCC) and the Rottnest Island Authority (RIA). This project established baselines for a long-term monitoring program to detect change through time to fish, rock lobster and benthic communities in three A-class marine reserves along the Perth metropolitan coast. The monitoring methods developed in this project are likely to be used in future surveys of other marine parks in WA to fulfill the Department of Fisheries and the Department of Environment and Conservation's marine park research obligations.

A collaborative project between the Department of Fisheries and the Western Australian Museum, which was also supported by the Swan Catchment Council, has been describing the community structure of the marine fauna in Cockburn Sound. This project aims to establish methods and identify key indicator species to facilitate the assessment of the current and future health of the marine ecosystem in this embayment. A particular focus will be the stocks of blue swimmer crab and snapper, for which Cockburn Sound constitutes an integral part of their life history. The acquisition of this information will be timely, considering the recent increases in urban and industrial development and proposals for future development in this area.

The largest of these proposed developments, with the highest potential for impact on the marine fauna in this area, is undoubtedly the proposed Outer Harbour Facility for the Port of Fremantle. The main purpose of this development is to alleviate

the Port of Fremantle of some of its shipping operations, as it is expected to reach its optimal working capacity by 2015. The Port of Fremantle has provided funding to the Department of Fisheries to assess the potential impacts from this development on important aspects of the biology of the native fauna and to user groups in this area.

A research program monitoring the health of coral communities at the Houtman Abrolhos Islands has been expanded. This program, utilising permanent coral transects located at each of the island groups, will collect important baseline information on coral communities, allowing researchers to quantify whether lobster fishing with pots results in damage to sensitive coral habitats, and to determine the vulnerability of coral communities at the Abrolhos to climate change.

Researchers from the Biodiversity and Biosecurity Branch have also been involved in 'Marine Futures', a National Heritage Trust (NHT)-funded collaborative project managed by the University of Western Australia, which has been collecting baseline scientific data to develop marine resource indicators for marine habitats, biodiversity and human use patterns in south-western Australia. The focus of the project has been on mapping the dominant marine habitats, and conducting biodiversity surveys in order to build spatial habitat models of the marine environment.

Outputs from habitat mapping and biodiversity surveys will assist in the identification of key marine indicators, and will support regional natural resource management groups in establishing marine ecosystem monitoring targets. The habitat maps produced will provide information on the distribution and extent of various substrates (e.g., reef versus sediment), relief, dominant vegetation types, and different classes of sessile invertebrates.

In the West Coast bioregion, sampling has focused on the Abrolhos Islands, Jurien Bay, Rottnest and Cape Naturaliste. Bathymetric and towed video surveys have been completed at all of these sites, as well as biodiversity sampling including research trawls using the *RV Naturaliste* and Baited Remote Underwater Video Stations (BRUVS).

Concern about over-collecting of molluscs, particularly the abalone *Haliotis roei*, on intertidal platforms in the Perth metropolitan area, led the Department of Fisheries to ban collecting in early 1982. Detailed surveys of molluscs were conducted from 1983 to 1986 at Cottesloe, Trigg and Waterman – platforms with different fishing histories for abalone. Echinoderms were examined in 1986. These surveys were repeated in early 2007 with funding from the SCC to determine whether there were any changes in mollusc and echinoderm populations on intertidal platforms in the last quarter of a century. Data collected indicate that present populations are within the range of variability experienced in the 1980s, and present management regimes are working.

In December 2007 a similar survey was conducted at Radar Reef and Cape Vlamingh at Rottnest Island. Again, variability in mollusc populations was within the expected range. At the same time a study was undertaken of imposex in the genus *Conus* at Rottnest Island. In 1991 the finding of imposex in *Conus* at Rottnest Island was the first record in the state.

Imposex is a reproductive abnormality in female marine snails caused by tributyltin (TBT) used as an antifoulant in boat

paints. Partly as a result of finding imposex in *Conus*, bans were imposed on the use of TBT on vessels smaller than 25 metres in 1991, and the rate of leaching permitted from larger vessels was decreased. A 1996 study showed some decrease in the level of imposex. In the December 2007 re-examination, no TBT could be found in sand on the platforms or in the snails. The proportion of snails affected by imposex had also decreased.

Over the past fishing season, sea lion exclusion devices (SLEDs) were implemented in the commercial and recreational west coast rock lobster fisheries in an effort to eliminate the incidental mortality of the threatened Australian sea lion pups in lobster pots. Research has been undertaken monitoring the success of the SLEDs, in their ability to exclude further sea lion mortalities while at the same time not impacting on lobster catches in any way. Recent research into the interaction between sea lions and the western rock lobster fishery at the Abrolhos Islands suggests that SLEDs may be required in this part of the fishery as well.

In concert with this research, the monitoring of the seasonal pup production at the four Australian sea lion breeding colonies on the west coast has continued this year – and recent data suggest that the population on the west coast is currently stable. Fishery-dependent data on interactions between commercial fisheries and all protected species is monitored for its use as an indicator in risk assessments.

Finally, with funding from Natural Heritage Trust a project commenced in 2006 to evaluate the extent of introduced marine species in Western Australian waters and developing strategies to minimise further introductions. In the first two years, the project has developed considerable information on the status of introduced marine species in WA.

A major paper has been written drawing together information on 60 introduced marine species in the State, and where they have been found. While 60 is a substantial number, only three are on the national list of species of concern. Amongst the areas surveyed as part of this project was the Port of Geraldton, which was inspected for Caribbean species of snails and barnacles that could have been introduced by the dredge *Leonardo da Vinci* when it arrived from Jamaica in October 2002. Fortunately, no species that could be attributed to the dredge were found.

Other work in progress includes an assessment of whether a monitoring program should be established for introduced marine species in marine parks and Fish Habitat Protection Areas. The Swan River, Fremantle Harbour, Rous Head, and Cockburn Sound have been surveyed for four species of concern. A separate study is examining whether the 46 introduced species known from those areas have spread onto the adjacent open coast.

ENVIRONMENTAL MANAGEMENT

Regional Overview (West Coast)

The marine benthic habitat along the west coast is largely protected from any physical impact of commercial fishing by extensive closures to trawling. These closures were introduced in the 1970s and 1980s, in recognition of the significance of extensive areas of seagrass and reef as fish habitat (West Coast Habitat Protection Figure 1).

Fish habitat and biodiversity protection is also provided within individual marine protected areas along the west coast including:

- Fish Habitat Protection Areas (FHPAs) at the Abrolhos Islands, Lancelin Island Lagoon, Cottesloe Reef, and Kalbarri Blueholes;
- Reef Observation Areas within the Abrolhos Islands FHPA and closures to fishing under section 43 of the *Fish Resources Management Act 1994* at Yallingup Reef, Cowaramup Bay, the Busselton Underwater Observatory, and around the wrecks of the Saxon Ranger (Shoalwater Bay) and Swan (Geographe Bay); and
- marine conservation areas proclaimed under the *Conservation and Land Management Act 1984* at Jurien Bay, Marmion, Swan Estuary, Shoalwater Islands, and the proposed Capes Marine Park between Cape Leeuwin and Cape Naturaliste (West Coast Habitat Protection Figure 2).

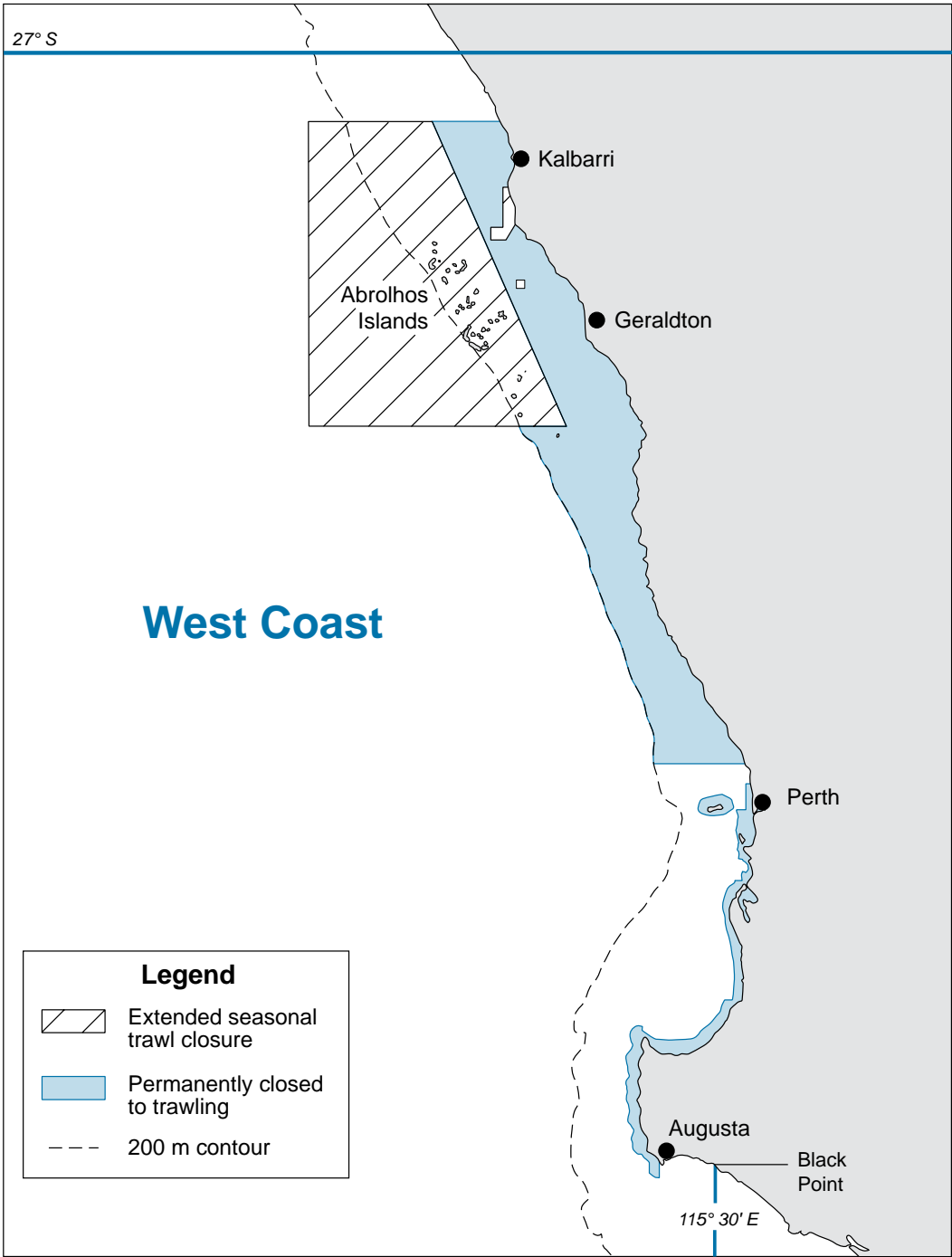
The Australian Government's Department of Environment, Water, Heritage and the Arts (DEWHA) is also undertaking a Marine Bioregional Planning process for Commonwealth waters between Kangaroo Island, South Australia and Shark Bay. The DEWHA plan to complete a draft South West Marine Bioregional Plan (MBP), which will contain individual marine protected areas, in mid 2009.

The marine habitat and biodiversity along the West Coast bioregion is in generally good condition. However, near-shore waters face increasing threats from coastal development through direct loss as a result of dredging and coastal infrastructure development, e.g. ports, reduced water quality through nutrient-rich and/or polluted terrestrial run-off impacting estuaries and some protected near-shore waters, and the risk posed by the introduction of exotic aquatic pests through international shipping movements.

In recognition of the need to manage the State's fish resources on an ecosystem-wide basis, the Department of Fisheries has initiated an Ecosystem-Based Fisheries Management (EBFM) framework. The West Coast and Gascoyne bioregions have been selected to trial this process.

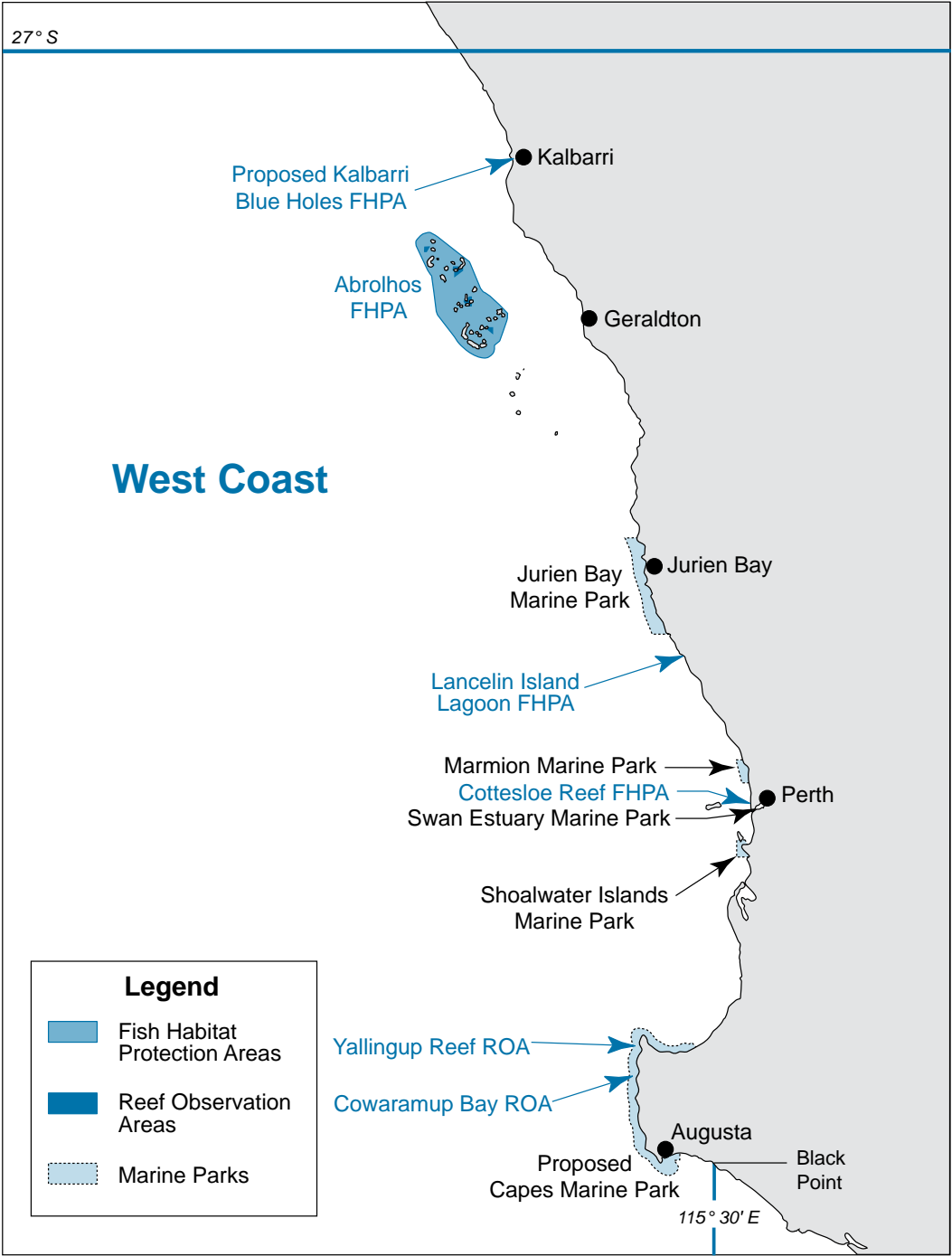
EBFM is a risk-based management approach that recognizes the social, economic and environmental values of the region, and the ecological links between exploited fish stocks and the broader marine ecosystem. EBFM will now guide fisheries management arrangements in the West Coast bioregion to ensure the sustainable management of fish stocks in the future. The Department of Fisheries also continues to provide advice to the Environmental Protection Authority on individual 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 west coast to promote sustainable use of the aquatic environment, and has 'introduced aquatic organism incursion' and 'fish kill incident response' programs in place to minimise risks to the marine environment through the introduction of exotic aquatic organisms, or other incidents which have the potential to have an adverse effect



WEST COAST HABITAT PROTECTION FIGURE 1
Map showing areas of permanent and extended seasonal closures to trawl fishing in the west coast bioregion.

WEST COAST BIOREGION
GASCOYNE COAST BIOREGION
NORTH COAST BIOREGION
SOUTH COAST BIOREGION
NORTHERN INLAND BIOREGION
SOUTHERN INLAND BIOREGION
STATE-WIDE
REFERENCES AND APPENDICES



WEST COAST HABITAT PROTECTION FIGURE 2

Map showing current and proposed marine protected areas in the west coast bioregion.

FISHERIES

West Coast Rock Lobster Fishery Status Report

S. de Lestang, R. Melville-Smith, A. Thomson and M. Rossbach.
Management input from K. Donohue

Fishery Description

Commercial

The West Coast Rock Lobster Managed Fishery (WCRLF) targets the western rock lobster, *Panulirus cygnus*, on the west coast of Western Australia between Shark Bay and Cape Leeuwin, using baited traps (pots). With an annual production that averages in excess of 11,000 t, this is Australia's most valuable single-species fishery.

Recreational

The recreational rock lobster fishery primarily targets western rock lobsters in the Perth metropolitan area and Geraldton, using baited pots and by diving.

Governing legislation/fishing authority

Commercial

West Coast Rock Lobster Management Plan 1993; West Coast Rock Lobster Managed Fishery Licence; Various Notices and Orders under the *Fish Resources Management Act 1994*; Commonwealth Government *Environment Protection and Biodiversity Conservation Act 1999* (Export Exemption)

Recreational

Fish Resources Management Act 1994 and subsidiary legislation; Recreational Fishing Licence

Consultation processes

Commercial

Rock Lobster Industry Advisory Committee (RLIAC) and subcommittees;
annual RLIAC coastal tour; meetings between the Department of Fisheries and industry

Recreational

Recreational Fishing Advisory Committee

Boundaries

Commercial

The boundaries of this fishery are 'the waters situated on the west coast of the State bounded by a line commencing at the intersection of the high water mark and 21°44' south latitude drawn due west to the intersection of 21°44' south latitude and the boundary of the Australian Fishing Zone; thence southwards along the boundary to its intersection with 34°24' south latitude; thence due east along 34°24' south latitude to the intersection of 115°08' east longitude; thence due north along 115°08' east longitude to the high water mark; thence along the high water mark to the commencing point and divided into zones'.

The fishery is managed in 3 zones: south of latitude 30° S (C Zone), north of latitude 30° S (B Zone) and, within this northern area, a third offshore zone (A Zone) around the Abrolhos Islands.

Recreational

The recreational rock lobster fishery operates on a state-wide basis and encompasses the take of all rock lobster species. Fishing is concentrated on western rock lobsters in inshore regions in depths of less than 20 metres between North West Cape and Augusta.

Management arrangements

Commercial

This fishery is managed using a total allowable effort (TAE) system and associated input controls. The primary control mechanism is the number of pots licensed for the fishery, together with a proportional usage rate, which creates the TAE in pot days. Unitisation in the fishery and transferability provisions allow market forces to determine what is the most efficient use of licences and pot entitlements. This is known as an individually transferable effort (ITE) management system.

The number of pots allowed in the fishery was set at 68,961 in the early 1990s. In 1993/94 the usage rate of these pots was reduced to 82%. This was further reduced in the northern part of the fishery to 72% for part of the season beginning in 2005/06 to keep the TAE at a sustainable level (see below).

The fishery is divided into 3 zones, which distributes effort across the entire fishery, reducing concentration of effort and the potential for unacceptable exploitation rates. This also permits the implementation of management controls aimed at addressing zone-specific issues, including different maximum size restrictions in the northern and southern regions of the fishery.

The management arrangements also include the protection of females in breeding condition, a minimum size limit of 77 mm carapace length applies from 15 November to 31 January, and a minimum of 76 mm from 1 February to 30 June. A maximum size limit for female lobsters was re-imposed in 2002/03 that prohibits the take of female lobsters larger than 105 mm from waters between 21°44' S and 30° S (northern region) and those larger than 115 mm between 30° S and 34°24' S (southern region), excluding waters east of 115°08'.

Gear controls, including escape gaps and a limit on the size of pots, also play a significant role in controlling exploitation rates. The season is open from 15 November to 30 June annually, with the Abrolhos Islands zone operating from 15 March to 30 June. Additional effort reductions were introduced in 2005/06.

In the northern coastal region, pot usage was reduced to 72% from 15 November – 14 March and 82% from the 15 March to 30 June. The northern zone was also closed to fishing from 15 January – 9 February, with no fishing on Sundays (15 March – 30 June), Christmas Day and New Year's Day. Pot usage in Zone A was also reduced to 72% for the first four weeks of the season (15 March – 15 April), before returning to 82% for the remainder of the season. In the southern region, pot usage remained at 82% all season, the season began 10 days later (24 November), 3-day moon closures occurred from 1 February to 30 June (1 day prior to the full moon, the day of the full moon and the day after the full moon) and the fishery was closed for Christmas Day and New Year's Day.

In 1999/2000, the West Coast Rock Lobster Managed Fishery became the world's first fishery to receive Marine Stewardship Council (MSC) certification. The ongoing requirements of maintaining this certification continue to require a high level of research and management input.

A comprehensive Ecologically Sustainable Development assessment of this fishery has been undertaken to identify any potential sustainability risks requiring direct management. The issues identified through this process were lobster breeding stock levels, by-products (octopus) and interactions with protected species. Boxed text in this status report provides the annual assessment of performance for these issues.

Recreational

The recreational component of the western rock lobster fishery is managed under fisheries regulations, which impose a mix of input and output controls on individual recreational fishers. These arrangements are designed to complement the management plan for the commercial fishery.

Input controls include the requirement for a recreational fishing license (either a specific rock lobster license or an 'umbrella' license covering all licensed recreational fisheries). Fishers are restricted to 2 pots per license holder, although the total number of licenses is not restricted. The pots must meet specific size requirements and have gaps to allow under-size rock lobsters to escape. Divers are also restricted to catching by hand, snare or blunt crook in order that the lobsters are not damaged. Fishing for rock lobsters at the Abrolhos Islands is restricted to potting.

An open season runs from 15 November to 30 June each year, with a shorter season (15 March to 30 June) at the Abrolhos Islands. Night-time fishing for lobsters by either diving or potting is prohibited. Management regulations on minimum size limits, protection of breeding females and the maximum size of females that can be taken are the same as those for commercial fishers.

A daily bag limit of 8 lobsters per fisher per day is used to control individual catches, and limits the ability of recreational fishers to accumulate quasi-commercial quantities of lobsters. A daily boat limit of 16 provides further control on high individual catches where there are 2 or more people fishing from the same boat. There is also a requirement for recreationally-caught lobsters to be tail-clipped in order to stop these animals from being sold illegally as part of 'shamateur' activity.

Integrated Fisheries Management

The IFAAC's Western Rock Lobster Allocation Report was released for public comment in November 2005. The IFAAC recommended an allocation of 4.9% and 95.1% of the western rock lobster resource to the recreational and commercial sectors, respectively. The associated public submission period closed at the end of March 2006.

The IFAAC's allocation report was released with the Minister's preliminary responses in early 2007 for a further period of comment, which closed at the end of April 2007. In March 2008 the Minister finalized his decisions with respect to the allocation of the State's western rock lobster resource. His decisions, amongst other things, included approving an allocation of 5% and 95% of the resource to the recreational and commercial sectors respectively.

Research summary

Research activities continue to focus on the core business of assessing stock sustainability and forecasting future catch levels. This involves fishery-independent monitoring of breeding stock levels and puerulus settlement. Industry performance is monitored through compulsory catch and effort records from both fishers and processors and comprehensive data from the voluntary log book scheme, all of which are used for modelling and stock assessment.

An environmental management strategy was developed for use in the assessment of the broader ecosystem impacts of rock lobster fishing in the context of ESD and MSC certification. This strategy includes research into the ecosystem effects of rock lobster fishing in deep water. A Fisheries Research and Development Corporation (FRDC) funded project to examine the effects of western rock lobster fishing on the deep-water ecosystem off the west coast of Western Australia began in 2004/05 and this has now been completed. This project provided critical baseline data on the relationships between the abundance and size distributions of rock lobster and the different benthic habitats located in deeper waters, plus preliminary data on diets and the trophic role of rock lobster within these depths.

Further ecological research in deep waters will be based on comparing fished and unfished areas using research closures. A new FRDC project will begin in 2009 after suitable fished and unfished areas within deep water have been established in collaboration with industry. This project will collect baseline information on lobster stocks, habitat and community structure to facilitate comparisons between fished and unfished areas. The ultimate outputs of this project will enable any impacts of lobster fishing on deepwater ecosystems to be quantified.

A further project focusing on the changes to lobster populations within unfished zones compared to fished areas funded by the Swan Catchment Council, will be completed in June 2008. Results from this project have identified the short-term impacts that 'no-take' areas have on lobster populations in shallow waters. Further funding will be sought to continue this monitoring.

A second FRDC project, which is to be completed in 2008/09, is investigating reproductive biology issues relevant to managing the western rock lobster broodstock. Results from this project, including temporal changes in the sizes at maturity and double breeding and the spatial distribution of egg production, have been published in peer reviewed journals.

A stock assessment workshop was held in July 2007 at the Department of Fisheries' Western Australian Fisheries and Marine Research Laboratories. The workshop provided the forum for a peer review of the integrated biological stock-assessment model that was being developed by the Department for use in providing future management advice for the fishery. A draft version of this model has since been used to assess the impact of possible future effort reductions on commercial catch and breeding stock levels. This workshop also enabled the assembled experts to complete the review of the Department's stock assessment methods and advice provided for 2004 and 2005 seasons, which was an MSC condition. A report on this workshop can be found on the Departments website.

For the recreational component of this fishery, an annual mail-based survey of participants has been used to estimate the annual catch and effort for the past 20 years. These trends, together with data on puerulus settlement, are used to predict the recreational catch and effort in following seasons.

Since 2000/01, telephone diary surveys of recreational rock lobster fishers have been undertaken in most years. Estimates of recreational catch using this method are compared to the estimates from mail surveys. The results of the phone diary surveys are considered to be more accurate than those of the mail surveys because the former eliminate the recall bias in the mail surveys and additionally, there is a higher participation rate in the survey from random sample selection. Sample sizes for the phone diary surveys have been increased since the 2006/07 survey to improve the accuracy of the result.

Retained Species

Commercial landings (season 2006/07): 8,577 tonnes

Trends in the annual catches from the West Coast Rock Lobster Managed Fishery (WCRLF) are shown in West Coast Rock Lobster Figure 1. The 2006/07 catch in the WCRLF was forecast from puerulus settlement 3 to 4 years previously to be 9,350 t. The actual catch from the WCRLF for the 2006/07 season was 8,577 t, which was 22.6% lower than the long-term average catch (1980/81 to 2005/06) of 11,083 t and 16.6% lower than the previous season's 10,326 t. In 2006/07, the catches in A Zone, B Zone and C Zone were 2,008, 2,957 and 3,611 t respectively, with A Zone 3.3% lower, B Zone 0.1% higher and C Zone 31.8% lower than the previous season.

Octopus are also caught in rock lobster pots, generally in shallow water (0 – 20 fathoms or 0 – 37 m), and a catch rate of 0.03 octopus per pot lift was recorded in the 2006/07 voluntary research log book data. This was 25% above the average of 0.024 per pot lift over the historical range (1985/86 to 2003/04).

This catch rate translates to an estimated 140,878 octopus caught in shallow regions of the fishery during 2006/07. Octopus catches were estimated for A, B and C Zones as 37,199, 52,604, and 51,074, respectively.

The catch rate of octopus (incidental landings) is a performance indicator for this fishery, and at 0.03 octopus per pot lift achieved the performance measure of being within 10% of the historical range. The historical range ($\pm 10\%$) is 0.013 – 0.033 octopus per pot lift.

**Recreational catch estimate
(season 2006/07):**

174 tonnes

Based on the first 2 phone diary surveys (2000/01 and 2001/02), catch estimates from previous mail surveys going back to the 1986/87 season were adjusted downwards by the average ratio of 1.9. A fourth phone diary survey undertaken in the 2005/06 season produced a different ratio between the mail and phone diary recreational catch estimates. However, in the interests of maintaining consistency from year-to-year, the 1.9 conversion factor has been maintained as the current best estimate until a series of comparative data are available and a more reliable conversion factor can be determined.

The recreational catch of western rock lobster for 2006/07 was estimated at 174 t based on the adjusted mail survey, with 117 t taken by potting and 57 t by diving. Comparative catch estimates for 2005/06 were 157 t by potting and 57 t by diving. The estimated recreational catch in 2006/07 was 18.7% below the 2005/06 catch. The 2006/07 season catch estimate was within the catch prediction confidence limits (i.e. 150 – 300 t) produced by the model constructed using adjusted mail survey catch estimates.

Fishing effort/access level

Commercial

Management initiatives aimed at reducing effort have had the secondary effect of a reduction in fleet size, as vessels purchased additional pot entitlements to improve their economic efficiency. In 2006/07 the numbers of vessels fishing for lobster were 128 in A Zone, 111 in B Zone and 252 in C Zone. Thus, in comparison to the 500 active boats in 2005/06, a fleet of 491 vessels fished in 2006/07, which was a reduction of 1.8%.

The nominal fishing effort was 8.3 million pot lifts in 2006/07 – 5.7% lower than the 8.8 million pot lifts for 2005/06 and the lowest level since the 1970s (West Coast Rock Lobster Figure 1). This decline in nominal pot lifts is due in part to the sustainability package adopted by the fishery in the 2005/06 season and reduced fishing due to lower catch rates and increased costs.

The 2006/07 nominal effort for A, B and C Zones was 1.2, 2.7 and 4.4 million pot lifts respectively, which was 7.7% less, 1.8% less and 7.4% less than the previous season's pot lifts.

Recreational

A total of 37,488 licenses were sold that permitted fishing for lobsters during some part of the 2006/07 season (made up of specific rock lobster licenses plus umbrella licenses), with an estimated 22,000 (59%) utilised for lobster fishing. License usage was forecasted to be 20,800 but came in above that prediction at around 22,000.

Recruitment of lobsters to the fishery is dependent on puerulus settlement with a 3 to 4-year time lag. As might be expected, sales of licenses and associated usage figures are substantially higher in years of good recruitment into the fishery, which in turn results in those years producing a relatively higher overall recreational rock lobster catch due to a combination of increased lobster abundance and higher fishing effort. The number of licenses used for rock lobster fishing in 2006/07 was 5% higher than the number of active licenses (21,000) for the 2005/06 season.

The average rates of usage by active pot and diving fishers (i.e. excluding all those who held a license but failed to use it) were 15 and 5 days respectively during the 2006/07 fishing season. These rates were similar in the 2005/06 fishing season. Finally, the average number of lobsters caught for the season by pot and dive fishers was amongst the lowest on record for both groups.

In addition to long-term trends in license usage, the annual recreational catch in Zone C has also been shown to be correlated with puerulus settlement indices recorded on the Alkimos collectors 3 to 4 years earlier.

Stock Assessment

Assessment complete:	Yes
Breeding stock levels:	Adequate
Projected commercial catch next season (2007/08):	9,250 tonnes
Projected recreational catch next season (2007/08):	240 tonnes

Stock assessment in this fishery utilises the broad range of fishery data and fishery-independent monitoring outlined in the research summary above.

Indices of breeding stock are the main indicators for assessing the health of this fishery. A 3-year moving average (smoothing) is used to show the underlying trends in the trajectory of the breeding stock indices, rather than highlighting individual data points which can vary significantly due to environmental effects on the catchability of lobsters.

Under the current management arrangements introduced in 1993/94 and updated in 2005/06, which included a reduction in pot usage rate, the protection of setose and maximum size females, and a number of temporal closures, the overall breeding stock remains at, or above, the target levels of the late 1970s and early 1980s (West Coast Rock Lobster Figures 3 and 4).

The north and south coastal fishery-dependent breeding stock indices, based on commercial monitoring data, together with the related coastal fishery-independent breeding stock survey (IBSS) index, are presented in West Coast Rock Lobster Figures 3 and 4. The Abrolhos Islands index from the IBSS is presented in West Coast Rock Lobster Figure 5.

A performance measure for the fishery is that the breeding stock index remains above that estimated to be the 1980 level (22% of virgin biomass). The breeding stock levels in 2006/07 for A and C Zones were clearly above this threshold value, although B Zone is close to this value (see West Coast Rock Lobster Figures 3 and 4). The fishery has therefore met its performance measure.

Depletion Analysis

Another measure used to assess stock condition is depletion-based estimates of the harvest rate. This is a measure of the proportion of the legal biomass that is removed by fishing each season. Over the past 11 years the harvest rate in A Zone has decreased slightly, while a significant increase has occurred in the coastal fishery (West Coast Rock Lobster Figure 6). This analysis also highlighted an increasing trend in catchability (reflecting increasing efficiency) in B Zone and a declining trend in the residual biomass of legal-sized lobsters at the end of the year in this zone.

Catch per Unit Effort (CPUE)

A third assessment measure is the catch per unit of effort (CPUE) achieved annually by the fishery (West Coast Rock Lobster Figure 2). This provides a broad indicator of variations in the abundance of the legally catchable stock.

Commercial

The downward trend from the 1950s to the 1980s reflects the increasing effort during this period (West Coast Rock Lobster

Figure 1), which automatically leads to lower CPUE. This trend was reversed in the early 1990s through a substantial management-induced reduction in effort (i.e. pot usage was reduced to 82% of the unit holding).

Shorter-term fluctuations in abundance represent the cyclical nature of puerulus settlement, which is reflected in the legal-sized abundance (CPUE) 3 to 4 years later. The decrease in CPUE to 1.032 kg/pot lift in 2006/07 (around 13.3% less than the previous year) relates directly to the levels of puerulus settlement recorded previously. It should be noted that the catch rate does not directly reflect the overall abundance of lobsters, as legal catches are generally only a proportion of the overall biomass due to the large biomass of under-size animals and breeding females, which are fully protected.

Recreational

The average recreational pot and diving catch rates were 1.1 and 2.2 lobsters per person per fishing day in the 2006/07 fishing season. These catch rates are similar for potting to those in the 2005/06 fishing season and are slightly higher for divers compared to the 1.6 lobsters per person per fishing day recorded last season.

Juvenile recruitment and Catch Prediction

Post-larval (puerulus) recruitment to the fishery is monitored monthly and is affected by fluctuations in environmental conditions such as strength of the Leeuwin Current and the frequency and intensity of low-pressure systems generating westerly winds. Annual indices of puerulus settlement for 2006/07 were below average at all sampling sites (West Coast Rock Lobster Figure 7). This reflects the negative Southern Oscillation Index (an indicator of El Niño conditions which affects the strength of the Leeuwin Current), which occurred in 2006. This low 2006/07 settlement will first impact on catches during the 'reds' of 2009/10 and the 'whites' throughout the fishery in 2010/11.

Total catch predictions for the WCRLF are made by summing the regional catch predictions from puerulus settlement at the Abrolhos Islands (A Zone), Seven Mile Beach (B Zone) and Jurien Bay, Lancelin, Alkimos and Warnbro Sound combined (C Zone) (West Coast Rock Lobster Figure 7). Seasons 2007/08 and 2008/09 are expected to produce commercial catches of around 9,250 t and 9,550 t respectively (West Coast Rock Lobster Figure 7). Catches during the 2009/10 season are expected to decline to 8,450 t.

It is also forecast that the recreational rock lobster catch for the whole fishery will be around 240 t in 2007/08 (West Coast Rock Lobster Figure 8), with catches of about 277 t and 209 t expected in 2008/09 and 2009/10. Therefore, license sales and usage in 2007/08 are expected to remain at similar levels; the prediction is that sales will be approximately 40,300 and usage 23,000 in the 2007/08 season.

Non-Retained Species

Bycatch species impact: **Low**

Fishery-independent monitoring on commercial vessels records the catch rates of fish and invertebrate bycatch species caught during normal rock lobster fishing operations. Approximately 125,150 fish and invertebrates other than rock lobster and octopus were captured during the 2006/07 fishing season, of which most were released (Table 1).

WEST COAST ROCK LOBSTER TABLE 1.

Catch rate of bycatch in lobster pots recorded during observer monitoring programs in 2006/07. The total number caught is an estimate based on the catch rate and the total number of pot lifts in 2006/07 fishing season (a catch rate of 0.06 equates to just one individual fish being caught during the monitoring program).

Bycatch Species	Catch/1,000 Pot Lifts	Estimated Total Number Caught (whole fishery)
Baldchin groper (<i>Choerodon rubescens</i>)	0.58	4,832
Black-banded seaperch (<i>Hypoplectrodes nigrorubrum</i>)	0.06	483
Blackspot pigfish (<i>Bodianus vulpinus</i>)	0.06	483
Blue-barred parrotfish (<i>Scarus ghobban</i>)	0.06	483
Boxfish (Ostraciidae)	0.06	483
Breaksea cod (<i>Epinephelides armatus</i>)	2.09	17,396
Bullseye (<i>Pempheris</i> sp.)	0.06	483
Chinaman cod (<i>Epinephelus rivulatus</i>)	0.81	6,765
Cobbler Carpetshark (<i>Orectolobus tentaculatus</i>)	0.06	483
Cuttlefish (<i>Sepia</i> sp.)	0.93	7,732
West Australian dhufish (<i>Glaucosoma hebraicum</i>)	0.17	1,450
Eel (Muraenidae)	1.4	11,598
Flathead (Platycephalidae)	0.06	483
Footballer sweep (<i>Neotypus obliquus</i>)	0.06	483
Gurnard (<i>Chelidonichthys</i> sp.)	0.17	1,450
Harlequin fish (<i>Othos dentex</i>)	0.06	483
Hermit crab (Paguroidea)	0.12	966
Leatherjacket (Monacanthidae)	0.52	4,349
Leopard wrirah (<i>Acanthistius pardalotus</i>)	0.7	5,799
Lined dottyback (<i>Labracinus lineatus</i>)	0.06	483
North-west blowfish (<i>Lagocephalus scleratus</i>)	0.06	483
Pink snapper (<i>Pagrus auratus</i>)	0.23	1,933
Port Jackson shark (<i>Heterodontus portusjacksoni</i>)	1.92	15,947
Queen snapper (<i>Nemadactylus valenciennesi</i>)	0.06	483
Scalyfin (<i>Parma muccullochi</i>)	0.06	483
Scorpion fish (Scorpaenidae)	0.81	6,765
Silver spot (<i>Threpterus maculosus</i>)	0.06	483
Skipjack trevally (<i>Psuedocaranx dentex</i>)	0.12	966
Spangled emperor (<i>Lethrinus nebulosus</i>)	0.06	483
Sweetlips emperor (<i>Lethrinus miniatus</i>)	0.76	6,282
Unknown fish	0.17	1,450
Urchin (Echinoidea)	0.06	483
Western foxfish (<i>Bodianus frenchii</i>)	0.12	966
Western wrirah (<i>Acanthistius serratus</i>)	0.12	966
Wobbegong shark (<i>Orectolobus</i> spp.)	1.69	14,014
Wrasse (Labridae)	0.7	5,799
Total		125,153

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BIOREGIONNORTH COAST
BIOREGIONSOUTH COAST
BIOREGIONNORTHERN INLAND
BIOREGIONSOUTHERN INLAND
BIOREGION

STATE-WIDE

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Protected species interaction:**Low**

Previously, the WCRLF interacted with the Australian sea lion, *Neophoca cinerea*, resulting in the accidental drowning of a small number of sea lion pups in rock lobster pots, as the pups attempted to retrieve bait or rock lobsters that were contained in lobster traps. Incidents were restricted to shallow waters (< 20 m) and to areas within 30 km of the mainland sea lion breeding colonies on the mid-west coast.

In order to eliminate these accidental drownings, from 15 November 2006 all pots fished in waters less than 20 metres within approximately 30 km of the 3 breeding colonies (i.e. just north of Freshwater Point to just south of Wedge Island) were fitted with an approved Sea Lion Exclusion Device (SLED). Video trials have indicated that this device does stop sea lion pups from entering lobster pots and drowning.

Approved SLED designs include an internal rigid structure, directly under the pot neck, and an external design across the top of the pot, both of which ensure that the diagonal distance from the SLED to the neck of the pot is not greater than 132mm. Further information on the SLED management package is available at: <http://www.fish.wa.gov.au/docs/pub/SeaLionExclusionDevices/index.php>

Monitoring of commercial pots in the SLED zone in 2006/07 showed that over 95% of pots checked had an approved SLED fitted.

A performance measure for this fishery is that no increase in the rate of capture of sea lions occurs. During the 2006/07 western rock lobster season, no sea lion captures were reported, whereas the historical level is just over three sea lions per season. The fishery has therefore met this performance measure.

Turtle deaths as a direct result of interaction with the lobster fishery are very rare. Of the 6 turtle species that occur in the waters of the western rock lobster fishery, only the entanglement of leatherback turtles (*Dermochelys coriacea*) was concluded to be above a negligible risk, and this was still rated as a low risk.

A performance measure for the fishery is that there is no increase in interactions with turtles. In 2005/06, no leatherback turtles were reported to have been entangled in lobster fishing gear. This incident rate is below the historical range of between 2 and 5 entanglements per season over the preceding five seasons. The fishery has therefore met this performance measure.

There are occasional reports of a whale becoming entangled with pot ropes. The humpback whale is the predominant species that interacts with the WCRLF, during its northward migration to the North West Shelf breeding grounds in June to August. Owing to the fishery's closed season, there is a limited period for interaction, but with the increasing population of whales, more interactions are likely to occur in the future.

Interactions are reported by industry to the Department of Environment and Conservation (DEC) and a specialist team is used to disentangle the animal, with a very high success rate. The western rock lobster fishing industry has developed a code of

practice to minimise the interaction with whales in conjunction with DEC and SeaNet. The environmental management strategy adopted for the WCRLF requires monitoring of, and attempts to, minimise accidental interaction with these species wherever practicable.

A performance measure for the fishery is that there is no increase in the rate of interactions with whales and dolphins (entanglements). Over the recorded history (1989 – 2005), commercial lobster fishing has resulted in zero to 4 whale/dolphin interactions per season. During the 2006/07 lobster season, one whale was recorded as becoming entangled and subsequently successfully disentangled, therefore the fishery did meet this performance measure.

Ecosystem Effects**Food chain effects:****Moderate**

Overall, the fishery is unlikely to cause significant trophic ('food web') cascade effects, as the protected sub-legal-sized lobsters and breeding stock components form a relatively constant significant proportion of the biomass which remains from year-to-year, and the catch, particularly in inshore areas, is less than the annual variability in biomass due to natural recruitment cycles. However, a recent rock lobster-specific ecological risk assessment considered that, due to the lack of information, the removal of lobster in deep-water regions might have some level of impact on their surrounding ecosystem. This forum subsequently classed this as a moderate risk. Consequently it has become a focus of research, with preliminary work, funded by the FRDC, almost completed. A second FRDC-funded project has been initiated to expand on these preliminary findings.

Habitat effects:**Low**

The legislated design of rock lobster pots, the materials they are made from and the strict control of replacement pots prevents 'ghost fishing' problems arising. A study of human impacts on the marine environments of the Abrolhos Islands estimated that potting might impact on less than 0.3% of the surface area of fragile habitat (corals) at the Abrolhos, where fishing is only allowed for three and a half months of the year.

Generally, throughout the coastal fishery, rock lobster fishing occurs on sand areas around robust limestone reef habitats, covered with coralline and macro-algae such as kelp (*Ecklonia* spp.). This type of high-energy coastal habitat is regularly subjected to swell and winter storms and so is considered highly resistant to damage from rock lobster potting.

Social Effects**Commercial**

The western rock lobster fishery is an important sector of Western Australia's economy, with the commercial catch from the current reporting season valued ex-vessel at \$245 million. Employment is seasonal, the fishing season covering seven and a half months from 15 November to 30 June.

A total of 491 vessels and 1,360 people were engaged directly in fishing for rock lobsters in 2006/07. This equates to 1 skipper

and an average of about 1.76 deckhands per vessel, which is very similar to that recorded during the 2005/06 season. During the year, 5 processing establishments, located in the Perth metropolitan area (3) and Geraldton (2), serviced practically every location where western rock lobster fishing occurred.

Recreational

With around 22,000 people taking about 400,000 individual lobsters annually, this fishery represents a major recreational activity and provides a significant social benefit to the Western Australian community.

Economic Effects

Estimated annual commercial value

(to fishers) for year 2006/07: **\$245 million**

The price that commercial fishers received for the western rock lobster in 2006/07 was an estimated average of \$28.50/kg in all zones of the fishery. This was a 1.8% increase on the \$28.00/kg paid in 2005/06, and is mainly attributable to the smaller catch in 2006/07. The overall value of the fishery declined marginally from the previous season's value of \$289 million as a result of the lower catch recorded.

The bulk of the product was exported to Japan, Taiwan, Hong Kong/China and the United States.

Fishery Governance

Commercial

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

Target commercial catch range: **8,166 – 14,523 tonnes**

Between 1975/76 and 2006/07 commercial catches have averaged $10,951 \pm 565$ t (95% confidence intervals of the mean) and ranged from 8,166 t in 1985/86 to 14,523 t in 1999/2000. Variation of these catches results primarily from variable levels of recruitment, which are driven by the environmental conditions experienced by western rock lobster larvae and post-larvae, and levels of fishing effort. With fishing effort having been reduced, catches are still expected to fall within the above range.

Recreational

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

Target recreational catch range: **115 – 468 tonnes**

Between 1986/87 and 2006/07 commercial catches have averaged 239 ± 46 t (95% confidence intervals of the mean) and ranged from 115 t in 1987/88 to 468 t in 2002/03. Variation of these catches results primarily from variable levels of recruitment, which are driven by the environmental conditions as described above.

New management initiatives (2007/08)

A new management package, currently being developed by the Department of Fisheries and the Rock Lobster Industry Advisory Committee (RLIAC), will be implemented by the start of the 2008/09 season. This package will make use of the newly developed 'biological model' to ensure that the breeding stock for both southern and northern regions remains above the 1980 level, given the current poor recruitment period.

A draft paper outlining new 'decision rules' for the West Coast Rock Lobster Fishery was released in 2008. Key proposals contained in this paper are the addition of harvest rates and allowing for uncertainty into the decision rules framework. The inclusion of these two proposals will make the decision rules framework more robust. It also means that management decisions will be more consistent, predictable and transparent. The proposed framework is consistent with the recently released Harvest Strategy Policy for Commonwealth Fisheries.

The introduction of harvest rate into the existing framework was proposed by the Department of Fisheries in early 2007, and endorsed during a stock assessment workshop in 2007. The need to include uncertainty into the framework was recommended during the aforementioned stock assessment workshop, and formed part of a condition for the Marine Stewardship Council (MSC) re-certification of the fishery.

In parallel to the development of a new management package under 'input' controls, a RLIAC working group has been formed to develop a quota management system (output controls) business case. The business case will consist of two components:

1. a management paper that describes the proposed quota management settings if the fishery went to a quota management system; and
2. an interactive spreadsheet financial model for licensees to explore the impact of the proposed management settings on their business.

It is expected that the management paper will be released to industry for comment in August 2008.

External Factors

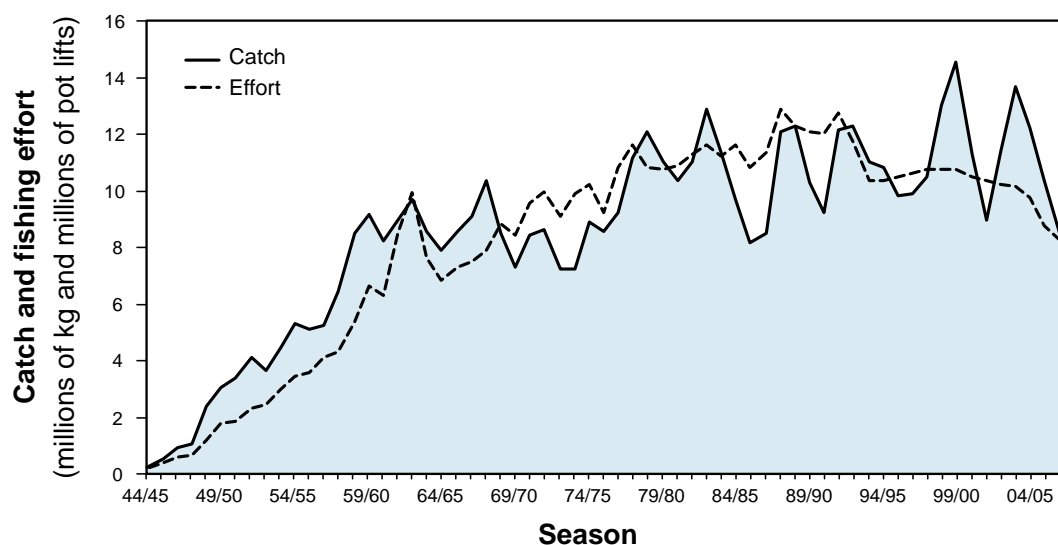
The variations in western rock lobster catches both commercially and recreationally are largely a result of variable levels of puerulus settlement due to changes in the Southern Oscillation (El Niño or La Niña events in the Pacific Ocean) and their effect on the Leeuwin Current. A positive relationship exists between Leeuwin Current strength and levels of puerulus settlement. The southward-flowing Leeuwin Current also affects the spatial distribution of puerulus settlement along the coast. Catches are also dependent upon the environmental conditions at the time of fishing.

The fishery has been affected by seven years of El Niño or neutral conditions, which has generally resulted in average or below-average puerulus settlement, due to the weaker Leeuwin current strength.

Increases in water temperatures over the last 30 to 40 years appear to be affecting some of the biological parameters such as size at maturity and size of migrating lobsters. These changes need to be taken into account in future stock assessments.

The economic performance of the fishery is being strongly affected by the high value of the Australian dollar (affecting the price of lobsters) and high fuel and labour costs. This has resulted in reduced fishing effort during periods of low catch rates.

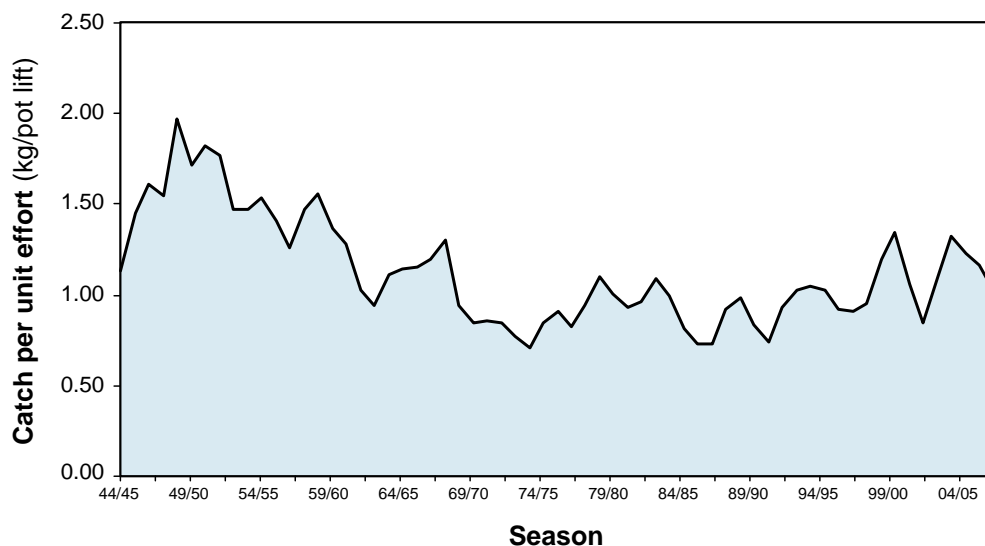
Western Rock Lobster Annual Catch and Effort



WEST COAST ROCK LOBSTER FIGURE 1

Annual catch and nominal fishing effort from fishers' compulsory monthly returns for the West Coast Rock Lobster Managed Fishery from 1944/45 to 2006/07.

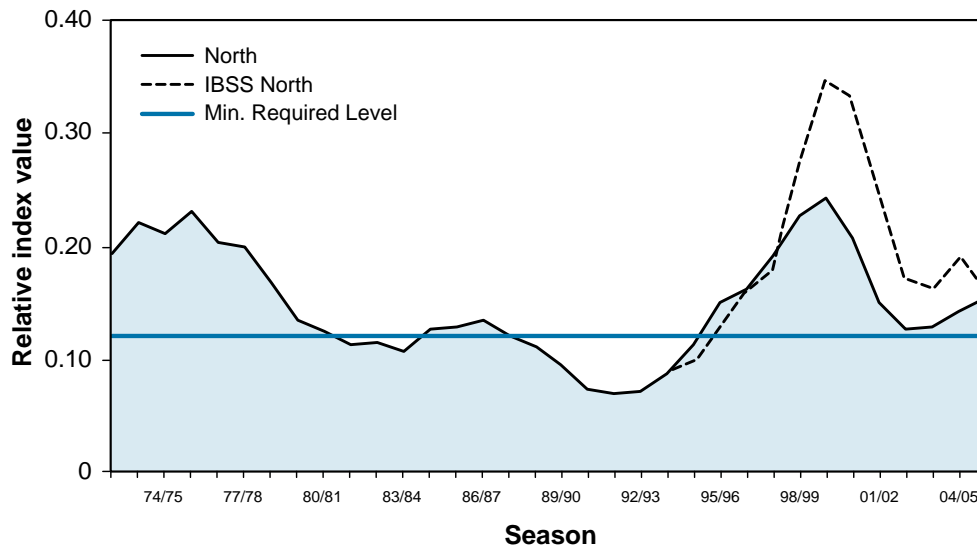
Western Rock Lobster Annual Catch Rate



WEST COAST ROCK LOBSTER FIGURE 2

Annual catch rate (kg/pot lift) for the West Coast Rock Lobster Managed Fishery from 1944/45 to 2006/07.

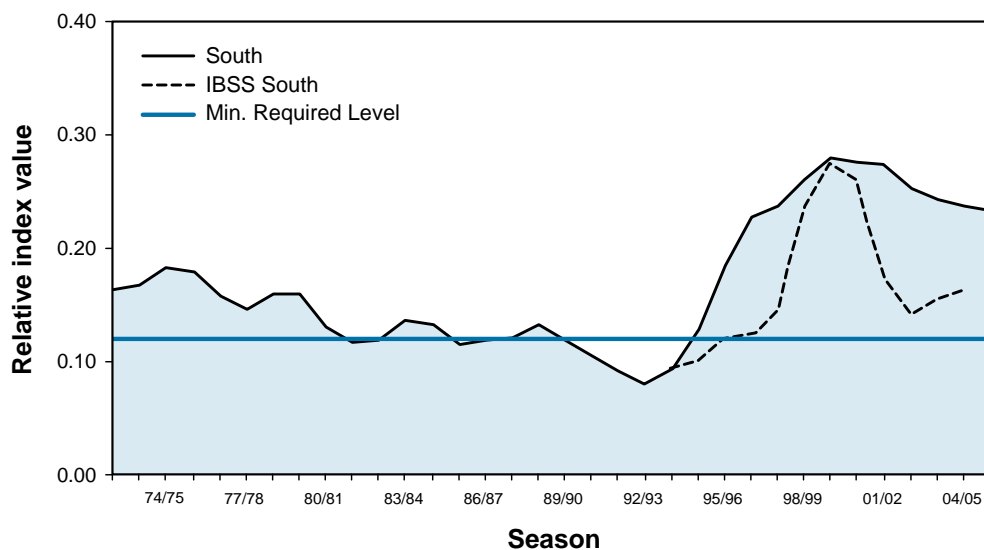
North Coast Spawning Stock Indices



WEST COAST ROCK LOBSTER FIGURE 3

Three-point smoothed average of the northern (Jurien and Dongara) spawning stock indices derived from commercial vessel monitoring (eggs per pot lift over the whole season) and from the fishery-independent breeding stock survey (eggs per pot lift in October/November). The initial value of the independent index has been scaled to be equivalent to the 1992/93 average of the monitoring index.

South Coast Spawning Stock Indices



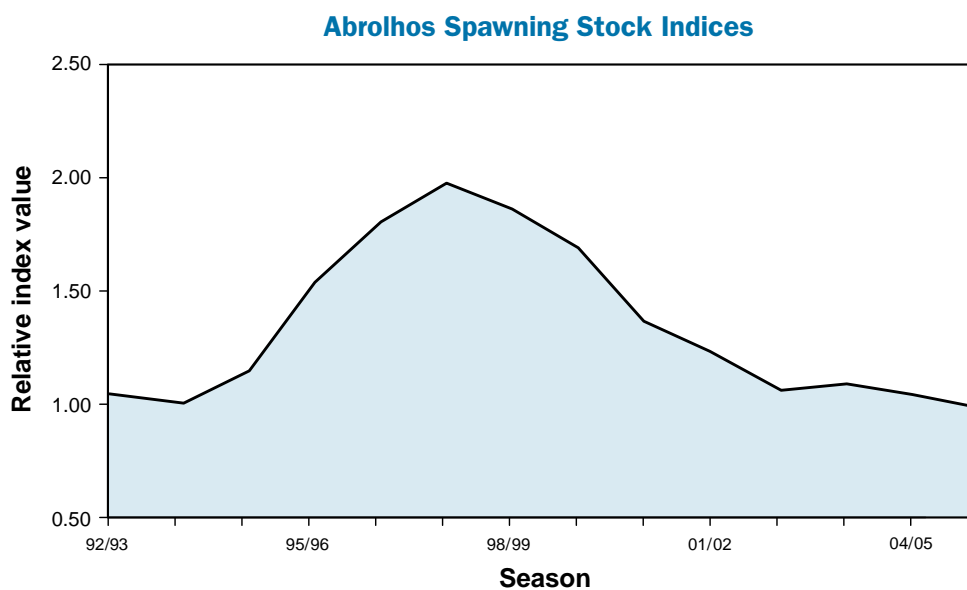
WEST COAST ROCK LOBSTER FIGURE 4

Three-point smoothed average of the southern (Fremantle and Lancelin) spawning stock indices derived from commercial vessel monitoring (eggs per pot lift over the whole season) and from the fishery-independent breeding stock survey (eggs per pot lift in October/November). The initial value of the independent index has been scaled to be equivalent to the 1992/93 average of the monitoring index.

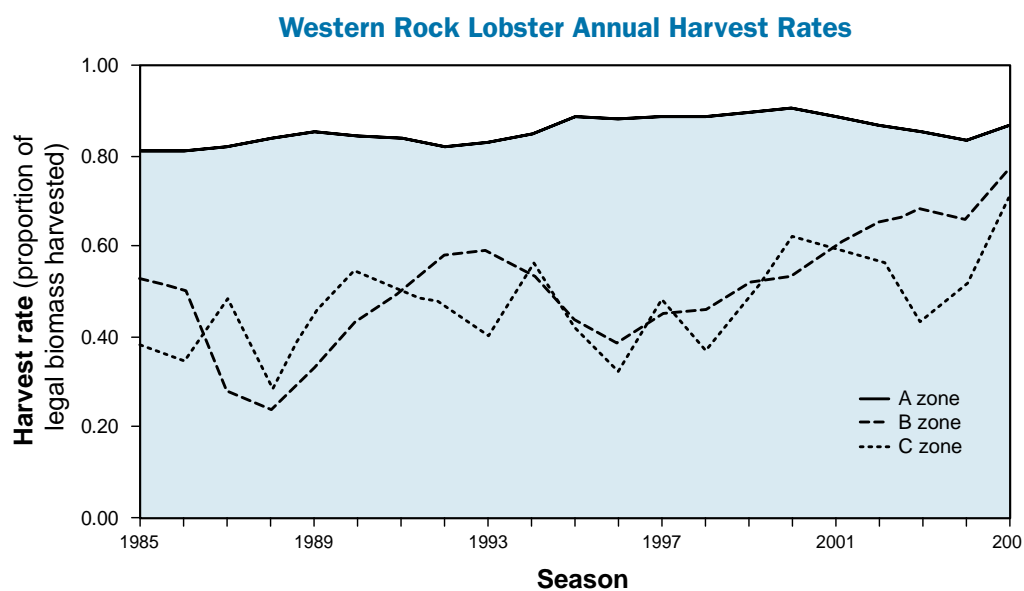
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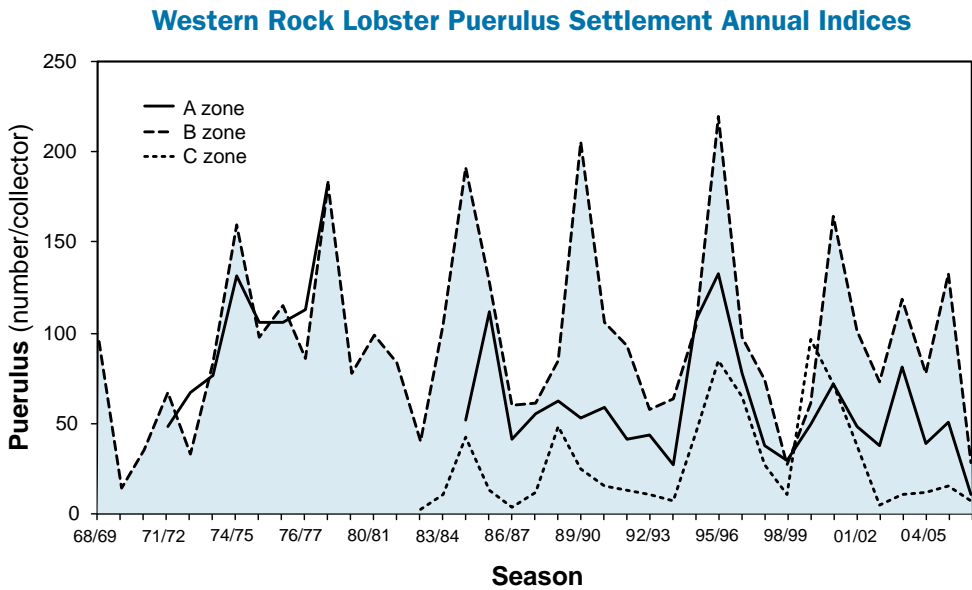
REFERENCES AND
APPENDICES

**WEST COAST ROCK LOBSTER FIGURE 5**

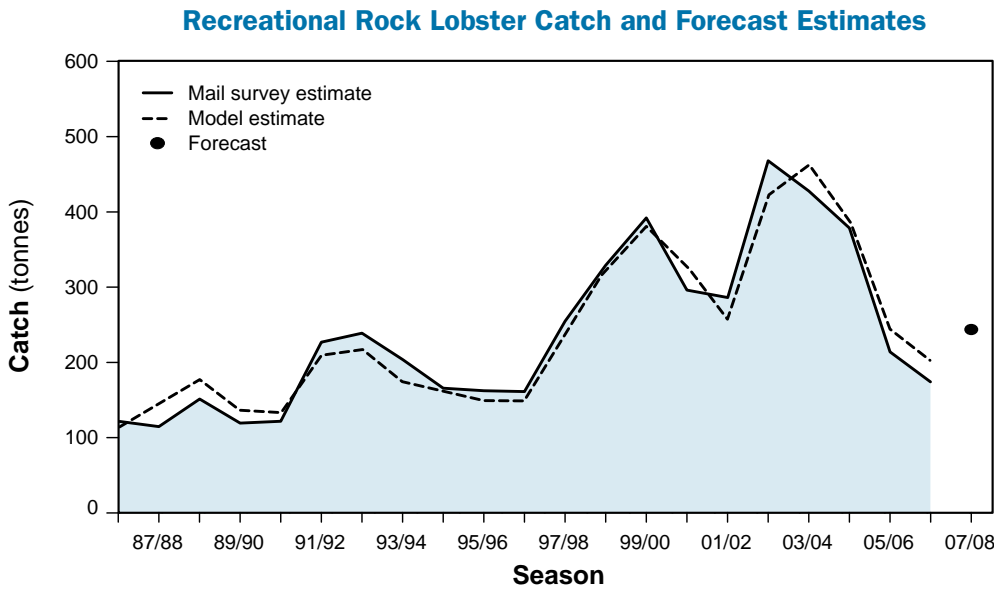
Egg production indices as measured by the independent breeding stock survey at the Abrolhos Islands smoothed by a moving average of 3 years.

**WEST COAST ROCK LOBSTER FIGURE 6**

Annual harvest rates of western rock lobster in Zones A, B and C smoothed using a moving average.



WEST COAST ROCK LOBSTER FIGURE 7
Annual indices of puerulus settlement for the Abrolhos (A Zone), Seven Mile Beach (Dongara) (B Zone) and Alkimos (C Zone).



WEST COST ROCK LOBSTER FIGURE 8
Estimates of the recreational rock lobster catch since 1986/87 using adjusted mail survey results, and model estimates of catches in 2007/08 based on puerulus settlement 3 to 4 years earlier and expected licence usage.

Roe's Abalone Fishery Status Report

A. Hart, J. Brown and T. Bahartha.

Management input from M. Holtz

Fishery Description

The Western Australian Roe's abalone (*Haliotis roei*) fishery is a dive and wade fishery, operating in shallow coastal waters along WA's western and southern coasts. Roe's abalone are found in commercial quantities from the South Australian border to Shark Bay, although they are not uniformly distributed throughout this range.

The commercial fishery harvest method is a single diver working off a 'hookah' (surface-supplied breathing apparatus) using an abalone 'iron' to prise the shellfish off rocks. Abalone divers operate from small fishery vessels (generally less than 9 metres in length).

The recreational fishery harvest method is primarily wading and snorkeling, with the main focus of the fishery being the Perth metropolitan stocks (West Coast Fishery).

Governing legislation/fishing authority

Abalone Management Plan 1992

Ministerial Policy Guideline no. 10

Abalone Managed Fishery Licence

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

Recreational Fishing Licence

Consultation process

Abalone Management Advisory Committee

Meetings between the Department of Fisheries and industry

Recreational Fishing Advisory Committee

Boundaries

Commercial

The Abalone Management Plan covers all Western Australian coastal waters, which are divided into 8 management areas. Commercial fishing for Roe's abalone is managed in 6 separate regions from the South Australian border to Busselton Jetty – Areas 1, 2, 5, 6, 7 and 8 (Roe's Abalone Figure 1).

Recreational

The recreational abalone fishery regulations relate to three zones: the Northern Zone, the West Coast Zone, and the Southern Zone (Roe's Abalone Figure 2). The West Coast Zone is the centre of the fishery.

Management arrangements

Commercial

The commercial Roe's abalone fishery is managed primarily through output controls in the form of total allowable commercial catches (TACCs), set annually for each area and allocated to license holders as individual transferable quotas (ITQs).

The overall TACC for 2007 was 109.7 t whole weight (note this small species is generally landed in the whole condition). The TACC is administered through 25,180 ITQ units, with a

minimum unit holding of 800 units generally applying, although some Roe's abalone licences are permitted to operate below this minimum in recognition of historical fishing practices.

The licensing period (fishing year) runs from 1 April to 31 March of the following year.

The legal minimum length for Roe's abalone is 60 mm shell length in most parts of the fishery (the same as in the recreational fishery). However, commercial legal minimum lengths of 75 mm and 70 mm apply in Area 1 (WA/South Australia border to Point Culver) and Area 7 (Cape Bouvard to Moore River) respectively.

Recreational

The recreational Roe's abalone fishery is managed under a mix of input and output controls. Recreational fishers must purchase a dedicated abalone recreational fishing licence or an umbrella licence (which covers all licensed recreational fisheries). These licences are not restricted in number.

The fishing season in the Northern and Southern Zones extends from 1 October to 15 May. The West Coast Zone is only open for 6 Sundays annually, and the time of fishing in 2006 was reduced from 90 to 60 minutes (between 7.00 a.m. and 8.00 a.m.), commencing on the first Sunday in November.

These restrictive management controls on the west coast are necessary to ensure the sustainability of an easily accessible (and therefore vulnerable) stock located adjacent to a population in excess of 1.6 million people (including Geraldton).

For Roe's abalone, the minimum legal size is 60 mm shell length, the daily bag limit is 20 per fisher, and the household possession limit (the maximum number that may be stored at a person's permanent place of residence) is 80.

A comprehensive Ecologically Sustainable Development assessment of this fishery has been undertaken to identify any potential sustainability risks requiring direct management. The only issue identified through this process related to the breeding stock levels of Roe's abalone. Boxed text in this status report provides the annual assessment of performance for this issue.

Research summary

Commercial

Commercial abalone divers provide daily catch information on the total weight of abalone collected, the hours fished, the date and location of harvest and the name of the person(s) harvesting. These data are used to assist in research, compliance and management matters.

An annual standardized catch per unit effort (CPUE) model was developed that took into account diver and month of fishing, as well as technological improvements that aid fishing efficiency.

Current research is focused on stock assessment using catch and effort statistics, fishery-independent surveys of Perth metropolitan stocks, and digital video imagery (DVI) surveys by industry divers, who survey selected sites with an underwater video camera. Size and density of Roe's abalone across the near-shore sub-tidal reef habitat is measured annually at 11 indicator sites between Mindarie Keys and Penguin Island. Nine of these are fished while the other 2 are the Waterman's Reserve Marine Protected Area (MPA), and the Cottesloe Fish Habitat Protection Zone.

Recreational

Current annual recreational catch and effort estimates are derived from a field survey (West Coast Zone / Perth metropolitan fishery), and a telephone diary survey covering the entire state.

The field survey estimates the catch and effort from each distinct Roe's abalone stock within the Perth fishery, and estimates are based on average catch (weight and numbers), catch rates (derived from 1,000 interviews in 2007), and fisher counts conducted by Fisheries Volunteers and research personnel from shoreline vantage points and aerial surveys. This method provides a comprehensive assessment, but is too resource-intensive to be applied routinely outside of the Perth metropolitan area.

The telephone diary survey estimates the catch of all 3 species on a state-wide basis. 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, or at the end of the season for those only involved in the Perth abalone season.

Retained Species

Commercial production

(season 2007):

90.8 tonnes whole weight

The TACC for the 2007 quota year was 109.7 t whole weight for Roe's abalone. The catch of 90.8 t whole weight for 2007 (Roe's Abalone Table 1) was 8% lower than in 2006 and 18.9 t lower than the TACC. The overall TACC was not caught because of poor weather in Area 1 of the fishery (Roe's Abalone Figure 1), and catches below the TACC in Area 5 (80% of TACC caught) and Area 8 (50% of TACC caught). Total TACC is not usually caught in this fishery because of weather-related issues in the marginal regions (Area 1 and Area 8) of the fishery.

Recreational catch

(season 2007):

**Roe's Perth Fishery 34.4 tonnes
Roe's rest of state 14.4 tonnes
22 – 36% of total catch**

The catch estimate for Roe's abalone from the Perth metropolitan area in 2007 is 34 t, as estimated from the field survey (Roe's Abalone Table 2). This is an increase of about 11% from 2006, caused by a combination of increases in catch rates as a result of good weather conditions, and a 5% increase in license numbers (Roe's Abalone Figure 3).

Catch estimates of Roe's abalone from the phone diary surveys were 24.0 t (range: 18.8 – 29.3 t) in the Perth Fishery (Roe's Abalone Figure 4), 9.0 t (range: 5.6 – 12.4 t) in the West Coast Fishery, and 5.3 t (range: 1.3 – 9.4 t) in the South Coast Fishery (Roe's Abalone Table 3). These estimates are similar to the 2006 telephone diary survey estimates.

The Perth Fishery estimates from the telephone diary survey are lower than the estimates from the field survey as they were in 2006.

Recreational fishing represented about 22 – 36% of the total (commercial and recreational) Roe's abalone catch across the state in 2007. This is similar to the 2006 estimate of 21 – 34% of the total catch.

Fishing effort/access level

Commercial

Total effort for dedicated Roe's abalone divers in 2007 was 585 diver days, which was the lowest effort on record (Roe's Abalone Table 1). The low effort is a combination of high abundance and only 83% of TACC being caught.

Recreational

For the 2007 season, 22,500 licences were issued. This was a 6% increase over the 2006 figure of 21,200 licenses, but overall license numbers have been stable for 7 years (Roe's Abalone Figure 4).

Effort in the 2007 Perth fishery of 12,433 hours was a 19% increase on 2006 effort of 10,433 hours (Roe's Abalone Table 2), but still at the lower end of the historical range. In both 2006 and 2007, daily season length has been shortened from 1.5 hours to 1 hour and this is likely to affect overall effort, but catch rates have increased, resulting in a minimal impact on overall catch.

Effort estimates for recreational abalone fishing from the 2007 telephone diary survey were 13,400 days (10,500 – 16,200 days) in the Perth metropolitan area, 6,300 days (3,800 – 8,800 days) on the west coast (excluding the Perth metropolitan area), and 4,900 days (1,700 – 8,000 days) on the south coast (Roe's Abalone Table 3).

Stock Assessment

Assessment complete:

Yes

Breeding stock levels:

Adequate

CPUE and TACC assessment: The commercial divers' catch rates are the principal indicator of the abundance of legal-sized abalone and are assessed annually

The catch rate for dedicated Roe's abalone divers in 2007 was 142 kg/day, which was higher than the 2006 catch rate of 136 kg/day and the highest catch rate since 2000 (Roe's Abalone Table 1). The catch, effort and catch rate statistics indicate that, overall, Roe's abalone stocks are in an acceptable state and at higher than historically average levels. However, market forces (preference for large-sized abalone) have impacted on Area 8, where there is only a limited area of habitat producing large-sized animals, and the current TACC is not being caught. As a result of this, a reduction in Area 8 TACC from 12 to 9 t was recommended for 2008, resulting in an overall TACC reduction to 106.7 t (Roe's Abalone Table 1).

The catch rate of recreational fishers in the Perth metropolitan fishery of 28 abalone/hour was the second highest since surveys began in 1999 (Roe's Abalone Table 2).

Stock surveys: Densities of sub-legal animals (less than 60 mm in size) on the platform habitat increased from 35 in 2007 to 42 abalone m⁻² in 2008 (Roe's Abalone Table 4). This is the highest level since 2001. On the sub-tidal habitat, densities of sub-legal animals increased from 5.6 to 7.2 abalone m⁻², which is the highest density since the survey began in 1997.

Densities of legal-sized animals (60+ mm) on the platform habitat were slightly higher in 2007 (21 m⁻²), compared to 19 m⁻² in 2006 (Roe's Abalone Table 4). However, overall, densities are at the

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lowest levels in recent years, due principally to localised declines at Penguin Island and Mettams Pool. These locations will be closely monitored in continuing years.

In the sub-tidal habitat, legal-sized densities increased from 11 in 2007 to 15 abalone m⁻² in 2008, which is the highest level recorded (Roe's Abalone Table 4). With the increased abundance of sub-legal animals, densities of legal-sized animals are expected to be maintained into the future.

Mean densities of legal-sized Roe's abalone in the MPA (Marine Protected Area) are significantly higher compared with the fished stocks, for both platform and sub-tidal habitats. However, the difference is less evident for sub-legal animals.

Breeding stocks: Size at sexual maturity (50% of animals mature) of Roe's abalone in the Perth metropolitan area is approximately 40 mm (2 to 3 years of age). Preliminary growth data for these same metropolitan Roe's abalone indicate that they have a minimum of 1 year's spawning before reaching 60 mm – the minimum legal size at which Roe's abalone are harvested anywhere in Western Australia.

This is considered to provide adequate protection for the breeding stock under normal environmental conditions, especially since the commercial fishery's legal minimum size in Area 7 (the Perth metropolitan area) is 70 mm – which is 10 mm larger than that used by the recreational sector. In Area 1, the commercial fishery's legal minimum length is 75 mm.

The main performance measure for the fishery relates to the maintenance of adequate breeding stocks in each area of the fishery. This is assessed using a combination of the level of quota achieved and the effort required to achieve the quota, both of which reflect stock abundance.

In 2007, catch and effort in most areas fished were within the agreed ranges, indicating that overall breeding stock levels were adequate (Roe's Abalone Table 5). Adverse weather conditions limited the fishing in the remote Area 1 and, to a lesser extent, in Area 5 (80% of TAC caught). A reduction in Area 8 TAC (12 t to 9 t) was recommended for 2008 to account for less productive stocks.

Non-Retained Species

Bycatch species impact:

Negligible

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

Protected species interaction:

Negligible

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

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 feed on drift algae, their removal is unlikely to result in any changes to the algal growth cover in areas fished.

Social Effects

There are 26 vessels commercially fishing for Roe's abalone, employing approximately 50 people across WA. The dispersed nature of the Roe's abalone fishery means that small coastal towns from Kalbarri to Eucla receive income from the activity of divers.

Over 22,000 licences were issued that would have allowed fishers to participate in the recreational abalone fishery (Roe's Abalone Figure 4). The recreational fishery provides a major social benefit to those sectors of the community that appreciate the abalone as a delicacy.

Economic Effects

Estimated annual value

(to commercial fishers) for 2007:

\$2.2 million

The estimated average price for Roe's abalone in 2007 was \$24/kg, a reduction from \$29/kg in 2006, and \$33/kg in 2005. On the basis of the average price, the fishery was worth approximately \$2.2 million – a decrease from the 2006 value of \$2.9 million. Overall, the price of Roe's abalone has dropped by over 50% since 2000, when it was \$55/kg whole weight. This is due to the value of the Australian dollar, which has also increased from \$US0.58 in 2000 to \$US0.90 in 2007, and to competition from abalone produced by aquaculture.

Fishery Governance

Target effort range:

620 – 750 diver days

To assess whether the catch quota set in 2007 is appropriate (sustainable) relative to the stock available, Roe's abalone catches should be taken within the range of effort (620 – 750 diver days) recorded over the 1999 – 2006 fishing years. This range reflects the acceptable variation in catch rates due to weather and recruitment cycles.

The effort value of 585 diver days in 2007 (Roe's Abalone Table 1) falls below the expected effort range, suggesting stocks are at historically-high levels, however not all quota was caught (83% of the quota was taken), so a lower effort is expected.

New management initiatives (2007/08)

The main new management initiative in 2007/08 was the review of performance indicators for the Roe's abalone fishery. Substantial consultations and discussions of these performance indicators have taken place with stakeholders, and a draft report of the outcomes is being prepared. This process shall be completed within the 2008/09 fishing year, with TAC setting for 2009 being undertaken with revised performance indicators alongside existing indicators.

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

The main external factor influencing the Roe's abalone fishery has been the decline in beach price and overall economic value. The small size of Roe's abalone means that, as a fishery product, it is in direct competition with small hatchery-produced greenlip abalone, which are now being released onto the market.

ROE'S ABALONE TABLE 1

Roe's abalone catch and effort¹ by quota period

Quota period ²	Roe's TACC kg whole weight ³	Roe's caught kg whole weight	Diver days ⁴ (Roe's divers only)	Kg whole weight per diver day (roei divers only)
1990	105,000	116,447	936	112
1991	101,000	109,489	832	118
1992	105,000	111,341	735	134
1993	128,000	115,281	832	123
1994	125,960	117,835	908	113
1995	125,960	114,501	1,047	98
1996	125,960	118,715	1,004	106
1997	126,790	118,738	855	120
1998	93,960 ⁵	86,425	695	108
1999 ⁶	119,900	112,949	659	149
2000	115,900	107,735	647	144
2001	107,900	99,174	685	126
2002	107,900	100,471	700	125
2003	110,900	96,005	723	118
2004	110,900	107,593	736	126
2005	112,700	96,496	672	131
2006	112,700	98,370	625	136
2007	109,700	90,750	585	142
2008	106,700			

Notes

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 year.
3. Standard conversion factors for meat weight to whole weight for Roe's abalone were 2.5 prior to 2000 and 3.0 from 2000.
4. Effort (diver days) for dedicated Roe's divers only.
5. Reduced quota for a 6-month season.
6. In 1999, fishing restrictions (100 kg daily catch limit) in the Perth metropolitan area were lifted. This had the immediate effect of doubling the catch rate (kg/day) in that area.

ROE'S ABALONE TABLE 2

Summary of effort (fisher hours), catch rate (abalone per hour), catch (number of abalone and tonnes whole weight) and mean whole weight (g) for the Perth recreational Roe's abalone fishery, from annual field surveys.

Field Survey					
Year	Effort (hours)	Catch rate	Catch (number)	Catch (tonnes)	Meanweight (g)
1999	16,449	23	383,600	35.3	92
2000	15,818	21	330,300	30.2	91
2001	17,727	27	481,300	44.1	92
2002	18,127	22	401,500	36.0	90
2003	17,963	26	442,400	42.6	96
2004	14,614	24	342,900	31.7	93
2005	12,328	21	262,700	24.3	92
2006	10,435	29	297,000	30.2	101
2007	12,433	28	338,000	34.4	102

ROE'S ABALONE TABLE 3

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

Location	Year	Effort	Roe's	
			Catch Rate	Catch (tonnes)
Perth Metro ¹	2004	17,200 (14,000 – 20,500)	17.8	28 (25 – 31)
	2006	12,600 (9,900 – 15,500)	18.2	23 (20 – 26)
	2007	13,400 (10,500 – 16,200)	17.6	24 (19 – 29)
West Coast ¹ (excluding Metro)	2004	10,100 (6,500 – 13,600)	11.0	10 (7 – 14)
	2006	8,000 (4,700 – 11,300)	14.7	12 (7 – 17)
	2007	6,300 (3,800 – 8,800)	14.1	9 (6 – 12)
South Coast ²	2004	2,700 (1,700 – 3,700)	6.2	2 (1 – 3)
	2006	2,800 (1,600 – 3,900)	6.3	2 (1 – 2)
	2007	4,900 (1,700 – 8,000)	10.8	5 (1 – 9)

1. Both areas are within the West Coast bioregion.

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

ROE'S ABALONE TABLE 4

Mean densities (abalone/m²) of sub-legal (< 60 mm shell length) and legal-sized Roe's abalone (60 mm and over) from 9 monitoring sites (fished stocks) and the Marine Protected Area (MPA) in the Perth fishery. The platform habitat is primarily the recreational fishery, while the sub-tidal habitat is primarily the commercial fishery. Data has been standardised by a GLM (Generalized Linear Models) analysis, as the sites are not the same for all years and, consequently, density estimates calculated in 2008 vary from 2007.

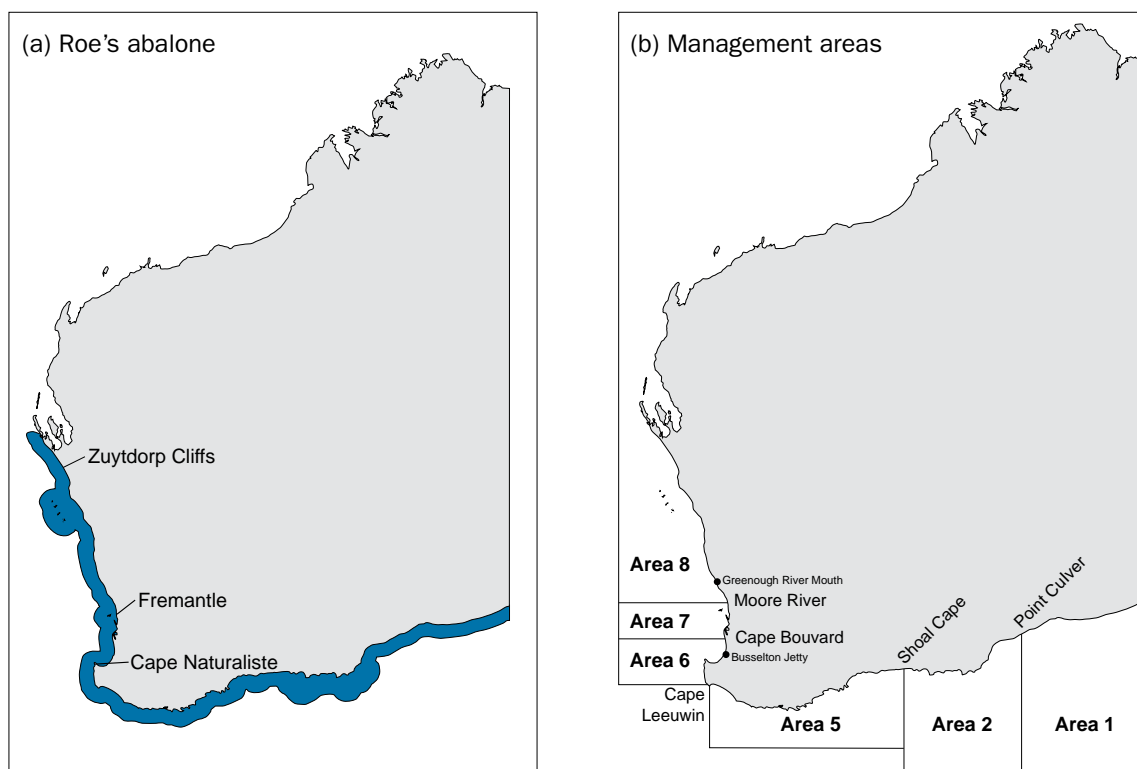
Year	Platform habitat				Sub-tidal habitat			
	Fished stocks		Waterman's Reserve (MPA)		Fished stocks		Waterman's Reserve (MPA)	
	<60	60+	<60	60+	<60	60+	<60	60+
1997	32	29	44	26	4.2	12	9	21
1998	42	27	51	37	5.2	13	11	29
1999	47	26	52	26	3.8	7	12	27
2000	45	24	29	35	2.7	10	8	31
2001	44	25	38	34	3.7	10	8	28
2002	35	27	42	39	3.2	10	7	31
2003	29	24	36	41	4.5	11	4	25
2004	31	21	33	52	3.8	9	5	20
2005	32	20	43	39	5.0	9	9	22
2006	33	19	49	38	6.8	9	6	20
2007	35	19	42	35	5.6	11	7	23
2008	42	21	69	37	7.2	15	7	19

ROE'S ABALONE TABLE 5

Assessment against agreed performance measures for 2007.

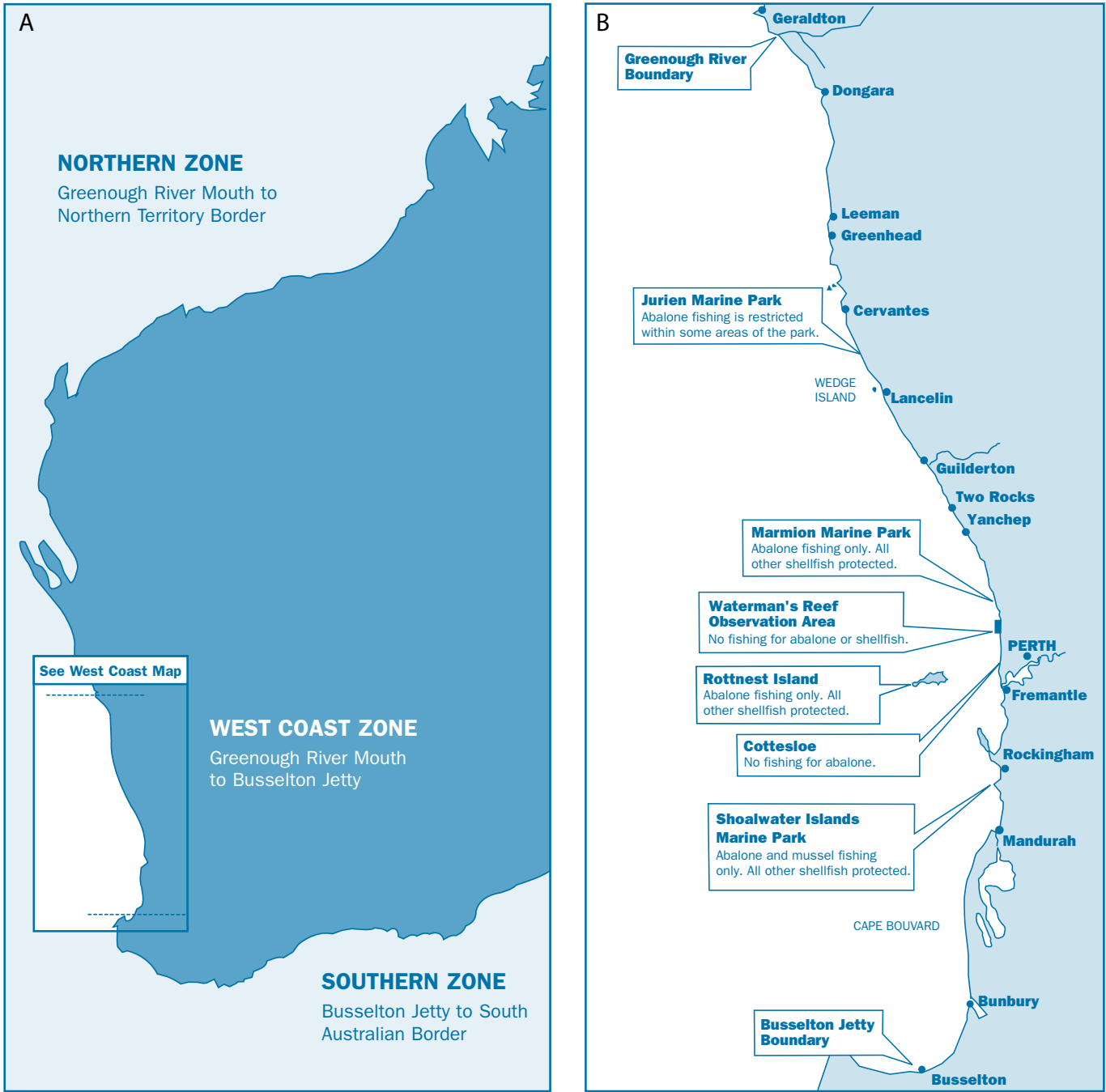
Performance Indicator	Performance Measure ¹	2007 Values	Assessment/Comments
Area 1			
Total catch (TACC)	9,900 kg	1,302	Exploratory quota – only a small percentage caught due to poor weather.
Total effort (diver days)	14 – 43	2	See above.
Area 2			
Total catch (TACC)	19,800 kg	18,940	Met – 99% of quota caught.
Total effort (diver days)	80 – 106	79	Met – within agreed level.
Area 5			
Total catch (TACC)	20,000 kg	16,094	Not met – 80% of quota caught.
Total effort (diver days)	100 – 140	90	Not met – below agreed level, but due to lower-than-average catch.
Area 6			
Total catch (TACC)	12,000 kg	11,980	Met – 99% of quota caught.
Total effort (diver days)	80 – 127	98	Met – within agreed level.
Area 7			
Total catch (TACC)	36,000 kg	35,998	Met – 98% of quota caught.
Total effort (diver days)	175 – 215	215	Met – within agreed level.
Area 8			
Total catch (TACC)	12,000 kg	6,444	Not met – 54% of quota caught.
Total effort (diver days)	140 – 200	101	Not met – below agreed level, but due to lower-than-average catch

1. Note that these effort ranges (totalling 589 – 831 days) differ from the range presented in the governance section because they are spatially standardised, whereas the governance ranges are averaged over the entire fishery.



ROE'S ABALONE FIGURE 1

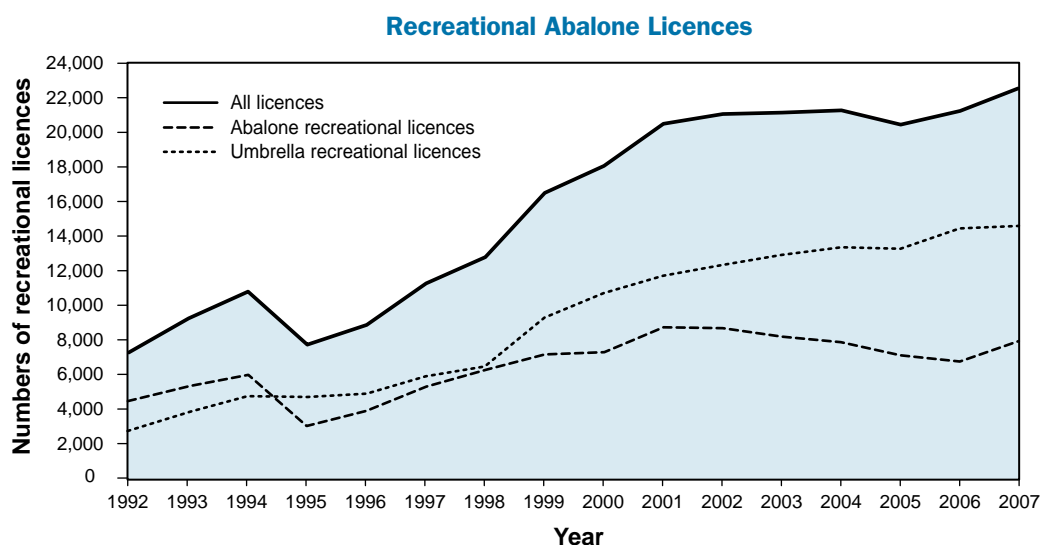
Maps showing (a) the distribution of Roe's abalone in Western Australia, and (b) the management areas used to set quotas for the commercial fishery.



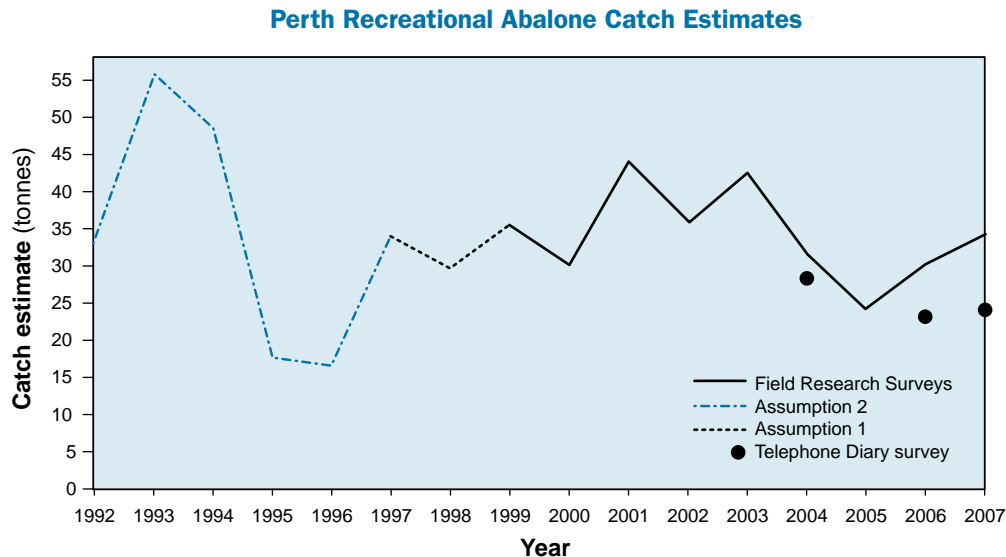
ROE'S ABALONE FIGURE 2

Maps showing (a) the recreational fishing boundaries for abalone, and (b) the West Coast (Perth Fishery) zone, showing conservation areas within this zone.

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**ROE'S ABALONE FIGURE 3**

The number of licences issued in the recreational abalone fishery, by licence type, for the period 1992 to 2007.

**ROE'S ABALONE FIGURE 4**

Catch estimates for the Perth recreational abalone fishery for the period 1992 to 2007, including backwards projections through time, based on two assumptions. Error bars are SE.

Assumption 1: assumes that the mean weight of abalone taken during 1997 and 1998 is equal to the average of the 2 mean weight values measured for 1999 and 2000 (i.e. 91.6 g, averaged from 92 g in 1999 and 91.3 g in 2000). Numbers caught are estimated using the field survey technique (Roe's Abalone Table 3).

Assumption 2: assumes that effort from 1992 to 1996 is the average percentage of the potential effort utilised for the years 1997 to 2000; that the catch rate for the years 1992 to 1996 is the average of the annual catch rates for the years 1997 to 2000; and that the mean weight of abalone taken from 1992 to 1996 is the same as applied to 1997 and 1998 in Assumption 1.

Note that the recreational season totalled 16 days in 1993, 12 days in 1992 and 1994, 5 days in 1996 and 6 days in 1995 and 1997 – 2006. In 1992 – 1994, fishing was permitted for 2 hours per season day (7 a.m. to 9 a.m., Saturdays and Sundays). From 1995 – 2005, permissible fishing time per season day was 1.5 hours (7 a.m. to 8.30 a.m., Sundays only). In 2006 and 2007, permissible fishing time per season day was 1 hour.

Abrolhos Islands and Mid West Trawl Managed Fishery

E. Sporer, M. Kangas S. Brown

Management input from J. Kennedy

Fishery Description

The Abrolhos Islands and Mid West Trawl Managed Fishery (AIMWTF) is based on the take of southern saucer scallops (*Amusium balloti*), with a small component targeting the western king prawn (*Penaeus latisulcatus*) in the Port Gregory area. The catch is taken using otter trawls.

Governing legislation/ fishing authority

Abrolhos Islands and Mid West Trawl Management Plan 1993
Abrolhos Islands and Mid West Trawl Managed Fishery Licence
Commonwealth Government *Environment Protection and Biodiversity Conservation Act 1999* (Export Exemption)

Consultation process

Meetings between the Department of Fisheries and industry

Boundaries

The boundaries of this fishery are 'all the waters of the Indian Ocean adjacent to Western Australia between 27°51' south latitude and 29°03' south latitude on the landward side of the 200 m isobath'.

Management arrangements

The AIMWTF operates under an input control system, with restrictions on boat numbers and trawl gear size as well as seasonal closures and significant spatial closures protecting all near-shore waters. The fishery operates to a threshold catch level to cease fishing for the season at an agreed minimum catch rate of 250 kg (meat weight) per 24 hours trawling (fleet average).

The fishing gear (net size) in this fishery is unitised, with one headrope unit being equivalent to 4 fathoms (7.32 m) – a total maximum headrope length of 184 fathoms.

In 2007, the scallop season opened on 17 April and closed on 17 June. The Port Gregory prawn trawl area of the fishery also opened and closed in conjunction with the Abrolhos scallop season (i.e. 17 April – 17 June 2007).

Bycatch reduction devices to release large species are fully implemented in the AIMWTF as a licence condition. The Department of Fisheries' vessel monitoring system (VMS) continues to monitor the activities of all boats.

A comprehensive Ecologically Sustainable Development (ESD) assessment of this fishery has been undertaken to identify any potential sustainability risks requiring direct management. The only issue identified through this process related to the breeding stock levels of the target scallop species. Boxed text in this status report provides the annual assessment of performance for this issue.

Research summary

Research monitoring of the scallop stocks in the fishery is undertaken using fishers' monthly returns data. All boats also complete detailed logbooks validated by processor returns.

These, together with an annual pre-season survey, provide the information required for assessing the fishery. Advice on the status of stocks and appropriate season opening and closing dates is provided to industry.

Retained Species

Commercial landings

(season 2007):

48 tonnes whole weight

The total landings for the 2007 season were 48 t whole weight (9.6 t meat weight) of scallops (Abrolhos Islands Scallop Figure 1). The predicted catch range for the 2007 season, based on a pre-season survey, indicated a low season total catch of scallops between 150 and 225 t whole weight. The total landings were below the predicted catch range. This was in part because boats ceased fishing at a catch rate threshold, whereas historically they may have fished to lower catch levels.

Recreational catch:

Nil

Fishing effort/access level

For the 2007 season, 14 of the 16 licensed boats operated in the fishery, resulting in 176 fathoms of net headrope (out of a maximum of 184 fathoms) being utilised by the boats that operated. The swept area for this season was a total of 12 square nautical miles.

A total of 521 trawl hours (nominal effort) were recorded for the 2007 season (Abrolhos Islands Scallop Figure 1), equivalent to 468 standardised trawl hours (adjusted to 14 fathoms headrope length). The season effort in fishing days of 3 days was extremely low and similar to the low number (9 days) fished in 2006. The fleet ceased fishing by 20 April.

The effort applied in this fishery since 1997 is more in line with the available stock. The aim has been to reduce ineffective fishing effort by providing annual survey catch abundance and location reports to fishers so as to reduce search time and enable fishing effort to be applied where scallop abundance is high. Ceasing fishing at a catch rate threshold is also another factor in reducing effort.

Stock Assessment

Assessment complete:

Yes

Breeding stock levels:

Adequate

Projected catch range

next season (2008): 2,250 – 3,400 tonnes whole weight

The annual fishing season arrangements enable the majority of the mature scallops to spawn before fishing occurs. Breeding stocks are therefore protected, ensuring recruitment is dependent only on environmental conditions each year.

This fishery is highly variable, being dependent on sporadic recruitment that appears to be strongly influenced by environmental conditions, e.g. the Leeuwin Current. A pre-season recruitment survey is undertaken annually. A relationship between catch rates during surveys and subsequent catch is evident. Due to the patchy spatial distribution of recruits it is not possible for pre-season surveys to cover all potential settlement areas, particularly in high abundance years. Therefore the catch

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projection is for the areas covered by the survey only. In years when recruitment settlement is widespread the prediction is likely to be conservative, but in years when recruitment is low the total catch is dependent on the level of effort that is applied. It should be noted that fishing ceases at a catch rate threshold level so that stock is left for spawning. This provides both economic and conservative fishing practice.

Specified areas were closed to scallop fishing towards the end of the season because of the high numbers of small scallops observed. This initiative was a collaboration between the Research Division and industry to protect areas of small scallops which will contribute to the breeding stock and catch the following year.

The survey index provided a catch prediction of 2,825 tonnes whole weight (565 tonnes meat weight) providing a catch range $\pm 20\%$ for the 2008 season of 2,250 to 3,400t. The 2007 survey showed that most of the catch is mainly in the southern part of the fishery and is not widespread throughout the northern part of the fishery. Additional catches may be achieved in areas not covered by the survey.

The main performance measure for the fishery relates to maintaining breeding stocks of scallops. This is done in two ways – by setting the season fishing period according to the catch prediction and by closing the fishery at a threshold catch rate level. The 2007 fishing season was set at two months, consistent with the low yield predicted from the survey in November 2006. Hence, the breeding stock indicator was met.

Non-Retained Species

Bycatch species impact:

Low

The trawl fleet operates over a small portion of the licensed fishing area, focusing on scallop aggregations on the relatively bare sand habitat associated with this species. In 2007, the total area of the fishery that was fished by scallop boats was approximately 1% (Abrolhos Islands Scallop Figure 2). The maximum area coverage has been 11%, which, occurred during the 2003 season when the scallops were widespread and in very high abundance. Owing to the focused nature of this fishery, the confined area fished in 2007 and the large mesh size (100 mm), little bycatch was taken during the fishing season.

Protected species interaction:

Low

While turtles do occur in the Abrolhos Islands, these species are towards the southern extent of their range, and do not breed in the Abrolhos Islands area because water temperatures are too low. Consequently, interactions with turtles were always minimal and, now that grids are compulsory in the fishery, their capture should be eliminated. No records of turtle captures were made in 2007. Few other protected species occur in this area.

Ecosystem Effects

Food chain effects:

Low

The total biomass taken by this fishery is generally very small. Moreover, due to the high natural variability of scallop stock abundance it is unlikely that any predators are highly dependent on this species.

Habitat effects:

Low

The fishers generally operate over a very small proportion (approximately 4% on average) of the licensed area and therefore the total area impacted by trawling is small. Trawling was not extensive during 2007 and was confined to trawl grounds where fishable scallop abundance was indicated by the survey, rather than fishing throughout the fishery.

The areas associated with scallops are sandy habitats and trawling activity does not impact these significantly. An underwater survey was undertaken by the Department of Fisheries in 1994 to delineate trawlable sand habitats in the Abrolhos Islands and trawling is largely contained within these areas.

Social Effects

The boats in this scallop fishery generally have relatively high crew numbers – up to 13 per boat – in order to carry out on-board processing during the short period of fishing in the season. During the 2007 season, crew numbers were restricted to 10. The estimated employment for the year 2007 was 110 skippers and crew, as not all boats had the maximum number of crew for the 2007 season.

Economic Effects

Estimated annual value (to fishers) for year 2007:

\$0.2 million

The estimated value of the catch has been based on the average wholesale price per kilogram obtained in the Shark Bay fishery, that is \$3.60/kg whole weight or \$18.00/kg meat weight. Meat weight is approximately 20% of the whole weight.

Fishery Governance

Target catch range: 95 – 1,830 tonnes whole weight

Current fishing level: Acceptable

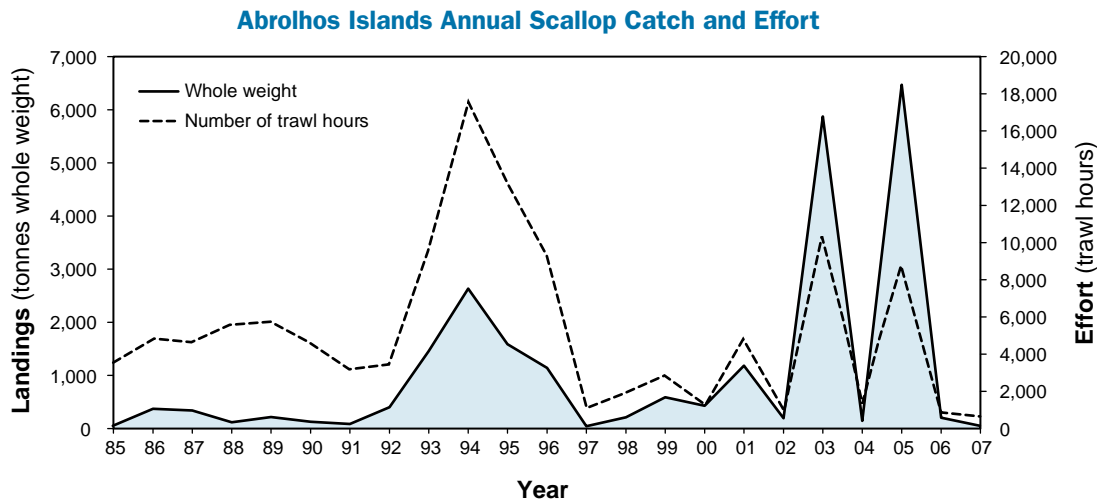
Apart from the exceptional catches of the mid-1990s, 2003 and 2005, which were due to beneficial environmental conditions increasing the success of recruitment, the historic catch range for this fishery is 95 – 1,830 tonnes whole weight. The catch in 2007 was predicted to be within the lower part of this range, due to a survey showing low pre-season recruitment.

New management initiatives (2007/08)

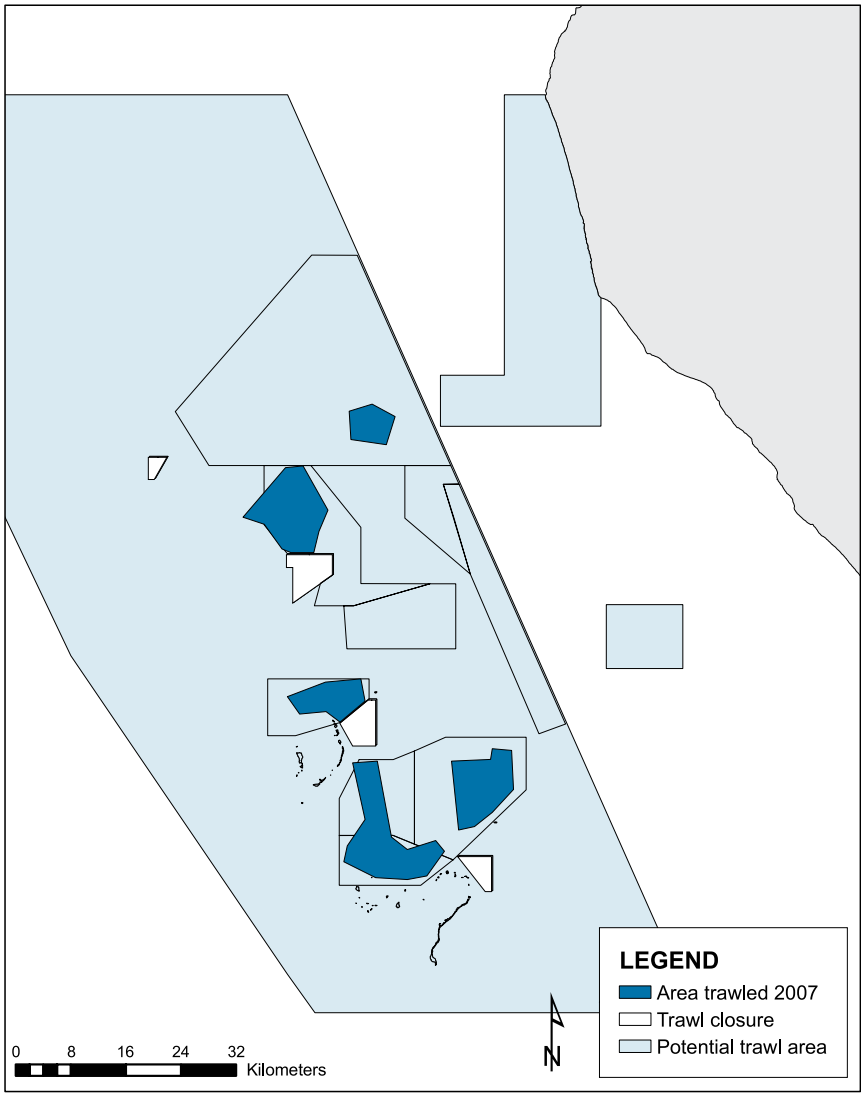
None

External Factors

The high level of recruitment seen in late 2002 and 2004, following very low catch in previous seasons, and then followed by low recruitment in 2005 and 2006, highlights the dependence of recruitment success upon environmental conditions, such as the Leeuwin Current, rather than spawning stock levels. It also illustrates the extreme level of annual variability in recruitment. The relationship between environmental factors and recruitment success is being evaluated.



ABROLHOS ISLANDS SCALLOP FIGURE 1
Annual scallop landings and nominal effort for the Abrolhos Islands and Mid West Trawl Managed Fishery, 1985 – 2007.



ABROLHOS ISLANDS SCALLOP FIGURE 2
Boundaries of the Abrolhos Islands and Mid West Trawl Managed Fishery and trawl area in 2007.

WEST COAST BIOREGION
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NORTH COAST BIOREGION
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NORTHERN INLAND BIOREGION
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REFERENCES AND APPENDICES

South West Trawl Managed Fishery Status Report

M. Kangas

Management input from J. Kennedy

Fishery Description

This fishery includes two of the state's smaller scallop fishing grounds – Fremantle and Geographe Bay. It is a multi-species fishery that targets western king prawns (*Penaeus latisulcatus*) and saucer scallops (*Amusium balloti*) using otter trawls.

Governing legislation/fishing authority

South West Trawl Management Plan 1989

South West Trawl Managed Fishery Licence

Consultation

Meetings between the Department of Fisheries and industry

Boundaries

The boundaries of this fishery are: 'all the waters of the Indian Ocean adjacent to Western Australia between 31°43'27" south latitude and 115°08' east longitude where it intersects the high water mark at Cape Leeuwin, and on the landward side of the 200 m isobath'.

The area is further divided into four management zones, with a limited number of operators (indicated in brackets) permitted access to fish within each zone as follows:

Zone A	from 31°43'27" S to 32°16' S	(3 boats)
Zone B	from 32°16' S to 115°08' E	(12 boats)
Zone C	north-east of Cape Naturaliste	(0 boats)
Zone D	Comet Bay off Mandurah	(3 boats)

Management arrangements

The fishery is managed under an input control system that limits boat numbers, gear sizes and fishing areas. A total of 14 boats are licensed to operate in this fishery, some in more than one zone. Zone A and B boats may fish between 1 January and 15 November and Zone D boats can fish all-year-round. Access to Zone C ceased following a Fishery Adjustment Scheme in which all four authorisations were removed prior to the 2003 season. The management plan also includes large closures to protect sensitive coastal habitats (including seagrass beds) and fish nursery areas such as Cockburn Sound, Warnbro Sound and inshore Geographe Bay.

Research summary

Research monitoring of the scallop stocks in this fishery is undertaken using fishers' monthly returns data.

Retained Species

Commercial production
(season 2007):

Prawns 6 tonnes
Scallops 3 tonnes whole weight

Landings

The total landings for the season were 6 t of western king prawns and 3 t whole weight of scallops. The catch of king prawns was low, representing only about 40% of the average catch over the last five years, with scallop catches also being low, but slightly up on 2005 and 2006. The fishery also lands a mixture of by-product species of which the most abundant species recorded was 5 t of western sand whiting and 2 t of blue swimmer crabs (*Portunus pelagicus*). All other landings of by-product species were less than 1 t each.

Fishing effort/access level

A total of 175 days were recorded as being fished – only slightly up on 2006, which had been the lowest effort recorded in the fishery since 2002. This low level of effort reflects the continued and increasingly high cost of fishing and low catches.

Recreational component:

Nil

Stock Assessment

Assessment complete:

Not assessed

Exploitation status:

Not assessed

Breeding stock levels:

Not assessed

Non-Retained Species

Bycatch species impact:

Low

Trawling for scallops is focused on a few small offshore areas, while the prawn catch is mainly taken from Comet Bay. An extensive study (Laurenson *et al.* 1993b) of the environmental effects of this fishery has shown that the fishery has minimal impact on bycatch species' populations.

Protected species interaction:

Negligible

Protected species that are susceptible to capture by trawling do not occur regularly in this fishing area.

Ecosystem Effects

Food chain effects:

Low

The food chain effects are considered to be low owing to the low overall exploitation rate and the very small percentage (< 5%) of the fishing area within the legislated boundary that is trawled annually.

Habitat effects:

Low

Laurenson *et al.* (1993b) concluded that the fishery has minimal impact on the benthic sand habitats involved.

Social Effects

The estimated employment in the fishery for the year 2007 was 6 skippers and crew.

Economic Effects

Estimated annual value (to fishers)
for year 2007:

Prawns Negligible
Scallops Negligible

Prawns: Wholesale prices for prawns vary, depending on the type of product and the market forces operating at any one time. Generally, prices for king prawns averaged \$12.00/kg.

Scallops: The estimated value of the catch has been based on the average wholesale price per kilogram obtained in the Shark Bay fishery, that is \$3.60/kg whole weight or \$18/kg meat weight. Meat weight is approximately 20% of the whole weight.

Fishery Governance

Acceptable catch range for next season: Not available

New management initiatives (2008/09)

Although a legislative amendment to provide for the introduction of the Department of Fisheries' vessel monitoring system (VMS) has been approved, it has continued to be 'on-hold', pending the resolution of a number of issues.

External Factors

The level of fishing activity and quantity of catch within the South West Trawl Managed Fishery is variable. This variability has largely been driven by the level of scallop recruitment to the fishing grounds and the product price paid to fishers, as well as the rising costs of fishing. Variations in recruitment are naturally high in scallop stocks. In other Western Australian scallop fisheries, these variations are thought to be related to the flow of the Leeuwin Current.

West Coast Blue Swimmer Crab Fishery Status Report

D. Johnston and D. Harris

Management input from N. Harrison

Fishery Description

The blue swimmer crab (*Portunus pelagicus*) is found along the entire Western Australian coast, in a wide range of inshore and continental shelf areas, from the inter-tidal zone to at least 50 metres in depth.

However, the majority of the commercially and recreationally-fished stock is concentrated in the coastal embayments between Geographe Bay (in the south) and Port Hedland (in the north). Crabbing activity in the West Coast bioregion is centered largely on the estuaries and coastal embayments from Geographe Bay north to the Swan River and Cockburn Sound.

Blue swimmer crabs account for nearly all of WA's commercial inshore crab landings, with more than three quarters of the annual catch now coming from Shark Bay, following the temporary closure of the Cockburn Sound Crab Fishery.

Blue swimmer crabs are targeted using a variety of fishing gear. Originally, commercial crab fishers in WA used set (gill) nets or drop nets, but most have now converted to purpose-designed crab traps. The State's prawn and scallop trawl fisheries also retain crabs as a by-product.

Blue swimmer crabs are commonly targeted by recreational fishers, particularly in the estuaries and bays between Albany and Fremantle, and around Nickol Bay in the Pilbara region. They represent the most important recreationally-fished inshore species in the south-west of WA in terms of participation rate. While the majority of recreational fishers use either drop nets or scoop nets, diving for crabs is becoming increasingly popular.

This report is based on the blue swimmer crab fishery in the West Coast bioregion. Separate reports for crab fisheries in the Gascoyne and North Coast bioregions can be found in the appropriate sections of this document.

Governing legislation/fishing authority

West Coast Estuarine Fishery (Interim) Management Plan 2003
Cockburn Sound (Crab) Management Plan 1995

Warnbro Sound (Crab) Management Plan 1995

Exceptions to the Fish Traps Prohibition Notice 1990 and Fish Traps Restrictions Notice 1994

Exemptions under Section 7 of the *Fish Resources Management Act 1994*

Consultation process

Meetings between the Department of Fisheries and the commercial fishing sector (WAFIC)

Meetings between the Department of Fisheries and the Recreational Fishing Advisory Committee (RFAC) and Recfishwest

Boundaries

The Cockburn Sound (Crab) Managed Fishery encompasses the inner waters of Cockburn Sound, from South Mole at Fremantle to Stragglers Rocks, through Mewstone to Carnac Island and Garden Island, along the eastern shore of Garden Island, and back to John Point on the mainland.

The Warnbro Sound (Crab) Managed Fishery includes Warnbro Sound itself and adjacent waters, extending from Becher Point to John Point.

The West Coast Estuarine Fishery encompasses the waters of the Swan and Canning Rivers and the waters of the Peel Inlet and Harvey Estuary, together with the Murray, Serpentine, Harvey and Dandalup Rivers.

The Mandurah to Bunbury Inshore Experimental Crab Fishery covers the waters south of the Shoalwater Islands Marine Park (32°22'40" S) to just north of 'The Cut' (33°18' S), and offshore to 115°30' E. The fishery is further divided into a northern zone with one 80-pot exemption (the Comet Bay Oceanic Crab Pot Trial zone) and a southern zone with four 60-pot exemptions (in the waters between Cape Bouvard and the southern boundary of the fishery). The area separating the 2 zones is closed to commercial fishing.

The former Geographe Bay fishery covered the waters south of a line drawn from the north-west tip of Cape Naturaliste to McKenna Point lighthouse in Bunbury. This commercial fishery was officially closed on 21 January 2005 to reduce conflict between the recreational and commercial fishing sectors.

Commercial fishing in the Leschenault Estuary at Australind ceased in 2000.

Management arrangements

Commercial access to blue swimmer crab stocks in WA is governed by a series of separate management arrangements provided for under the legislative framework of the *Fish Resources Management Act 1994*. Individual fisheries are managed under an input control system, primarily through the regulation of vessel and trap numbers. Supplementary controls cover retainable species and associated minimum size limits, gear specifications and seasonal and daily time restrictions.

The principal management tool employed to ensure adequate breeding stock in the commercial crab fisheries involves maintaining minimum size limits well above the size at sexual maturity. Except for male crabs in Shark Bay, which mature at 115 mm carapace width, blue swimmer crabs become sexually mature below 100 mm carapace width. The legal minimum size range varies between 127 – 130 mm carapace width in the fisheries of the West Coast bioregion – well above the size at sexual maturity.

Recreational fishing for blue swimmer crabs in Western Australia is managed through a series of input and output controls. As with commercial fishing, the principal management tool employed to sustain an adequate breeding stock involves maintaining minimum size limits well above the size at sexual maturity. A minimum legal size limit of 127 mm carapace width applies in State waters, along with a bag limit of 20 crabs per person or 40 crabs per boat.

As of November 1, 2007, the recreational bag limits in the West Coast bioregion have been halved to 10 crabs per person and 20 crabs per boat.

Restrictions also govern gear types that can be used to take blue swimmer crabs, along with localised spatial and temporal closures. Interim management measures have been introduced in August 2007 to include a seasonal closure to both commercial and recreational fishers in the Peel-Harvey Estuary for the months of September and October to protect pre-spawning female crabs.

Following several years of rapidly-depleting commercial blue swimmer crab catches in Cockburn Sound, the Minister for Fisheries closed the fishery to both commercial and recreational fishing in December 2006. Commercial fishers were prohibited

from taking crabs in the whole of the Cockburn Sound Managed Crab Fishery, while recreational fishers were prohibited from taking crabs south of a line from Woodman Point across to Garden Island. The closure remained in place for the 2006/07 season.

A voluntary Fisheries Adjustment Scheme resulted in the number of licenses in the Swan/Canning River (Area 1 of the West Coast Estuarine Fishery) being reduced from 4 to 2 in July 2005. The current government policy to phase-out commercial fishing in the Swan/Canning Estuary is likely to result in the establishment of further adjustment schemes in the future.

Research summary

Data for the assessment of blue swimmer crab stocks in the West Coast bioregion are obtained from a variety of sources. Commercial catch and effort and population dynamics are assessed using fishers' compulsory catch and effort returns, voluntary daily log books from fishers in the Mandurah to Bunbury Inshore Experimental Crab Fishery, and data from on-board catch monitoring conducted by the Department of Fisheries' research staff.

Trawl programs in Cockburn Sound aboard both *RV Naturaliste* and *RV Snipe* provide information on the status of the spawning stock and subsequent strength of recruitment, along with data on the general crab population. Additional information on the biology and ecology of blue swimmer crabs has been provided by a number of projects funded by the Fisheries Research and Development Corporation (FRDC) and conducted by the Department of Fisheries and Murdoch University.

An FRDC project completed in 2005 developed a catch prediction model for the Cockburn Sound blue swimmer crab fishery that forecasts future commercial catches in the fishery.

Studies are currently being undertaken to investigate the relationships between environmental variables and the success of spawning of blue swimmer crab stocks. In Cockburn Sound, an Egg Production Index model is being developed which attempts to correlate water temperature, in the pre-spawning months of August and September, and the size of the breeding stock with the following season's commercial catch.

Following the closure of the Cockburn Sound crab fishery in December 2006, research funding (from the Development and Better Interest Fund) was granted to:

- undertake additional sampling in Cockburn Sound to provide a finer resolution to the assessment of recruitment and breeding stocks during the recovery of the resident stock;
- maintain the Cockburn Sound commercial catch monitoring program during the fishery closure;
- develop a commercial catch monitoring program in Warnbro Sound and the Swan River;
- examine the genetic relationship between the Cockburn Sound stock and those in Warnbro Sound and the Swan River;
- develop a commercial catch monitoring program in the Peel-Harvey Estuary and Comet Bay (Area 1 of the Mandurah to Bunbury Inshore Experimental Crab Fishery);

- f. develop a fishery-independent sampling program to assess the status of the Peel-Harvey crab stock; and
- g. undertake a 12-month recreational (creel) survey in the Peel-Harvey Estuary to provide an estimate of total recreational catch and effort.

Retained Species

Commercial landings (season 2006/07): 140 tonnes

The total commercial catch of blue swimmer crabs taken in Western Australian waters during 2006/07 (July to June) was 947 t (West Coast Blue Swimmer Crab Figure 1) – a 6% increase on the 896 t taken in 2005/06. However, total landings from the West Coast bioregion declined 12% over the same period from 160 t in 2005/06 to 140 t in 2006/07.

This reduction in catch was primarily caused by the significant decline of the Cockburn Sound crab stock. The commercial catch from dedicated trap fishers in Cockburn Sound decreased from 53 t for the 2005/06 season to 2 t, due to the low recruitment and the closure of the fishery in December 2006 (West Coast Blue Swimmer Crab Figure 2).

In contrast, the commercial catch from the Peel/Harvey Estuary (Area 2 of the West Coast Estuarine Fishery) for 2006/07 of 95 t represented a 31% increase from the previous year and the highest commercial catch for this fishery (West Coast Blue Swimmer Crab Figure 3).

This trend was repeated in the Mandurah to Bunbury Inshore Experimental Crab Fishery, with reported landings of 28 t representing a 64% increase on the 2005/06 catch of 17 t similar to 2003/04 (West Coast Blue Swimmer Crab Figure 4).

Recreational catch estimate (season 2006/07):

Recreational catch: approximately 70% of total catch

Most of the recreational blue swimmer crab fishing in Western Australia occurs in the West Coast bioregion. Departmental surveys have estimated recreational catches of blue swimmer crabs in this bioregion to be in the vicinity of 70% of the total catch.

The recreational take is dominated by catch from the Peel/Harvey Estuary. A 12-month creel survey in 1998/99 estimated the recreational catch to be 289 t, or 80% of the total catch from the estuary in that year. Recent surveys produced recreational catch estimates for Cockburn Sound of 18 t, 23 t and 18 t for the 2002, 2003 and 2004 calendar years respectively. However, the recreational take of blue swimmer crabs in Cockburn Sound for the 2005/06 financial year was estimated to be just 3 t.

The Minister for Fisheries closed the Cockburn Sound crab fishery to recreational fishing south of a line between Woodman Point and the northern end of Garden Island in December 2006. The closure was still in effect on 30 June 2007.

A 12-month survey of recreational fishing in the Swan/Canning Estuary Basin between August 1998 and July 1999 estimated the total recreational blue swimmer crab catch to be 7.3 t. This compares with a commercial catch during the 1998/99 financial year of 24 t. In subsequent years, commercial catches have

ranged between 10 t and 20 t, but no further recreational surveys have been undertaken.

Commercial fishing for blue swimmer crabs in Geographe Bay was prohibited from January 2005. This fishery is now exclusively for recreational use – previous surveys have found their catch was between 7 – 11 t per year.

Fishing effort/access level

Due to the low recruitment of the blue swimmer crab stock in Cockburn Sound, little fishing effort was expended during the second half of 2006 before the fishery was officially closed in December of that year. A single fisher operated at the weekends from July through September, accounting for just 2,786 trap lifts. This level of effort compares to 109,138 trap lifts during 2005/06 (West Coast Blue Swimmer Crab Figure 2).

Commercial fishers in the Peel-Harvey Estuary reported 66,114 trap lifts during the 2006/07 season – a 21% increase on the 54,522 trap lifts reported the previous year (West Coast Blue Swimmer Crab Figure 3). This represents the highest annual commercial effort since the fishery converted to purpose-designed hourglass crab traps in the late 1990s. The annual fishing effort in the estuary has been found to follow variations in the abundance of the resident crab stock.

Commercial effort in the Mandurah to Bunbury Inshore Experimental Crab Fishery almost doubled in 2006/07, with a total of 24,006 trap lifts reported compared to 12,200 trap lifts the previous year (West Coast Blue Swimmer Crab Figure 4).

Stock Assessment

Assessment complete: Yes

Breeding stock levels: Cockburn Sound – Inadequate
Other West Coast fisheries – Adequate

Catch rates from fisheries within the West Coast bioregion generally provide an index of abundance that can be used to assess individual fishery performance from year-to-year.

Cockburn Sound: Due to the low fishing effort, the CPUE for 2006/07 is not available. Historically, the annual commercial catch of blue swimmer crab in Cockburn Sound has experienced large fluctuations (e.g. 362 t in 1996/97 versus 92 t in 2001/02), with the catch (and effort) reflecting stock abundance. Inter-annual variations observed since 1977 are presumably related to variable recruitment, while the shift by commercial fishers from set nets to crab traps in the mid-1990s coincided with a marked increase in mean annual crab landings.

A preliminary stock-recruitment-environment relationship has been developed to investigate the factors affecting recruitment. The minimum legal size for both the commercial and recreational crab fishery (130 mm carapace width and 127mm carapace width respectively) are set well above the size at sexual maturity (98mm carapace width), allowing crabs to spawn at least once before entering the fishery. It appears that the 3 years of reduced recruitment since 2003, most likely due to below-average water temperatures during spawning months, coupled with continued high levels of fishing pressure, resulted in a significant reduction in the relative levels of egg production.

The introduction of traps in the 1990s led to catches increasing significantly over the winter months (April to September), which had previously been a period of minimal effort as unfavourable weather meant set nets could not be used. Length frequency analysis has shown that catches in these months are predominantly females, which increased the impact on egg production levels for this stock by removing these individuals before their second year of spawning.

Research trawling has been conducted in Cockburn Sound since 1999 to collect data on juvenile blue swimmer crab abundance for the development of a catch prediction index. The numbers of recruits recorded from this research correlate strongly with catch levels the following year. Sampling in 2006 found a lower abundance of recruits than experienced between 2003 and 2005 and hence catches in 2006/07 were predicted to be very low. Because of this low recruitment and the need to recover the breeding stock, the Cockburn Sound fishery was closed to both commercial and recreational crab fishing in December 2006. The juvenile recruitment was, while slightly improved, still low, so the closure has been continued to December 2008.

The experience gained from this stock collapse will add considerable value to the understanding of blue swimmer crab stock management, which will prove beneficial in determining the way that crab fisheries in Cockburn Sound and elsewhere in the State are managed in the future.

Peel Harvey: The mean catch rate for 2006/07 in the Peel-Harvey estuary was 1.43 kg/trap lift – a steady increase on the 1.33 kg/trap lift recorded the previous year (West Coast Blue Swimmer Crab Figure 3). Other than 2002/03 (1.06 kg/trap lift), catch rates for the past 6 years have been markedly consistent at around 1.3 – 1.4 kg/trap lift. As with catch and effort, the 2006/07 catch rate was the highest on record since the conversion to hourglass traps (West Coast Blue Swimmer Crab Figure 3).

A recreational creel survey conducted in 1998/99 estimated that the commercial take accounted for only 20 per cent of the total catch. Consequently, it was recognized that commercial catch data alone may not be providing an accurate indication of the status of crab stocks in this estuary.

In recent years, members of the Mandurah community have expressed concern over the status of blue swimmer crab stocks in the Peel-Harvey Estuary. This concern has been highlighted by apparent declines in recreational catch rates identified in Fisheries Volunteers data, and through anecdotal evidence from the community. However, it was not clear whether these observations were an indication of overall crab numbers, or a reflection of increasing numbers of recreational fishers.

In light of these concerns and the Cockburn Sound stock collapse, the Minister for Fisheries approved a grant from the Development and Better Interest Fund for a three-year project to adequately assess the crabs stocks in the Peel-Harvey Estuary and a 12-month survey to provide accurate estimates of recreational catch and effort.

Mandurah-Bunbury: Trap catch rates in the Mandurah to Bunbury Inshore Experimental Crab Fishery have increased steadily since the commencement of exploratory fishing along the coast south of Mandurah to Bunbury in 2002. This increase reflects more efficient

fishing of crab stocks in the region as the commercial operators' knowledge of the spatial distribution of resident stocks and localized environmental influences increased over time. The mean catch rate for 2006/07 in the Mandurah to Bunbury fishery was 1.05 kg/trap lift – a marginal increase on the 2005/06 catch rate of 1.03 kg/trap lift (West Coast Blue Swimmer Crab Figure 4).

Non-Retained Species

Bycatch species impact:

Negligible

The shift from using set nets to traps in most blue swimmer crab fisheries has resulted in a substantial reduction in bycatch from dedicated crab fishing. Pots are purpose-designed to minimise the capture of non-target species and are therefore an inefficient way to capture fish, the majority of which are able to escape through the entrance gaps when the pot is soaking or being hauled.

Small numbers of fish are infrequently captured in crab pots, but the fishers are not permitted to retain them. The low number of fish caught and returned by crab fishers is considered to pose a negligible risk to these stocks.

Discarded bycatch from trawl fisheries taking crabs as a by-product is dealt with in the status reports that are specific to each trawl fishery.

Protected species interaction:

Negligible

The crab trap longline system used in the targeted crab fisheries has little possibility of interacting with protected species. The fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species and avoids or minimises impacts on threatened ecological communities.

Ecosystem Effects

Food chain effects:

Low

As the commercial take of crabs represents a relatively small portion of the biomass, which is effectively renewed annually and subject to high levels of natural variation in abundance, secondary food chain effects are likely to be minimal in these fisheries.

Habitat effects:

Negligible

Fishing with traps results in limited habitat disturbance, with only minor dragging of traps on the bottom occurring during trap retrieval. Sand and associated biota do not get brought to the surface in commercial blue swimmer crab traps, as the mesh used on traps is sufficiently large to allow the escape of any sand-dwelling macro-benthos.

Although seagrasses are occasionally brought to the surface with the trap, the infrequent nature of this occurrence, and the small amount of living seagrass removed, results in minimal habitat damage.

Social Effects

During 2006/07, approximately 33 people were employed as skippers and crew on vessels targeting blue swimmer crabs in the West Coast bioregion. However, this employment has been adversely affected by the closure of the Cockburn Sound Crab Fishery in November 2006, which accounts for as many as 14 commercial fishers.

Blue swimmer crabs also provide a highly popular recreational fishery, particularly in the Peel-Harvey and Geopraphe Bay region, where they dominate the inshore recreational catch. The recreational fishing has also been affected by the closure of the Cockburn Sound crab fishery.

Economic Effects

Estimated annual value

(to fishers) for year 2006/07:

\$0.7 million

The value of commercial blue swimmer crab fishing across the State for the 2006/07 season was estimated to be \$4.3 million – up slightly on the \$4 million generated in 2005/06.

Despite the minimal catch from the Cockburn Sound crab fishery, the blue swimmer catch in the West Coast bioregion was again valued at \$0.7 million. This was attributed to a record catch in the Peel-Harvey Estuary and a slight increase in the beach price for blue swimmer crabs from the West Coast region because of the tightening of local supply caused by the Cockburn Sound closure. The catch from the West Coast bioregion was sold largely through local markets.

Fishery Governance

Target catch (or effort) range:

Under review

In the light of recent recruitment failures in the Cockburn Sound fishery, the target range will need to be reviewed when the fishery is re-opened.

Current fishing (or effort) level

Cockburn Sound: Under development

Other West Coast Bioregion fisheries: Under development

New management initiatives (2006/07)

Several interim management arrangements have been put in place following the decline of the Cockburn Sound crab stocks, and in response to concerns raised by the Mandurah community regarding anecdotal evidence of declines in recreational catch rates of blue swimmer crabs in the Peel-Harvey Estuary. An annual closure has been introduced in the Peel-Harvey Estuary to provide protection for pre-spawning females. The closure, which took effect on 1 September 2007, covers the months of September and October and applies to both recreational and commercial fishers. As of 1 November 2007, the recreational bag limits for the whole of the West Coast bioregion have been halved to 10 crabs per person and 20 crabs per boat.

These arrangements will be reviewed following the completion of the research programs being carried out in both Cockburn Sound and the Peel-Harvey Estuary.

Effort levels in the Mandurah to Bunbury Inshore Experimental Crab Fishery have been assessed as part of the Developing New Fisheries review process. Outcomes of this assessment are expected in 2008.

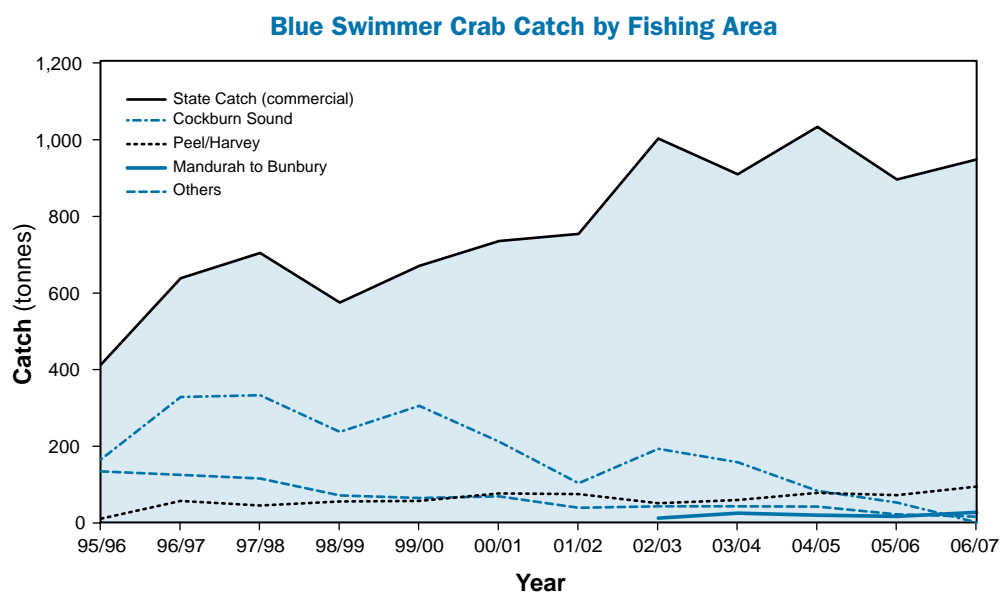
External Factors

Levels of recruitment to many of the crab fisheries fluctuate considerably. While the causes of these variations are not fully understood, it is considered most likely due to environmental influences on spawning success and larval survival through to recruitment. The relationship between environmental factors, recruitment and catch is being further evaluated, as data becomes available.

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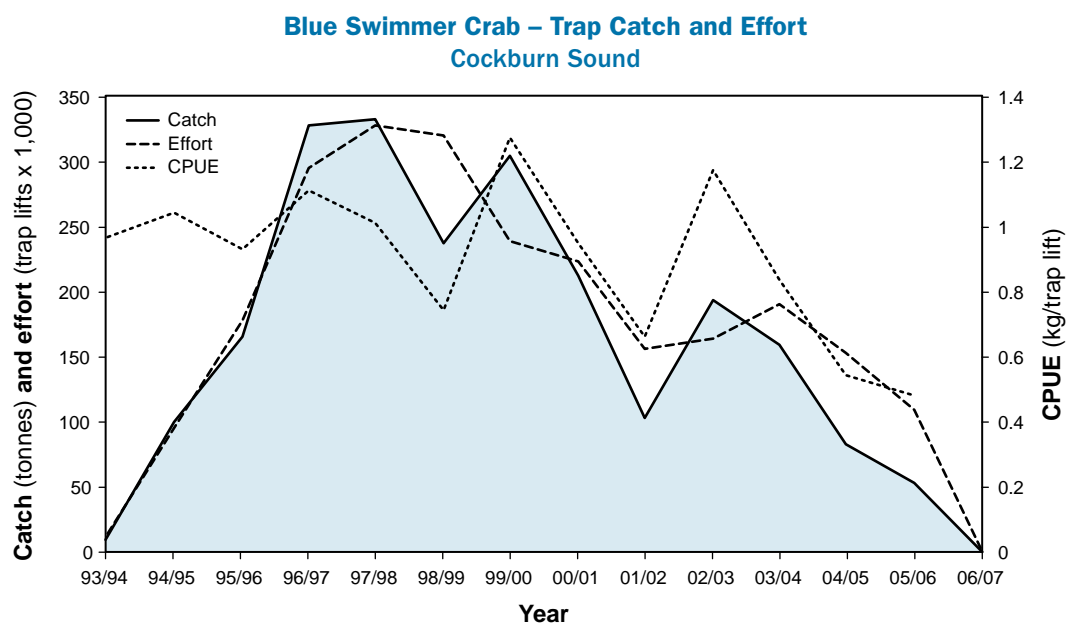
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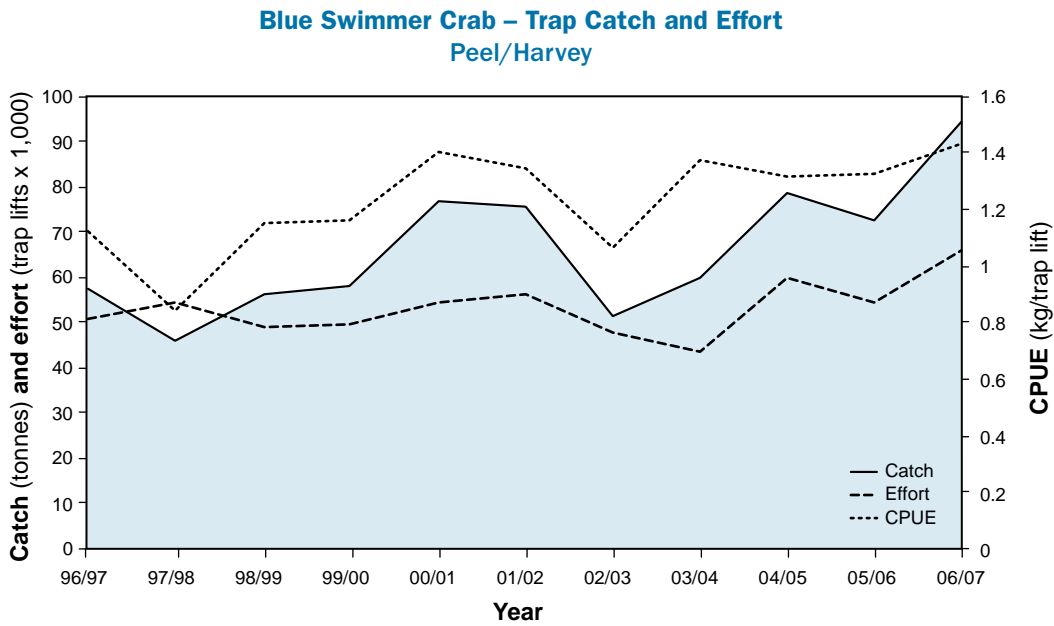
WEST COAST BLUE SWIMMER CRAB FIGURE 1

Commercial catch history for the blue swimmer crab (*Portunus pelagicus*) in Western Australia compared with fisheries in the West Coast bioregion since 1995/96.

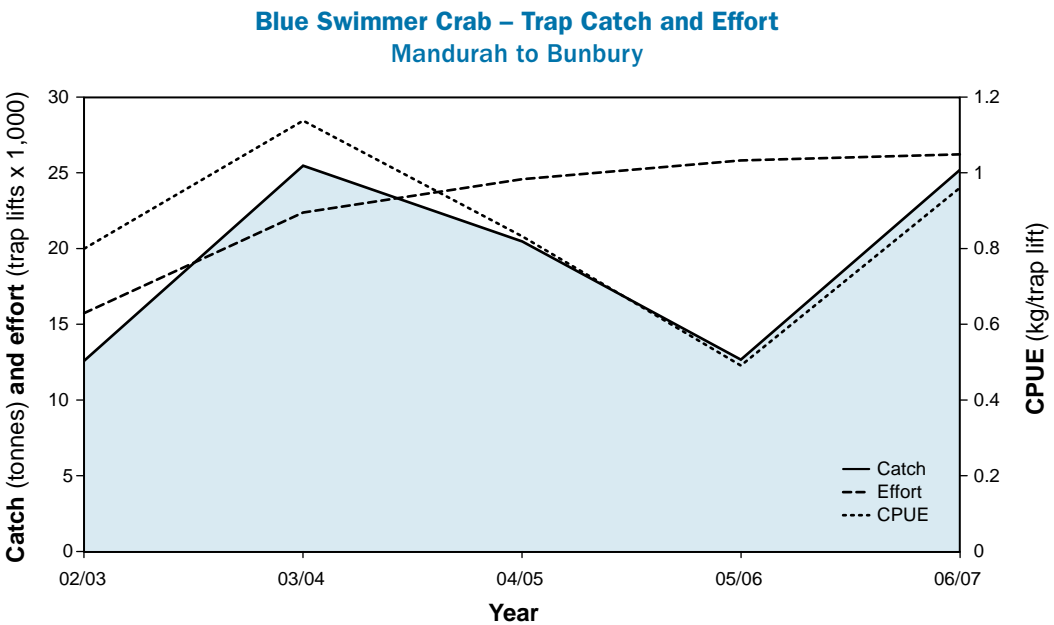


WEST COAST BLUE SWIMMER CRAB FIGURE 2

Blue swimmer crab catch (t), effort (trap lifts x 1,000) and catch per unit effort (kg/trap lift) in the Cockburn Sound Crab Fishery between 1993/94 and 2006/07 using traps.



WEST COAST BLUE SWIMMER CRAB FIGURE 3
Blue swimmer crab catch (t), effort (trap lifts x 1,000) and catch per unit effort (kg/trap lift) in Area 2 of the West Coast Estuarine Fishery (the Peel-Harvey Estuary) between 1996/97 and 2006/07 using traps.



WEST COAST BLUE SWIMMER CRAB FIGURE 4
Blue swimmer crab catch (t), effort (trap lifts x 1,000) and catch per unit effort (kg/trap lift) in the Mandurah to Bunbury Inshore Experimental Crab Fishery between 2002/03 and 2006/07.

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GASCOYNE COAST BIOREGION
NORTH COAST BIOREGION
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West Coast Deep Sea Crab (Interim) Managed Fishery Status Report

R. Melville-Smith and P. Unsworth

Management input by N. Harrison

Fishery Description

The West Coast Deep Sea Crab (Interim) Managed Fishery targets giant (king) crabs (*Pseudocarcinus gigas*), crystal (snow) crabs (*Chaceon albus*) and champagne (spiny) crabs (*Hypothalassia acerba*) using baited pots operated in a long-line formation in the offshore waters of the west coast.

Governing legislation/fishing authority

West Coast Deep Sea Crab Fishery (Interim) Management Plan 2003

Australian Government *Environment Protection and Biodiversity Conservation Act 1999* (Wildlife Trade Order)

Consultation process

Meetings between the Department of Fisheries and industry

Boundaries

The West Coast Deep Sea Crab Fishery, which during the season being reported (2007) was in an interim management phase, operates between Cape Leeuwin and the Northern Territory border and is divided into 5 areas. Vessels are only permitted to fish outside the 150-metre depth contour.

Management arrangements

The West Coast Deep Sea Crab (Interim) Managed Fishery is a limited entry 'pot' fishery. The fishery operates in depths of 150 – 1,200 metres, with the only allowable method for capture being baited pots ('traps'). These are operated in 'long-lines', which have between 50 and 100 pots attached to a main line marked by a float at each end.

For all species of deep sea crabs the Department of Fisheries either has in place, or is currently introducing, regulations to protect breeding females by the establishment of appropriate minimum size limits.

There are currently five full-time permits and two part-time permits to operate in the fishery. The existent interim management plan expired 31 December 2007 and was replaced by a new interim management plan on 1 January 2008.

The new interim management plan introduced a number of key management changes such as rezoning of the fishery, removing part-time permits and initiating a quota management system, with individual transferable quota for each existing permit holder.

A comprehensive Ecologically Sustainable Development (ESD) assessment of this fishery determined that performance should be measured annually against measures relating to the breeding stocks of deep sea crabs. These have now been defined as the catch level remaining within an acceptable range.

Research summary

Research for this fishery has involved assessing the current status of the west coast deep sea crab stocks based on commercial catch returns, log book information and at-sea research monitoring of the catch.

Funding was granted in 1999 by the Fisheries Research and Development Corporation (FRDC) to develop an understanding of the biology and fishery of champagne crabs. Further funding was made available in 2001 for similar research to be undertaken on crystal crabs. The Murdoch University component of this work became available in September 2004 and the Department of Fisheries component in mid-2007.

Retained Species

Commercial landings (season 2007): 233 tonnes

A catch of 233 t of crystal crabs was taken in the fishery in 2007 – an increase of 24% on the catch taken in the 2006 season (188 t) (Deep Sea Crab Figure 1). This is the highest annual catch that has been made in the short history of this fishery. There were no catches of giant crabs or champagne crabs landed by the fishery during the 2007 season.

Recreational catch estimate (season 2007): Nil

Fishing effort/access level

Effort increased by 7% from an estimated 115,000 pot lifts in the 2006 season to 123,000 pot lifts in the 2007 season. The effort estimate in this fishery is based on detailed catch and effort research logbook returns, which were required to be completed by fishers in this fishery during its developmental status.

Stock Assessment

Assessment complete: Yes

Breeding stock levels: Adequate

In recent years the research data obtained from research logbooks has become increasingly reliable and for the last four years the research logbook catch data has closely matched the Catch and Effort Statistics obtained from statutory monthly returns. As the effort data from research logbooks has always been used in the analysis of Catch Per Unit Effort (CPUE) for the fishery, it has been decided that all data since 2003 used in the catch and effort analysis will be obtained from research data. The analysis and graphs presented in this report reflect this change.

The standardised catch per unit of fishing effort for crystal crabs increased by 6%, from 1.39 kg/pot lift in 2006 to 1.48 kg/pot lift in 2007 (Figure 2).

Decreases and increases in nominal CPUE were recorded in different zones in the fishery. However, there would not appear to be cause for concern at this stage because catch rates per pot lift have been fluctuating over a range of about 20% since 2003. It is not clear to what extent the changes in CPUE in this fishery are influenced by efficiency increases resulting from improvements by fishers in the type of gear that they use and the way that they deploy it, compared to variations in the catchability and local abundance levels of the crabs.

Fisheries Research and Development Corporation-funded research has shown crystal crabs are very slow-growing, as are most other deep-water species. Preliminary estimates suggest that the males attain maturity at around 12 years and reach legal minimum size at about 14 years. Ageing estimates were not made for females, but size at maturity information shows that they mature well below the legal size limit and probably moult once after reaching maturity, which means that their contribution to the fished biomass is small and that egg production in the fishery is well protected by the legal size limit.

The performance measure for this fishery uses catch level as an indicator of breeding stock. In the case of crystal crabs, the catch is required to remain within the range 100 – 250 t. This criterion was met (see 'Landings' section).*

Non-Retained Species

Bycatch species impact: Low

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

Protected species interaction: Negligible

The pots and ropes used in crab longlines have minimal capacity to interact with protected species in this fishing area.

Ecosystem Effects

Food chain effects: Negligible

Catches of the 3 species of deep sea crabs landed represent a very small biomass, and any impact of fishing on the general food chain is expected to be minimal. Most of the commercial crystal crab catch is taken between 500 to 800 metres in depth. A rough estimate of the amount of ground between 500 – 1,000 m over the distributional range of crystal crabs is about 50,600 km². Assuming that all the ground is equally productive, this means that roughly 4 kilograms of crabs are being removed each year per square kilometre of ground.

Habitat effects: Low

Crab potting is considered to have a low impact on the largely soft mud habitat over which the fishery operates.

Social Effects

This fishery is based on mobile vessels that employ a skipper and two or three crew. The product is landed live at ports between Carnarvon and Fremantle, generating some additional economic activity and benefits.

Economic Effects

Estimated annual value (to fishers) for year 2007: \$2.9 million

The beach value of the fishery was about \$3.0 million in 2007, based on an average beach price of \$13/kg for crystal crab. The majority of the catch is exported live to south-east Asia.

Fishery Governance

Target catch (or effort) range: 100 – 250 tonnes

The effort in this interim managed fishery during 2007 was restricted to 3 full-time and 1 part-time fishers spread throughout the range of the fishery. Not all these permits are being used. The fishery has probably been fully exploited since about 2000 and at current levels of fishing a catch of 100 – 250 t would be expected in the next few years.

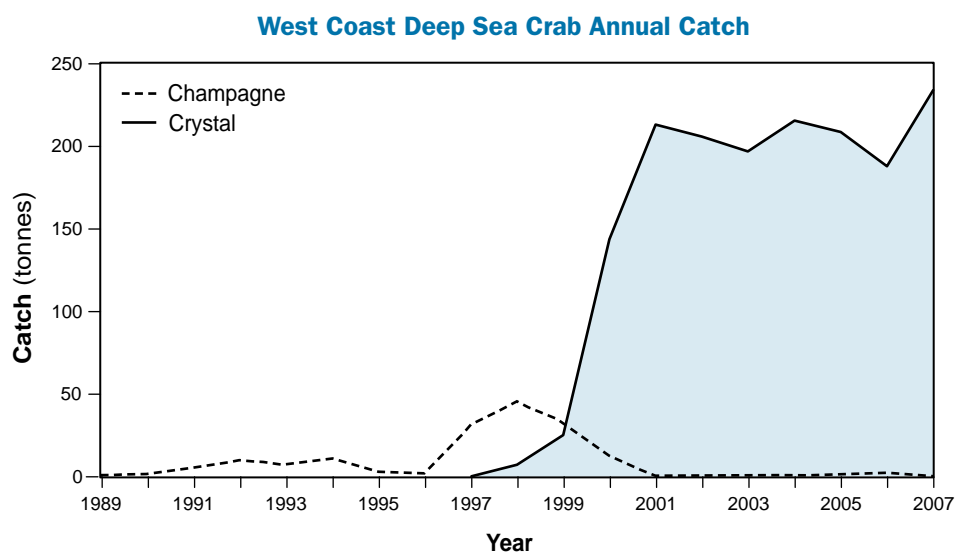
Current fishing (or effort) level: Acceptable

The catch in the crystal crab fishery has fluctuated between 186 and 233 t over the last 7 years. Over this same period, fishing effort has been more variable. This is a new commercial fishery that has only been fished on a full-time basis since 2000 and the target is a long-lived species. Given its recent history, sustainable levels of fishing are still being determined.

New management initiatives (2008)

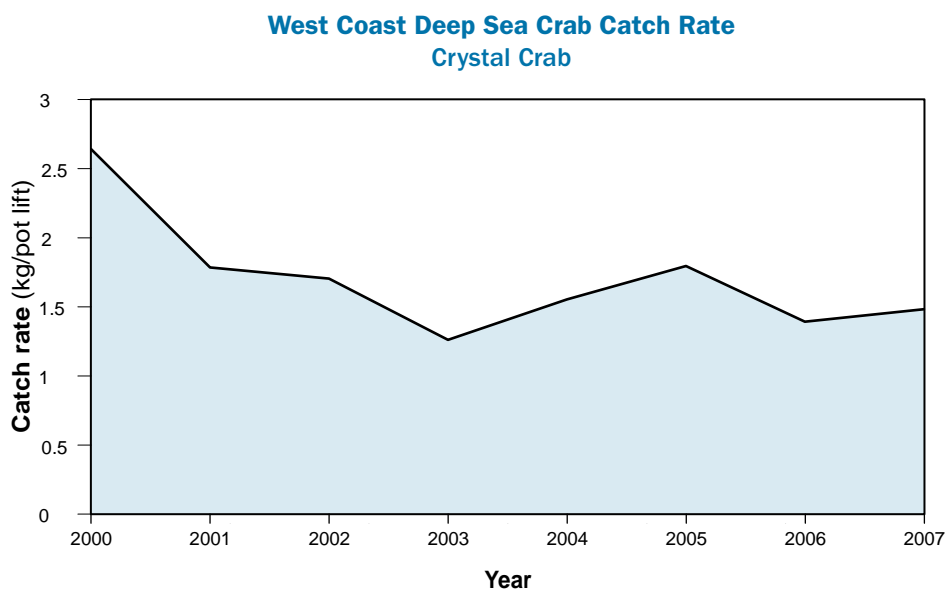
The fishery has moved to a new unitized, quota-based interim management plan in early 2008, set at 140 tonnes for the fishery. The new interim plan will run for a further 5 years and provide for 7,000 individual transferable units (1,000 per permit holder).





WEST COAST DEEP SEA CRAB FIGURE 1

Annual catches of crystal and champagne crabs since 1989. Annual giant crab catches have always been small, and they have therefore been excluded.



WEST COAST DEEP SEA CRAB FIGURE 2

Catch per unit effort since 2000 for crystal crabs.

West Coast Estuarine Fisheries Status Report

K. Smith and J. Brown

Management input from N. Harrison

Fishery Description

The West Coast Estuarine Managed Fishery (WCEF), which operates in the Swan/Canning and Peel/Harvey estuaries, is a multi-species fishery targeting blue swimmer crabs and many finfish species. The blue swimmer crab component of the fishery is reported in the West Coast Blue Swimmer Crab Fishery status report elsewhere in this document.

The Hardy Inlet fishery, although not included in the WCEF interim management plan implemented during 2003, is also reported here as it shares the characteristics of the other west coast estuarine fisheries.

The main fishing methods used are gillnets and haul nets, with crab pots used only in the Peel/Harvey estuary.

Governing legislation/fishing authority

Swan/Canning and Peel/Harvey Estuaries

West Coast Estuarine Fishery (Interim) Management Plan 2003
West Coast Estuarine (Interim) Managed Fishery Permit

Hardy Inlet

Closed waters and Permitted Gear Orders under Section 43 of the
Fish Resources Management Act 1994
Condition 19 on a Fishing Boat Licence
Condition 17 on a Commercial Fishing Licence
Directions to Licensing Officers

Consultation process

Meetings between the Department of Fisheries, industry and peak body members (e.g. the Western Australian Fishing Industry Council and Recfishwest).

Boundaries

Swan/Canning and Peel/Harvey Estuaries: The management plan encompasses all estuaries on the west coast between 27° S and 33°11' S. However, the plan incorporates a broad range of closures, so that in general terms (but with some exceptions) the only areas open to fishing are:

- The Swan and Canning rivers upstream from a line connecting Point Resolution to the Point Walter jetty to:
 - (in the Swan) a line from Plain Street running 100 m off the tip of Heirisson Island to the southern bank of the river; and
 - (in the Canning) a line connecting the northern extremity of Second Avenue, Rossmoyne to the southern extremity of Sulman Avenue.
- The exceptions relate to closures around Canning Bridge, waters around a number of jetties and some areas of 'Perth water'.

- The Peel/Harvey estuary, with a complex series of closures that effectively limit the fishery to the main body of the estuary.

Note: The closures in both the Swan/Canning and Peel/Harvey fisheries are complex – please refer to the management plan, the related legislation and regulations for details.

Hardy Inlet: Areas open to fishing are all waters of Hardy Inlet and the Blackwood River upstream from a line connecting Point Irwin to the Irwin Street boat ramp to a line drawn across the river from the eastern boundary of Sussex Location 133 (approximately Great North Road).

Management arrangements

The west coast estuarine 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. Fishing methods are restricted to gillnets and haul nets, but crab pots are also permitted in the Peel/Harvey estuary.

Research summary

Historically, monitoring of fisheries and fish stocks in west coast estuaries has been based on monthly catch and effort statistics (CAES) provided by commercial fishers. The Department of Fisheries' CAES database has provided a valuable and consistent long-term source of information for monitoring estuarine fish (including recreationally-important stocks) where they are harvested by both sectors.

However, levels of commercial fishing activity in west coast estuaries have been declining since 1992 as a result of the voluntary buy-back of commercial access, making the CAES data set less useful in assessing the status of certain estuarine species. The CAES database is still an important source of data for stock assessments, but it is now being used for this purpose in combination with increasing amounts of data from other sources, namely recreational fisheries and fishery-independent surveys.

Comprehensive assessments of fish stocks in west coast estuaries will require data from both the commercial and recreational sectors and from independent surveys. The Research Angler Program (including recreational fisher log books) and annual fishery-independent surveys of juvenile fish recruitment (including cobbler, herring, whiting, mullet and several other species) are among the strategies now being employed by the Department of Fisheries to meet future data requirements.

While commercial fishery catch levels in west coast estuaries are determined annually from data reported in compulsory commercial returns, recreational catch levels are estimated only occasionally when recreational fishing surveys are conducted. The most comprehensive estimates of recent recreational catches in west coast estuaries are available from the National Recreational and Indigenous Fishing Survey in 2000/01 (Henry and Lyle 2003). This survey included shore- and boat-based recreational fishing.

In addition, creel surveys were conducted by the Department of Fisheries in 1998/99 in the Swan-Canning, the Peel-Harvey and Leschenault estuaries (Malseed *et al.* 2000, Malseed and Sumner 2001a, 2001b). However, each of these creel surveys was focused on blue swimmer crabs and collected limited information on recreational landings of finfish.

Finally, a creel survey was conducted in the Hardy Inlet by Murdoch University in 2005/06 (Prior and Beckley 2006). This survey collected comprehensive information about finfish landings in the Hardy Inlet and Blackwood River. The 2005/06 survey used very similar methods to a previous survey of this system conducted by the Department of Fisheries in 1974/75 (Caputi 1976).

A considerable amount of knowledge on the biology of estuarine fish is available from many previous and ongoing research projects conducted on the south coast by universities and the Department of Fisheries. This knowledge assists in interpreting trends in monitoring data described above and provides a basis for management decisions.

This report presents specific data for 4 species that are important in west coast estuaries, namely blue swimmer crabs (*Portunus pelagicus*), cobbler (*Cnidoglanis macrocephalus*), black bream (*Acanthopagrus butcheri*) and King George whiting (*Sillaginodes punctata*).

Where only a small number of fishers are actively involved in a particular fishery, the data are subject to the Department of Fisheries' confidentiality policy as it relates to the *Fish Resources Management Act 1994* and are not reported separately. While not able to be published here, these confidential data are used by the researchers to monitor the status of the stocks and provide advice to management.

Retained Species

Commercial landings (season 2007): 199 tonnes

In 2007, the total catch from west coast estuaries was 199.1 t, including the following catches of key target species:

Blue swimmer crabs	<i>Portunus pelagicus</i>	87.8 t
Sea mullet	<i>Mugil cephalus</i>	58.3 t
Yellow-eye mullet	<i>Aldrichetta forsteri</i>	22.2 t
Western sand whiting	<i>Sillago vittata</i>	10.2 t
Australian herring	<i>Arripis georgianus</i>	8.2 t
Perth herring	<i>Nematalosa vlaminghi</i>	5.6 t
Tailor	<i>Pomatomus saltatrix</i>	1.5 t
Black bream	<i>Acanthopagrus butcheri</i>	0.9 t
King George whiting	<i>Sillaginodes punctata</i>	0.9 t
Cobbler	<i>Cnidoglanis macrocephalus</i>	0.7 t
Other species		2.6 t

Swan/Canning: Total annual catch in the Swan/Canning Estuary declined during the 1990s, primarily as a result of a decline in fishing effort associated with a reduction in the number of vessels operating in the fishery. From the year 2000 to 2005, the total catch, along with fishing effort, remained relatively stable. In 2006 and 2007, the catch and effort both declined.

The total fishery catch in 2007 was slightly lower than in 2006 (actual figure not reportable owing to the small number of operators).

The 2007 catch was composed primarily of blue swimmer crab, Perth herring and sea mullet, with small quantities of yellow-eye mullet, black bream and yellowtail perch (*Ammiataba caudavittata*). In total, at least 18 different species were caught in the Swan/Canning estuary during 2007.

Peel/Harvey: Reported catches in the Peel/Harvey Estuary since 1980 are shown in West Coast Estuarine Figure 1. From the mid-

1970s until 1990, total annual landings declined markedly, mainly due to declines in annual catches of yellow-eye mullet, sea mullet and cobbler. From 1990 to 1998, annual catches were stable and averaged 313 t. Annual catches declined from 329 t in 1998 to 188 t in 2000, but were then relatively stable from 2000 to the present. In 2007, the total Peel/Harvey estuary catch was 165 t.

As in the Swan/Canning Estuary, the catch trend in the Peel/Harvey estuary after 1990 closely followed the decline in fishing effort. In both estuaries, declines in total annual landings were due to declines in finfish landings. Unlike finfish landings, annual crab landings in these estuaries have gradually increased since 1980 despite declining effort levels.

In 2007, approximately 50% of the total Peel/Harvey catch consisted of blue swimmer crabs, with sea mullet, yellow-eye mullet, Australian herring and western sand whiting making up 96% of the finfish catch.

Hardy Inlet: The total fishery catch in the Hardy Inlet in 2007 was slightly lower than in 2006 (actual figure not reportable owing to the small number of operators). The catch level trend has been relatively stable since 1996. In 2007, the Hardy Inlet catch consisted of 6 different species. Western sand whiting and black bream comprised the majority of the catch (69 and 21%, respectively), with small quantities of blue swimmer crabs, black bream, cobbler and King George whiting comprising the rest.

Key species

Blue swimmer crabs: See 'West Coast Blue Swimmer Crab Fishery Status Report' elsewhere in this volume.

Black bream: Commercial landings of black bream were reported from the Swan/Canning estuary, Hardy Inlet and the Peel/Harvey estuary in 2007, although the amount caught in the latter was minimal. In the Swan/Canning estuary, the catch in 2007 was lower than in 2006, and well below the 10-year (1997 to 2006) average for this species in this estuary. The 2007 black bream catch in the Hardy Inlet, while up slightly on the previous year, was also well down on the 10-year average.

Cobbler: In 2007, cobbler was primarily caught in the Peel/Harvey estuary, with a minor amount caught in the Hardy Inlet estuary (a prohibition to catch cobbler in the Swan/Canning estuary was introduced on the 6 July 2007 in order to protect the species). The annual catch of cobbler in the Swan/Canning Estuary declined dramatically after 1988, when 10.4 t was reported. Since 1998, annual catches have not exceeded 170 kg. The situation is similar in the Peel/Harvey estuary, where cobbler catches have also declined following a peak in 1980 of 232.8 t. Since 2000, annual catches have not exceeded 5 t, with the 2007 catch of 498 kg being the lowest on record.

King George whiting: In 2007, commercial landings of King George whiting were reported from the Peel/Harvey Estuary and Hardy Inlet. Catches in recent years have been highly variable in response to strong fluctuations in recruitment. From 1985 to 1995, the average annual catch of King George whiting in the Peel/Harvey Estuary was 1.4 t.

Strong recruitment led to significantly higher catches between 1996 and 2000, including a peak of 20.3 t in 1998. These recruits eventually matured and moved offshore. The catch then declined to pre-1996 levels and averaged 2.6 t from 2001 to 2006. The

2007 catch of King George whiting in the Peel Harvey estuary was only 772 kg.

Recreational catch: 30 – 75% of total catch (approximately)

In 2000/01, the National Recreational and Indigenous Fishing Survey collected data on all target species. The recreational finfish catch during this survey was estimated to be similar to the commercial finfish catch in the Swan/Canning Estuary, about 50% of the commercial finfish catch in the Peel/Harvey Estuary and about 3 times the commercial finfish catch in the Hardy Inlet/Blackwood River.

With recent declines in commercial fishing effort and the continued growth of the recreational fishing sector, it can be reasonably expected that the recreational catch component in these estuaries has increased from when the last survey was conducted.

The national recreational fishing phone survey in 2000/01 estimated the total retained catch of finfish in the Swan-Canning estuary and its tributaries was numerically dominated by black bream (35%), Australian herring (20%), toadfish (*Torquingener pleurogramma*) (12%), whiting (9%) and tailor (9%) during the survey period.

In the Peel-Harvey estuary and tributaries, the retained finfish catch was numerically dominated by Australian herring (56%), whiting (17%) and tailor (14%). In Leschenault Inlet and tributaries, the total retained finfish catch was numerically dominated by small baitfish (34%), redfin perch (*Perca fluviatilis*, caught in river only) (34%), wrasse (Labridae) (10%) and tailor (7%).

In the Hardy Inlet and its tributaries, the national phone survey estimated that the total retained finfish catch was numerically dominated by whiting (63%), Australian herring (23%) and black bream (7%) during the survey period. This was similar to the results from the 2005/06 creel survey of the Hardy Inlet/Blackwood River, which also found the total retained recreational catch to be numerically dominated by whiting (47%) and Australian herring (17%). In 2005/06, a total of 8 t of finfish, comprising 17 species, was estimated to have been retained by recreational fishers in this system.

In the Swan-Canning, Peel-Harvey and Leschenault estuaries, prawns were a significant component of recreational landings.

Fishing effort/access level

Commercial fishing effort

Swan/Canning:	level of access – 2 licensees
Peel/Harvey:	level of access – 11 licensees
Hardy Inlet:	level of access – 1 licensee

The levels of access listed above are as at May 2007. Licence holders in the west coast estuaries that are open to commercial fishing are endorsed to fish a single estuary system only.

Fishing effort in the Peel/Harvey estuary, which has traditionally been reported here as the number of units of access, is now reported as the number of days fished by each method. It is considered that 'method days fished' provides a more accurate measure of the effort undertaken in this estuary.

Fishing effort in the Swan/Canning estuary will continue to be reported as the average number of boats fishing per month. This

measure of effort provides a general indication of effort changes over time. In these fisheries, the license buy-back scheme applied to commercial fishing licenses has resulted in a decline in effort and hence lower catches.

Swan/Canning: Fishing effort has steadily declined over recent decades. The mean number of active fishing units per month fell from about 25 in the mid-1970s to 2 in 2007.

Peel/Harvey: During the 1980s, fishing effort (number of method days fished) averaged 5,372 days per year, but this included a period of rapid decline between 1988 and 1990. Effort then stabilised and averaged 3,463 days per year from 1990 to 2000. After another pronounced decline between 1998 and 2000, effort again stabilized, with an average of 2,033 days fished per year between 2000 and 2007 (West Coast Estuarine Figure 1).

Hardy Inlet: Fishing effort (mean monthly number of fishing units) in the Hardy Inlet has declined from 3 in the 1970s to 1 in 2000 and subsequent years, including 2007.

Recreational fishing effort

In 2000/01, the National Recreational and Indigenous Fishing Survey estimated that the vast majority of total recreational effort expended in west coast estuaries and their tributaries occurred in the Peel-Harvey (43% of fishing events), Swan-Canning (32%), Hardy Inlet (8%) and Leschenault Inlet (8%) systems during the survey period.

A range of fishing methods was reported in these estuaries including line fishing (with bait or lure), drop netting, scoop netting, hand collecting, diving and spearfishing.

In the Swan-Canning, the most popular recreational methods were line fishing (80% of fishing events) and drop netting (14%). The vast majority of recreational fishing events in this system were shore-based.

In the Peel-Harvey system, the most popular recreational methods were line fishing (57% of fishing events), drop netting (27%) and scoop netting (13%). The majority of drop netting was undertaken by boat-based fishers, whereas the other 2 methods were mainly undertaken by shore-based fishers.

In the Leschenault system, the most popular recreational methods were scoop netting (48% of fishing events), line fishing (36%) and drag netting (13%). The vast majority of recreational fishing events in this system were shore-based.

In the Hardy Inlet system, the main recreational method recorded during the 2000/01 phone survey was line fishing (86% of all fishing events). The majority (72%) of line fishing events were undertaken by boat-based fishers. The creel survey in 2005/06 also found that the majority of fishing in Hardy Inlet/Blackwood River was boat-based. In 2005/06, the total annual recreational angling effort was estimated to comprise 44,655 boat-based hours and 26,910 shore-based hours. The total effort (boat + shore) was very similar to that estimated in 1974/75, during a similar survey of this system undertaken by the Department of Fisheries. However, boat-based effort represented a much greater proportion of the total effort in 1974/75 than in 2005/06.

Stock Assessment

Assessment complete: Preliminary

Breeding stock levels:
(black bream, King George whiting): Adequate

Breeding stock levels (cobbler): Inadequate

The annual abundances of the individual species that contribute to fishery landings in west coast estuaries are highly variable. For species such as black bream and cobbler that exhibit an estuarine-dependent life history, factors other than fishing, e.g. algal blooms, can cause high mortality and may necessitate changes to management.

Black bream: Black bream populations are genetically unique within each west coast estuary. The catch rates of bream increased markedly after 1990 in the Swan/Canning estuary and have been gradually increasing since the mid-1990s in the Hardy Inlet. These trends suggest recent increases in bream stock abundance in these estuaries.

Since the mid-1990s, several batches of reared black bream fingerling have been released into these estuaries. However, higher fishery catch rates over this period were due to natural recruitment and not related to stocking.

Increasing catch rates of black bream in the Swan estuary suggest that breeding stock levels are currently adequate to maintain recruitment. However, in recent years, fishery landings of black bream in the Swan/Canning estuary have been dominated by relatively small/young fish. This suggests that the stock is subject to a relatively high rate of mortality.

Environmental factors and fishing are both likely to be significant sources of mortality. Stock status in the Peel/Harvey system is unclear due to limited data, but is probably similar to that of the Swan/Canning stock.

Black bream possess different growth rates and attain maturity at different sizes in different estuaries. In all Western Australian estuaries, the legal minimum length is set above the length at maturity and therefore affords protection to each breeding stock.

Cobbler: Cobbler populations are genetically unique within each west coast estuary. They exhibit different growth rates, depending on the estuary in which they reside. In all locations, the size at maturity is less than the legal minimum total length, which would normally afford protection to each breeding stock. However, breeding stock levels in the 3 main west coast estuaries appear to be very low, due to a combination of environmental factors (e.g. loss of breeding habitat), fishing pressure and the biological characteristics of this species (e.g. low fecundity, aggregating behaviour) that make it inherently vulnerable to depletion.

The decline of this once important fishery species is reflected in declines in commercial and recreational catch rates commencing in the 1980s. Current stock levels in each estuary are not considered adequate to ensure their sustainability.

King George whiting: King George whiting breed in the open ocean at age 4+, but juveniles (aged 0 to 3+) use estuaries and coastal waters as nursery habitats. They are most vulnerable to capture while residing in estuaries. The age at which King George whiting become vulnerable to capture is typically 2+ to

3+ years, which corresponds to a length of about 250 mm.

The legal minimum length in the fishery is 280 mm, while the length at 50% maturity is 413 mm for females. Hence, the size at capture in estuaries is considerably less than the size at maturity.

Recent reductions in the number of commercial fishers in estuaries and coastal waters are likely to have reduced the inshore fishing pressure on this stock. However, targeted recreational fishing for this species, both inshore and offshore, is essentially unconstrained and will need to be monitored to ensure overall fishing mortality does not increase to an unsustainable level in the future. The current breeding stock level is considered adequate.

Non-Retained Species

Bycatch species impact: Low

These small-scale fisheries mainly use mesh nets that are deployed in a targeted manner. Few non-target species are taken. Mesh size regulations ensure that target species caught by this method are within an appropriate size range. Minimal discarding occurs because virtually all fish taken are retained and can be marketed in the greater Perth metropolitan area.

Protected species interaction: Negligible

No protected species occur in these fisheries that are susceptible to capture by the fishing gear used.

Ecosystem Effects

Food chain effects: Not assessed

Habitat effects: Low

The operation of gillnets and haul nets over predominantly sand and mud bottoms is unlikely to have any impact on these habitats in estuaries.

Social Effects

In 2007, there was an average of 14 fishers operating each month in the west coast estuarine fisheries, largely supplying fresh fish to meet demand for locally-caught product.

Economic Effects

Estimated annual value (to fishers) for year 2007: \$1.55 million

Fishery Governance

Target catch range: 75 – 220 tonnes (Peel/Harvey only)

Under the current management regime, the target range for total catch in the Peel/Harvey fishery is 75 – 220 t. The 2006 catch of 185 t was well within this range. This range was derived by a statistical quality control chart using catch data from 1978 to 2002.

Catch ranges are designed to allow catch levels to fluctuate in response to normal fluctuations in stock abundance. If annual catches fall outside acceptable ranges, an investigation into the cause will be triggered which, if required, may lead to changes in the management arrangements.

Acceptable catch ranges for the Swan/Canning and Hardy Inlet fisheries cannot be derived at this time, given the recent decreases in the number of commercial fishers operating in these estuaries and the low amount of data now available from each estuary.

Current fishing level (2007):

Acceptable

Commercial effort levels have been gradually declining over recent decades, due to reductions in the number of licensees, and the current total annual effort is very low relative to historic levels. This licensee reduction process has reduced catch levels and eased commercial fishing pressure on key stocks in west coast estuaries.

Recent changes in stock abundance are thought to be primarily due to environmental factors rather than fishing. Current commercial fishing levels are considered acceptable.

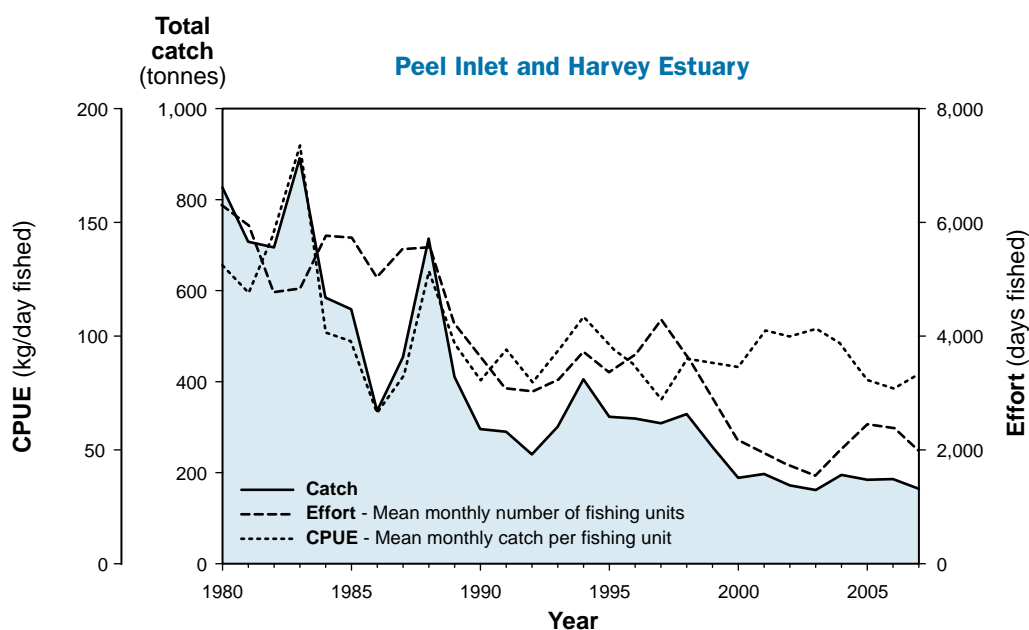
New management initiatives (2007/08)

Arrangements are still underway to incorporate the management of the Hardy Inlet commercial fishery into the South Coast Estuarine Fishery Management Plan.

External Factors

West coast estuaries are highly modified, and often degraded, environments. In these estuaries, the impacts of environmental factors on stock abundances are likely to be at least as important as fishing pressure. Hence, the sustainable management of the fish communities in west coast estuaries requires a collaborative effort between fishery and habitat managers.

Anecdotal reports suggest that habitat and climatic changes have altered the composition and abundance of fish communities in west coast estuaries, although lack of historical monitoring makes many of these changes difficult to quantify. However, in the Swan/Canning estuary, abundant fishery data provides evidence of marked declines in fish abundance since 1990 or earlier (Smith 2006). Declines are most pronounced among 'estuarine-dependent' species, i.e. those that rely on estuarine habitats for spawning, feeding and/or nursery areas (e.g. black bream, cobbler).



WEST COAST ESTUARINE FIGURE 1

The annual catch, effort and catch per unit effort (CPUE) for the total fishery of the Peel/Harvey Estuary over the period 1980 – 2007.

Cockburn Sound Fisheries Status Report

K. Smith and J. Brown

Management input from N. Harrison

Fishery Description

Cockburn Sound is a large marine embayment, approximately 10,000 hectares in size, which supports a number of commercial and recreational fishing activities (Cockburn Sound Figure 1). Collectively, these multiple fishing operations harvest a diverse array of finfish and invertebrates (Cockburn Sound Figure 2).

Since 2000, the majority of the finfish harvested annually within Cockburn Sound (approximately 69% by weight) have been baitfish taken by the West Coast Purse Seine Fishery (mainly scaly mackerel *Sardinella lemuru* and pilchards *Sardinops sagax*). The remainder have been taken by the Cockburn Sound (Fish Net) Fishery (mainly Australian herring *Arripis georgianus* and garfish *Hyporhamphus melanochir*) and the Cockburn Sound (Line and Pot) Fishery (mainly pink snapper *Pagrus auratus* and various skates and rays), with minor quantities also taken by the West Coast Beach Bait Fishery (mostly blue sprat *Spratelloides robustus* and whitebait *Hyperlophus vittatus*).

Historically, the majority of the invertebrates harvested within Cockburn Sound have been taken by the Cockburn Sound (Crab) Fishery. The remainder have been harvested by the Cockburn Sound (Line and Pot) Fishery (mainly octopus *Octopus tetricus* and squid *Sepioteuthis australis*), and by aquaculture (mussels *Mytilus edulis*).

Cockburn Sound is a very popular recreational fishing area and many of the species taken commercially in Cockburn Sound – including Australian herring, garfish, squid, blue swimmer crabs (*Portunus pelagicus*) and pink snapper – are also targeted by recreational fishers.

This report describes the Cockburn Sound (Line and Pot) and the Cockburn Sound (Fish Net) Managed Fisheries and the recreational fishery. Separate status reports are given elsewhere in this volume for the West Coast Beach Bait, West Coast Purse Seine and Cockburn Sound (Crab) Managed Fisheries and for mussel farming.

Fishing methods employed in 2007 by the Cockburn Sound (Line and Pot) Fishery include handlines, squid jigs and unbaited octopus pots. The Cockburn Sound (Fish Net) Fishery uses gillnets and haul nets.

Governing legislation/fishing authority

Cockburn Sound (Fish Net) Management Plan 1995

Cockburn Sound (Line and Pot) Management Plan 1995

Fish Resources Management Act 1994 and subsidiary legislation

Consultation process

Meetings between the Department of Fisheries and industry
Recreational Fishing Advisory Committee
Regional Recreational Fishing Advisory Committees

Boundaries

The Cockburn Sound (Fish Net) and Cockburn Sound (Line and Pot) Managed Fisheries operate within Cockburn Sound (Cockburn Sound Figure 1).

Management arrangements

The Cockburn Sound (Line and Pot) and Cockburn Sound (Fish Net) fisheries are primarily managed through input controls in the form of limited entry, gear restrictions and closed areas. Since the early 1990s, the number of licences in these two commercial fisheries has been substantially reduced via voluntary Fishery Adjustment Schemes. The removal of licences has eliminated a significant amount of latent effort (inactive licences) that previously existed in these fisheries.

A seasonal closure for pink snapper fishing was introduced in Cockburn Sound in 2000 and has since been applied annually. The annual closure applies to commercial and recreational fishing and protects the large breeding aggregations of snapper that occur in Cockburn Sound at that time.

From 2000 to 2004, the pink snapper closed season operated in Cockburn Sound from 15 September to 31 October. In 2005, the closure was extended and operated from 1 October to 15 December in both Cockburn and Warnbro Sounds. The same closure was applied in 2006 although, in late December, the ongoing presence of spawning fish prompted the period to be extended to 10 January 2007. In 2007, the closure was extended from the 1 October to 31 January 2008.

In November 2006, a state-wide ban was introduced on the commercial harvest of sharks and rays, except for licensees in dedicated shark fisheries and a limited number of special permit holders. This measure resulted in cessation of commercial fishing for sharks and rays in Cockburn Sound.

Due to poor recruitment and low numbers of blue swimmer crabs, Cockburn Sound was closed to commercial and recreational fishing for crabs on 15 December 2006, and remained closed for all of 2007.

Research summary

Historically, monitoring of fishery stocks in Cockburn Sound has been based on monthly catch and effort statistics (CAES) provided by commercial fishers. The CAES database has provided a valuable and consistent long-term source of information for monitoring these stocks, including those of recreationally important species that are harvested by both sectors.

However, levels of commercial fishing activity have declined recently as a result of voluntary license buy-backs and closures, making the CAES data set less useful in assessing the status of certain species. CAES is still an important source of data for stock assessments, but is now being used for this purpose in combination with increasing amounts of data from other sources, namely recreational fisheries and fishery-independent surveys. In Cockburn Sound, a greater focus on recreational fishery data is particularly appropriate because this sector takes the majority of finfish (excluding baitfish) that are landed in this area.

The Research Angler Program (RAP), including recreational fisher log books, and annual fishery-independent surveys of

juvenile fish recruitment are among the strategies now being employed by the Department of Fisheries to monitor the status of fishery stocks in Cockburn Sound.

Annual rates of juvenile recruitment by Australian herring, King George whiting (*Sillaginodes punctata*), tailor (*Pomatomus saltatrix*) and several other finfish species are assessed by research surveys at 6 sites along the south-west coast of WA. One of these sampling sites is in Cockburn Sound, as it is an important nursery ground for a number of key commercial and recreationally caught fish species (e.g. Pink Snapper). The recruitment indices derived from survey data are used to forecast fishery landings of each species.

A considerable amount of knowledge on the biology of key fishery species in Cockburn Sound is available from previous and ongoing research projects conducted by universities and the Department. This knowledge assists in interpreting trends in monitoring data described above and provides a basis for management decisions.

While commercial fishery catch levels in Cockburn Sound are determined annually from data reported in compulsory commercial returns, recreational catch levels are estimated only occasionally when recreational fishing surveys are conducted. The most comprehensive estimates of recent recreational catches in Cockburn Sound are available from the National Recreational and Indigenous Fishing Survey in 2000/01 (Henry and Lyle 2003). This survey included shore- and boat-based recreational fishing.

In addition, recent estimates of recreational landings by boat-based fishers are available from creel surveys of the west coast region that were conducted by the Department of Fisheries in 1996/97 (Sumner and Williamson 1999) and 2005/06 (Sumner *et al.* 2008). Additionally, a creel survey of shore- and boat-based fishing in Cockburn Sound was conducted by the Department in 2001/02. The main objective of the 2001/02 survey was to estimate recreational crab landings and, as a result, finfish landings may have been underestimated.

In addition to the compulsory monthly returns submitted to the Department of Fisheries, some commercial octopus fishers keep voluntary daily log books. A standardised annual catch rate is calculated from log book data and used as a relative index of octopus abundance in Cockburn Sound.

Australian herring, pink snapper, tailor (*Pomatomus saltatrix*) and blue swimmer crabs are among the main fishery target species in Cockburn Sound. For further details of research related to these stocks, see their separate status reports elsewhere in this volume.

Retained Species

Commercial landings

(season 2007): **35 tonnes of finfish (non-baitfish)**
39 tonnes of cephalopods

Since 1995, the total annual harvest by all commercial fisheries in Cockburn Sound, including finfish and invertebrates, has progressively declined from 977 t in 1995 to 123 t in 2007. This major reduction is largely due to declines in the landings of baitfish (mainly taken by the purse seine fishery) and crabs (mainly taken by the crab fishery which was closed in all of 2007

following low recruitment numbers) (Cockburn Sound Figure 2).

Between 1995 and 2007, annual landings of baitfish declined from 655 to 49 t and crab landings declined from 194 to 44 t in 2006 (the crab fishery was closed in 2007, and therefore no catch was recorded). Over the same period (1995-2007), non-bait finfish landings declined from 120 t to 35 t, while the annual catch of cephalopods increased from 8 t to 39 t.

Further information about commercial landings of baitfish (whitebait, pilchard, scaly mackerel, anchovy and blue sprat) and crabs in Cockburn Sound can be found in the status reports for the West Coast Purse Seine, West Coast Beach Bait and the Cockburn Sound (Crab) Managed Fisheries. The remainder of the commercial catch in Cockburn Sound is described below.

The commercial catch reported here is primarily from the Cockburn Sound (Line and Pot) and the Cockburn Sound (Fish Net) Managed Fisheries but does also include finfish (other than those five baitfish species mentioned above) caught in the West Coast Beach Bait and the West Coast Purse Seine Managed Fisheries, which conduct part of their respective operations within Cockburn Sound.

The annual commercial catch of non-bait finfish (hereafter 'finfish') in Cockburn Sound has steadily declined since reaching a peak of 165 t in 1992 (Cockburn Sound Figure 3). In 2006, the finfish catch was 34.5 t, which was the lowest catch on record. In 2007, the catch was marginally higher at 35.2 t.

The 2007 finfish catch included at least 12 teleost species. Approximately 84% of the 2007 catch consisted of Australian herring and southern sea garfish, which were caught primarily by gill netting. The next most abundant components of the catch were yellowtail scad (*Trachurus novaezelandiae*), Western Australian salmon (*Arripis truttaceus*), and pink snapper.

Prior to 2000, the commercial catch of cephalopods in Cockburn Sound was relatively low (2 to 5 t per year) and mainly comprised squid and minor quantities of cuttlefish (*Sepia* sp.). Since 2000, annual landings of squid have remained stable at approximately 2 to 4 t, but the total cephalopod catch has been increasing rapidly due to the development of the octopus fishery.

Key species

Australian herring: After 1980, annual commercial landings of Australian herring in Cockburn Sound increased steadily to reach a peak of approximately 50 t in 1994. Since 1994, the catches of herring have been lower and relatively stable, fluctuating between 15 t and 30 t per year. In 2007, the herring catch was higher than in the previous year (actual figures cannot be reported as there are fewer than five operators catching this species) and was only just below the 10-year average for the period 1997 to 2006. Herring caught commercially in Cockburn Sound represent only a small proportion of the total state landings of this species.

Southern sea garfish: From 1995 to 2007, the total annual commercial catch of sea garfish in the west coast region ranged from 44 t to 11 t (Cockburn Sound Figure 4). In this period, annual catches were quite variable, but the overall trend was downward. Approximately 85% of total commercial landings of garfish each year on the west coast were taken in Cockburn Sound.

The annual landings of sea garfish in Cockburn Sound increased gradually after 1980 to reach a peak of 36.9 t in 1999. Landings of garfish then declined to 13.8 t in 2001 and have since remained relatively stable, fluctuating between 10 t and 20 t per year. The 2007 catch was at the lower end of this range, only slightly above the 2006 level, which was the lowest recorded in the last 10 years.

Octopus: For the period 1995 to 2000, the annual commercial catch of octopus in Cockburn Sound averaged 3.3 t per year. Since 2001, the octopus catch has averaged 27.7 t per year. In 2007, the total Cockburn Sound octopus catch was 35.6 t – down from the 45.2 t reported in 2006 (Cockburn Sound Figure 5). About 19% of the total west coast commercial catch of octopus in 2007 was taken in Cockburn Sound. The majority of commercial landings of this species on the west coast are taken as a byproduct of the West Coast Rock Lobster Fishery (see the status report elsewhere in this volume).

Recreational catch:

80% of total finfish catch (approximately)

An estimate of the total recreational catch in Cockburn Sound is not available for the current year. The most comprehensive recent information on Cockburn Sound recreational shore and boat-based fishing is from a national phone survey in 2000/01. The catches and effort estimated in 2000/01 are summarised in Cockburn Sound Table 1. The survey indicated that the majority of non-bait finfish landings in Cockburn Sound are taken by the recreational sector.

In 2000/01, about 40 finfish species were estimated to have been retained by recreational fishers in Cockburn Sound. The total finfish catch was numerically dominated by Australian herring (approximately 44% of catch), various species of whiting (14%), garfish (10%), tailor (5%), trevally (*Pseudocaranx dentex*) (4%), yellowtail scad (3%) and snook (*Sphyrna novaehollandiae*) (3%).

The 2000/01 survey indicated that the recreational shore-based catch was higher and more diverse than the boat-based catch in Cockburn Sound. Overall, 74% of all retained finfish were taken by shore-based fishers. Shore-based fishers mainly caught herring, garfish, whiting and tailor, while boat-based fishers mainly caught herring and whiting.

Approximately 70% of the boat-based catch and 90% of the shore-based catch was in the northern part of Cockburn Sound (i.e. north of Woodman Point).

In 2000/01, 3 cephalopod species were retained by recreational fishers in Cockburn Sound. Cephalopods were mainly taken by boat-based fishers and landings were numerically dominated by squid (estimated to be 76% of total retained cephalopods) and octopus (22%) with minor quantities of cuttlefish (2%).

Key species

The 2007 recreational catch levels of the following species in Cockburn Sound are unknown. The most recent estimates available are from the National Recreational and Indigenous Fishing Survey conducted in 2000/01.

Australian herring: An estimated 438 t of herring was retained by recreational fishers in the west coast region in 2000/01, approximately 14% of which was taken in Cockburn Sound.

Approximately 75% of the Cockburn Sound recreational catch during the survey was taken by shore-based fishers.

Southern sea garfish: In 2000/01, an estimated 213,072 garfish (or 35 t, assuming 164 g per fish) were retained by recreational fishers in the west coast region during the survey period, with 47% of this catch being taken in Cockburn Sound. Approximately 65% of the garfish caught recreationally in the west coast region (and virtually all garfish caught in Cockburn Sound) were taken by shore-based fishers during the survey. In 2000/01, recreational landings of garfish were estimated to comprise 70% of total west coast landings (i.e. 2000/01 recreational catch plus 2001 commercial catch).

Octopus: In 2000/01, an estimated 11,245 octopus were retained by boat-based recreational fishers in Cockburn Sound, which represented 74% of the total west coast recreational octopus harvest during the survey. The weight of octopus landings was not estimated in this survey, but preliminary observations of the commercial catch suggest an average octopus body weight of 700 g. By applying this weight to the recreational catch, an estimated 8 t of octopus were retained by recreational fishers in Cockburn Sound in 2000/01.

Fishing effort/access level

Commercial fishing effort

Commercial fishing effort expended in the capture of finfish in Cockburn Sound is difficult to measure accurately because of the number of fisheries and fishing methods associated with the capture of each species. Fishing effort is measured here as the number of fishing boat days associated with finfish catches (excluding pot catches) from the Cockburn Sound (Line and Pot) and the Cockburn Sound (Fish Net) Managed Fisheries, plus the days fished in the West Coast Beach Bait where non-bait species were caught. This provides an approximate measure of the overall commercial effort expended in the capture of finfish in Cockburn Sound.

Annual commercial fishing effort associated with finfish landings in Cockburn Sound increased during the 1980s and then stabilised at 1,200 – 1,400 boat days per year during the early 1990s (Cockburn Sound Figure 3). It declined to 835 boat days in 1997 before rising to a record high of 1,468 boat days in 1999. After 1999, annual effort steadily declined and reached a record low of 353 boat days in 2005. In 2006 the number of boat days increased slightly to 461 and then declined again in 2007 to 409 boat days. The decline in commercial effort after 1999 reflected a reduction in the number of active fishers operating in Cockburn Sound.

Since the early 1990s, there has been a progressive decline in the number of commercial licences operating in Cockburn Sound as a result of voluntary Fishery Adjustment Schemes. In the early 1990s, there were about 45 licensees in the Cockburn Sound (Line and Pot) fishery and 6 licensees in the Cockburn Sound (Fish Net) fishery. Not all of these licensees were active in each fishery. From 1996 to 1999, there were 34 line and pot and 6 fish net licensees. In May 2000, these numbers were reduced to 26 and 2, respectively. In April 2003, these numbers were further reduced to 13 and 1.

The reductions in these 2 fisheries effectively eliminated a

substantial amount of latent effort (inactive licences) that previously existed in Cockburn Sound.

Since 2003, the number of licenses in these 2 fisheries has been constant (1 Fish Net licence and 13 Line and Pot licenses) and this stability is reflected in the total reported effort. Total annual effort was relatively stable and averaged 440 boat days per year from 2003 to 2007 (Cockburn Sound Figure 3).

In contrast to finfish-related effort in Cockburn Sound, the commercial effort associated with the capture of octopus has increased recently. Octopus is mainly caught using pipes or pots. The recent increase in effort is associated with an increase in the use of pipes, which became the main method of capture after 2003 and is now the basis of the developing octopus fishery. Current management arrangements allow an unlimited number of octopus pipes to be deployed by licensees in the Cockburn Sound (Line and Pot) fishery.

From 2000 to 2004, the total number of fishing boat days spent using these methods in Cockburn Sound was stable at approximately 275 per year. Effort then increased and was 498 days in 2005 and 451 days in 2006. In 2007, the effort declined to 274 days, as some licensees chose to operate in the ocean blocks outside of Cockburn Sound.

Recreational fishing effort

The national recreational fishing survey in 2000/01 estimated that the vast majority of recreational fishing effort in Cockburn Sound was by line fishing (bait or lure). This method was estimated to have been used in 94% of boat-based fishing events and 84% of shore-based fishing events during the survey period. Virtually all recreational landings of finfish and squid were taken by line fishing methods. Octopus was caught by hand.

Approximately 48,000 boat-based line fishing events and 145,000 shore-based line fishing events were estimated to have occurred in Cockburn Sound during the 2000/01 survey period.

In 2000/01, considerably more shore-based line fishing occurred in the northern area of Cockburn Sound (north of Woodman Point) than in the southern area (south of Woodman Point) (84% and 16% of events, respectively). In contrast, the amount of boat-based line fishing was similar in both areas.

Stock Assessment

See separate status reports for assessments of Australian herring, pink snapper, tailor and blue swimmer crabs, elsewhere in this volume.

Assessment complete: Preliminary
Breeding stock levels: Not assessed

Southern sea garfish: Southern sea garfish are distributed across southern Australia from Kalbarri, WA, to Eden, New South Wales, and Tasmania. Genetic differences suggest that there is limited mixing between sea garfish populations on the lower west and south coasts of WA and that these should be managed as separate stocks (Donnellan *et al.* 2000). Until finer spatial scale information about stock structure becomes available, garfish caught in Cockburn Sound and elsewhere on the lower west coast are assumed to belong to a single breeding stock.

The breeding stock level of sea garfish on the west coast is currently not assessed. Fishery catch rates provide a relative annual index of adult abundance in this region.

Sea garfish has been targeted in a relatively consistent manner by the Cockburn Sound (Fish Net) Fishery since 1995. Thus, CPUE from this commercial fishery provides a useful long-term index of stock abundance. From 1995 to 2007 there was a downward trend in CPUE, suggesting a gradual decline in the west coast garfish stock level over this period. The CPUE trend was very similar to the total west coast catch trend, suggesting that annual variations in the catches are strongly influenced by annual variations in stock abundance. A pronounced peak in catch level and CPUE in 1999 possibly reflected strong garfish recruitment at this time.

The recreational sector is estimated to take about 70% of total west coast landings. A comprehensive assessment of garfish stock status requires more information from this sector than is currently available. In particular, an estimated 65% of the total recreational garfish landings in the west coast region are taken by shore-based fishers. More up-to-date information about the shore-based catch is required to assess the impact by the recreational sector on the west coast garfish stock.

Gloomy octopus: Gloomy octopus occur along the Western Australian coast from Exmouth Gulf to Albany. Adults are benthic but the larvae are planktonic and can occur up to 65 km from shore (Joll 1983). The stock structure is not known, but the dispersal of larvae by ocean currents probably ensures a genetically homogeneous stock along the west coast. At least some of the recruitment to Cockburn Sound is probably by larvae spawned elsewhere. Octopi in Cockburn Sound are assumed to belong to a single west coast breeding stock.

The breeding stock level of octopus on the west coast is currently not assessed. Fishery catch rates in Cockburn Sound, using unbaited pipes as the method of capture, provide a relative annual index of octopus abundance. A mean annual catch rate is calculated from data supplied by commercial fishers in voluntary daily log books since 2003. The annual catch rate in Cockburn Sound was stable from 2003 to 2006 but increased in 2007. This can be attributed to a combination of reduced effort and improved fisher knowledge and gear technology.

Gloomy octopus have a short life cycle and attain a maximum age of 12 to 18 months. Each female spawns a single egg mass and then dies shortly afterwards (Joll 1983). Therefore, fishery landings are based on a single-year class and the population is replaced annually. If octopi in Cockburn Sound are mainly derived from spawning elsewhere on the west coast, then local recruitment will be independent of fishing pressure within Cockburn Sound.

Non-Retained Species

Bycatch species impact: Low

The small-scale commercial fisheries that operate in Cockburn Sound use lines and mesh nets. Targeted species are the dominant component of the finfish catch and minimal quantities of discarded bycatch are generated, as virtually all finfish species taken are marketed. Methods used to catch cephalopods are highly specific and result in virtually no bycatch of other species.

The recreational sector, which mainly uses line-based methods in Cockburn Sound, probably catches and releases a significant number of non-target species and undersized fish. This impact has not been assessed.

Protected species interaction: Not assessed

Ecosystem Effects

Food chain effects: Not assessed

Garfish and herring are consumed by a wide range of predators including larger fish, cetaceans and seabirds. Fishing may reduce the availability of prey to these predators.

Octopi are major predators of rock lobster. Higher fishery landings of octopus in Cockburn Sound may reduce localised predation of lobster and other species consumed by octopi.

Habitat effects: Low

The commercial fishing methods used in Cockburn Sound to target finfish and cephalopods do not impact significantly on the habitat.

Social Effects

During 2007, the total number of crew fishing for finfish in the Cockburn Sound (Line and Pot) Managed Fishery and Cockburn Sound (Fish Net) Managed Fishery was approximately 9. Landings from these fisheries are used to supply restaurant and retail sectors in the Perth metropolitan area.

Cockburn Sound is located within the Perth metropolitan area and is a very popular site for recreational activities including fishing and snorkeling.

Economic Effects

Estimated annual value (to fishers) for year 2007: \$159,223 (finfish)
\$142,380 (cephalopods)

The annual value of this fishery is estimated from Perth market prices for each species. These values more accurately reflect the prices paid to Cockburn Sound fishers than state-wide average prices. In particular, the average price paid for Australian herring on the Perth metropolitan fresh fish market is significantly greater than the average state-wide price, which is greatly influenced by the large catch of the herring trap net fishery that is often sold at a lower price as bait for the rock lobster fishery.

Fishery Governance

Target catch range: 30 – 112 tonnes (finfish only)

The target catch range for this fishery relates to non-bait finfish only. It was derived by applying an auto-regressive moving average quality control procedure to the annual catches from 1983 to 2002, subject to the corresponding fishing effort. The confidence intervals were obtained by estimating the variation of the observations compared with the variation of the predictions for the 20 years to 2002.

The target catch range assumes that future fishing effort will remain between 2000 and 2002 levels, although effort since

2004 has been substantially lower. The 2007 catch of 35.2 t was relatively low, but still within the target range. Relatively low effort levels are expected to continue in this fishery and will necessitate a revision of the target catch range in the future.

Current fishing level: Acceptable

The level of commercial fishing for sea garfish on the west coast is acceptable. The Cockburn Sound (Fish Net) fishery is responsible for approximately 85% of west coast commercial garfish landings. Effort in this fishery was substantially reduced after the late 1990s and is now at a historically low and stable level. Management arrangements effectively limit the maximum effort (and therefore the catch) in this fishery.

Recreational fishers, mainly shore-based, take an estimated 70% of the total west coast catch of sea garfish. However, the current catch level is uncertain because no estimates of shore-based recreational catch or effort within the last 5 years are available from the west coast region.

Garfish is listed as a Category 3 (low risk) species. There is no legal size limit. Available data indicate that the current recreational daily bag limit of 40 fish is rarely achieved and so does not constrain catch levels. Given the apparent decline in stock level over the past decade, as indicated by commercial catch trends, it is of concern that the total west coast catch level is essentially unconstrained under current management arrangements.

The recreational fishing level is probably acceptable, but more information about the recreational catch is needed and a review of the management of the recreational fishery is warranted.

The current catch level of octopus in Cockburn Sound is acceptable, although recent research indicates that nearly all of the Cockburn Sound octopus catch are juveniles that are yet to reproduce. In 2007, the majority (~80%) of octopus landings in the west coast region were taken by the rock lobster fishery, operating outside of Cockburn Sound. By comparison, the impact on the west coast octopus stock by fishing within Cockburn Sound was relatively low.

The octopus catch rate within Cockburn Sound has been stable for the last few years, indicating that recent recruitment has been adequate to maintain the catch level. At the same time, the octopus fishery in Cockburn Sound should continue to be closely monitored, especially while catch and effort levels continue to rise. The commercial catch has risen dramatically since 2000. In the Cockburn Sound (Pot and Line) Fishery, there are a limited number of licensees but they can deploy an unlimited number of octopus pots/pipes.

In the west coast region, recreational fishers are subject to a daily bag limit of 15 cephalopods (i.e. all octopus, squid and cuttlefish combined). A boat limit of 30 applies when 2 or more fishers are aboard.

New management initiatives (2007/08)

The appropriateness of the timing of the pink snapper fishing closure will be reviewed to ensure the closure adequately covers the peak spawning period. Large pink snapper are known to enter Cockburn Sound in early summer where they form spawning aggregations, although the exact timing of the peak spawning

period varies from year-to-year due to environmental conditions and moon phases. A government policy to eventually phase-out commercial fishing for pink snapper in Cockburn Sound is likely to affect catches in the future.

A state-wide prohibition on the take of shark by all commercial fishers was implemented in November 2006. Under this initiative, all species of shark are commercially protected unless an authorisation specifically entitles a commercial fisher to take shark. No authorisations have been issued within Cockburn Sound.

External Factors

Annual variations in the strength of the Leeuwin Current influence the abundance and catch rate of Australian herring on the west coast.

The abundance of sea garfish, octopus and other target species in Cockburn Sound is likely to be affected by the quantity and quality of coastal habitats (especially seagrass) that are available for spawning, feeding and/or nursery areas. Since the 1950s, approximately 80% of the seagrass meadows in Cockburn Sound have been lost as a result of environmental degradation (Cockburn Sound Management Council 2005).

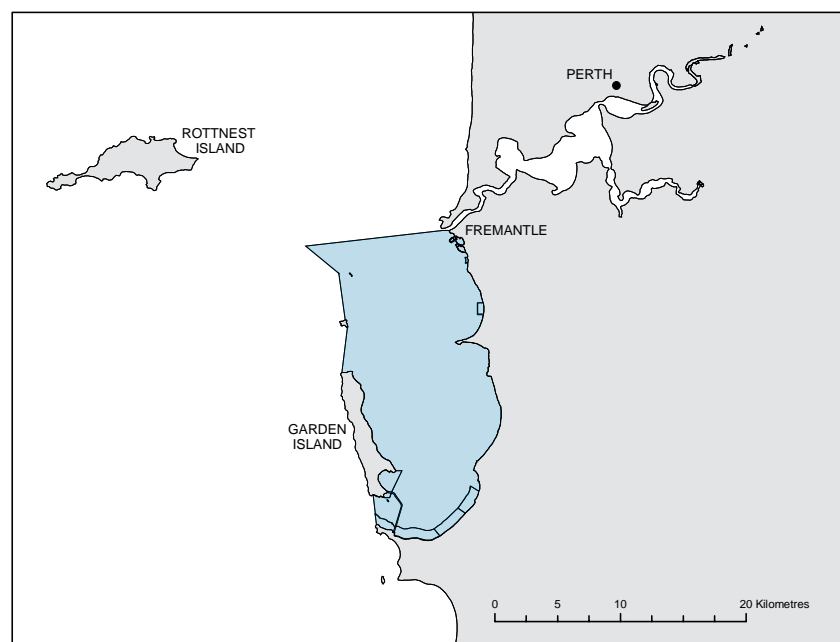
COCKBURN SOUND TABLE 1

The catch, effort and the recreational catch share of the total catch of key recreational target species in Cockburn Sound during 2000-2001 estimated by the National Recreational and Indigenous Fishing Survey.

Estimated Recreational Catch 2000 – 2001			
Finfish Species	Tonnes (t)	Percentage from shore	Percentage from boat
Australian herring	62	76	24
Skipjack	27	57	43
Whiting	26	20	80
Garfish	18	99	1
Tailor	17	98	2
Dhufish	14	0	100
Pink snapper	11	0	100
Silver bream	7	95	5
Cephalopod	Tonnes (t)	Percentage from shore	Percentage from boat
Squid	17	8	82
Octopus	8	0	100
Effort	Days fished (line fishing events only)		
Boat	66,700		
Shore	154,000		
Recreational catch share*	80%		

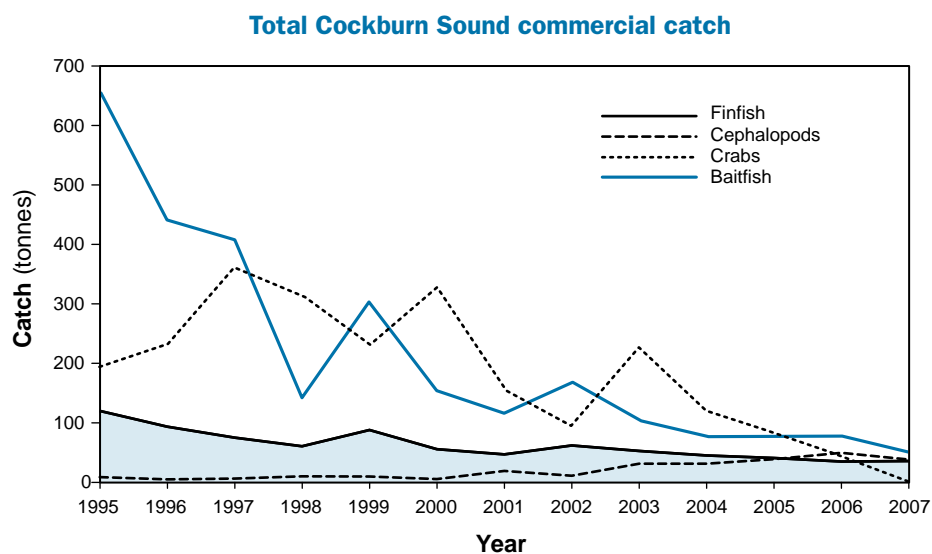
*Note:

Recreational catch share is expressed as a percentage of combined (recreational and commercial) catch for the key finfish species (listed above) only.

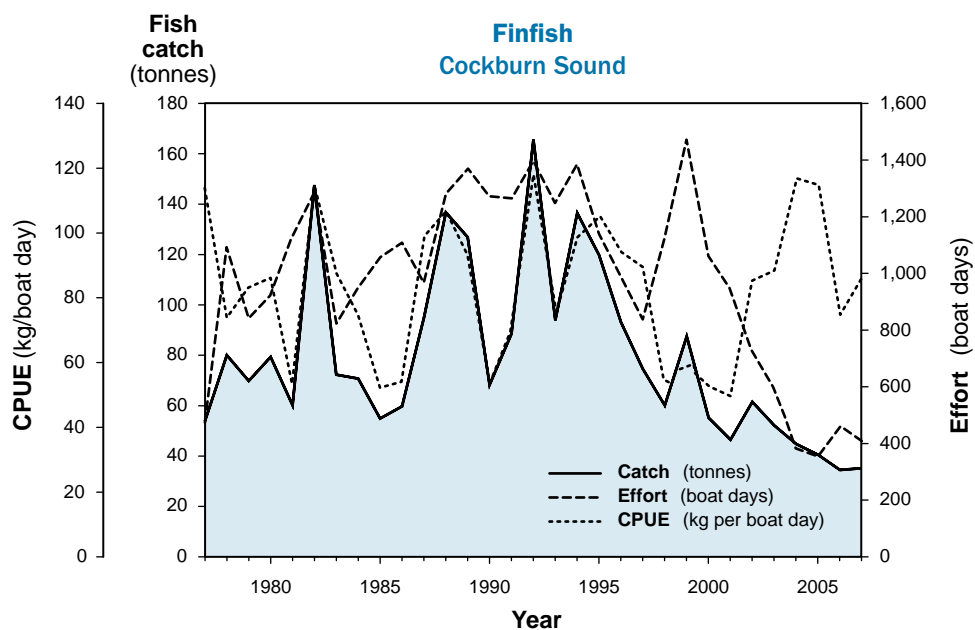


COCKBURN SOUND FIGURE 1.

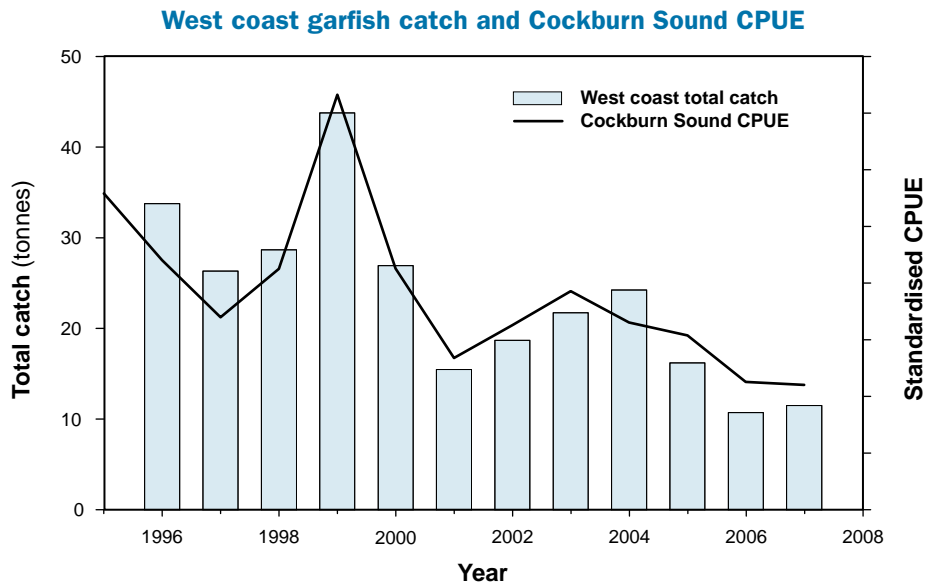
Boundaries of the Cockburn Sound (Fish Net) and Cockburn Sound (Line and Pot) Managed Fisheries.

**COCKBURN SOUND FIGURE 2**

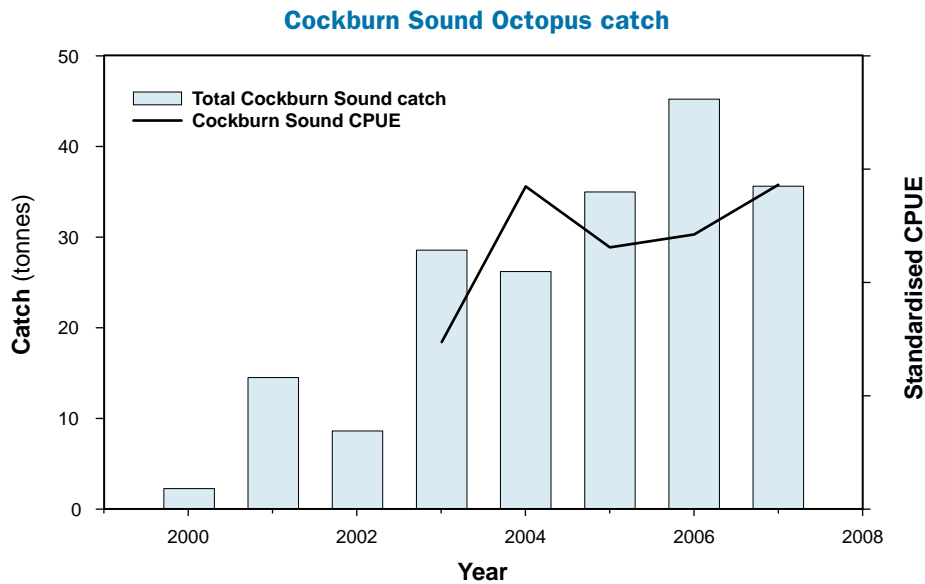
Total annual landings in Cockburn Sound by all commercial fisheries from 1995 to 2007. Finfish (non-baitfish) and cephalopods are mostly taken by the Cockburn Sound (Fish Net) and Cockburn Sound (Line and Pot) Managed Fisheries, as described in this report. Crabs and baitfish are mostly taken by the Cockburn Sound (Crab), West Coast Purse Seine and West Coast Beach Bait Managed Fisheries.

**COCKBURN SOUND FIGURE 3**

The annual catch, effort and catch per unit effort (CPUE) for finfish (excluding bait fish) for the Cockburn Sound fisheries over the period 1977 – 2007.



COCKBURN SOUND FIGURE 4
Total annual commercial catch in West Coast region and Cockburn Sound (Fish Net) Fishery standardised CPUE for sea garfish over the period 1996 – 2007.



COCKBURN SOUND FIGURE 5
Annual Cockburn Sound commercial catch and standardised Cockburn Sound commercial log book CPUE for octopus over the period 2000 – 2007.

WEST COAST BIOREGION
GASCOYNE COAST BIOREGION
NORTH COAST BIOREGION
SOUTH COAST BIOREGION
NORTHERN INLAND BIOREGION
SOUTHERN INLAND BIOREGION
STATE-WIDE
REFERENCES AND APPENDICES

West Coast Beach Bait Managed Fishery Status Report

T. Leary and B. Molony

Management input from N. Chambers

Fishery Description

The West Coast Beach Bait Managed Fishery is reported together with the much larger South West Beach Seine (SWBS) Fishery, as both primarily target whitebait (*Hyperlophus vittatus*). In addition to whitebait these fisheries also capture blue sprat (*Spratelloides robustus*) and mullet (*Mugil cephalus* and *Aldrichetta forsteri*).

The main fishing method is beach seine netting, although non-powered purse seining from small boats is also undertaken. Many of the fishers involved in the SWBS fishery are also involved in the South West Coast Salmon Managed Fishery, which operates in the same area and primarily targets western Australian salmon (*Arripis truttaceus*) using larger beach seine nets than are used for whitebait fishing. Other fish species caught and also reported elsewhere includes Australian herring, tailor and minor incidental captures of squid and octopus.

Governing legislation/fishing authority

West Coast (Beach Bait Fish Net) Management Plan 1995

Fish Resources Management Act 1994

Fish Resources Management Regulations 1995 and subsidiary legislation

Consultation process

Meetings between the Department of Fisheries and industry

Boundaries

The West Coast Beach Bait Managed Fishery extends from the mouth of the Moore River (31° 21.3'S, 115° 29.9'E) north of Perth, to Tim's Thicket (32° 39.2'S, 115° 36.6'E) in the south.

The south-west beach seining fishing activities occur from Tim's Thicket south to Point D'Entrecasteaux (35° 50.5'S, 116° 00'E), with activity typically concentrated in Geographe Bay (Cape Naturaliste to Preston Beach).

Management arrangements

The West Coast Beach Bait managed Fishery is managed primarily through input controls (limited entry and gear restrictions). The future management arrangements for the South-West Beach Seine (SWBS) Fishery (Bunbury sector) have progressed through to the final stages of consultation. Currently, a discrete group of fishers (18 SWBS licensees) operate in this area using similar methods to the managed beach bait fishers in the West Coast Beach Bait Fishery (Metropolitan and Mandurah areas).

Research summary

A significant research project on the biology and stock assessment of whitebait was completed in 1996. Based on this research, the annual catch of whitebait, obtained from the information supplied by fisher's monthly returns, is used as an indicator of abundance to report on the performance of the fishery. There is an ongoing research sampling program designed to predict recruitment of key inshore species, some of which contribute to this fishery.

Retained Species

Commercial landings
(season 2007):

All species 160 tonnes
Whitebait 101 tonnes

The main target species in this fishery is whitebait, of which 101 t were caught in the 2007 season (West Coast Beach Bait Figure 1). Catches of whitebait are discussed here according to the region in which they were landed. Metropolitan and Mandurah landings form part of the West Coast Beach Bait Managed Fishery, while Bunbury landings are from the 'south-west fishery'. Catches in each of the regions have varied significantly from the previous year and large inter-annual fluctuations in catch of whitebait are typical of this fishery (see 'Breeding stock levels').

Metropolitan: There were no whitebait reported catch in this fishery in 2007. This is a continuation of the decline in catches over recent years, reflecting low effort from the remaining fishers. The previous four seasons in the Metropolitan region have all returned minimal catches of below 2 t.

Mandurah: The 2007 whitebait catch at Mandurah was 4 t – half the previous years catch but similar to the 2005 landings.

Bunbury: In contrast to last season's decadal high catch of 221 t, whitebait captured in 2007 totaled 97 tonnes. This is below the long term average for the Bunbury region of 165 t, but not outside of the range of catches observed during the past 20 years.

The total catch of all other species in all regions in this fishery was 59 t, which was dominated by blue sprat, sea and yellow-eye mullets (West Coast Beach Bait Table 1). The catch of blue sprat increased significantly to 28 t from 12 t in 2006, while the catch of sea mullet further decreased to 8 t, down from 13 t landed in 2006.

The catch of yellow-eye mullet (5 t) was a feature of the 2007 season. Catches of other species were slightly lower than last year. Small quantities of pilchards (*Sardinops sagax*) and Australian herring (*Arripis georgianus*), sometimes caught in the beach seine fishery, are included in the catches reported for the West Coast Purse Seine Managed Fishery and the Australian Herring Fishery respectively.

Recreational catch estimate (season 2007):

Nil

There is no recreational fishery for whitebait.

Boat-based recreational catches of some non-whitebait species (e.g. western sand whiting, trevally), also landed by the West Coast Beach Bait Managed Fishery and the South West Beach Seine Fishery, have recently been estimated. Total catches (i.e. boat-based and shore-based) by recreational fishers in the West Coast bioregion were found to be significantly larger than the commercial beach seine catches of these species.

Fishing effort/access level

Overall, for the two fisheries, 23 boats participated during 2007, with 16 reporting catches of whitebait. This is less than the previous year's total of 19 boats landing whitebait.

Stock Assessment

Assessment complete: Yes

Breeding stock levels: Adequate

Given the schooling behaviour of whitebait (and most of the other retained species), the fishers' methods of targeting schools and the way the effort data are recorded on the monthly returns, these data are not useful for using CPUE as an index of abundance for the whitebait stock.

The annual assessment for whitebait stocks utilises total catch as an indicator of abundance, on the assumption that catchability remains stable but that fishing effort adjusts, so as to take a similar proportion of the available stock in all years. The region of the fishery south of Mandurah currently contributes nearly all of the total whitebait catch and thus catches from the 'Bunbury' region now dominate overall trends (West Coast Beach Bait Figure 1).

Previous modeling and plankton sampling indicate that the typical stock size of whitebait is probably less than 1,000 t for the entire west coast. The cyclical nature of the fishery, whereby very good catches (usually related to a strong Leeuwin Current during the previous year) were often followed by one to two years of low catches, suggests that breeding stocks may become a limiting factor in years following environmentally-driven low recruitment.

The combined fishery catch of 101 t whilst at the lower end of the range of the acceptable catch is not unusual for this fishery, given the strong influence that environmental conditions appear to have on the recruitment of whitebait.

Non-Retained Species

Bycatch species impact: Low

There is typically little non-retained bycatch in the targeted whitebait fishery. Where multi-species schools occur, for example of mixed whitebait and juvenile pilchards, catches are released because it is not economical to sort the catch. Most of the catch is saleable.

Protected species interaction: Negligible

The deployment of beach seine nets in this fishery is based on visual detection of fish schools and, as such, any larger protected species can easily be seen and avoided. Furthermore, few individuals of protected species occur in the near-shore fishing areas, which are mainly sandy habitats. Data from monthly returns now include mandatory wildlife interaction reports, but are not currently available for this reporting period and will be reported in future years.

Food chain effects: Low

The highly variable recruitment cycle of whitebait, apparently related to oceanographic effects, means that predatory birds and fish cannot rely solely on the availability of whitebait as a major food source in all years. Furthermore, the constraints of the beach seine gear and fishing method largely limit fishing to within 80 metres of the shore in accessible areas. However, stocks of whitebait are more widely distributed, suggesting that natural predators have greater access to whitebait than does the fishery.

If catches in the Perth metropolitan and Mandurah sectors of the fishery (currently the 'managed' component of the fishery) were to increase, there might be some localised resource conflict between some species of birds (e.g. little penguins) and fishers. However, in comparison to increasing environmental pressures, and under current licensing arrangements and effort levels, this is unlikely to be a significant issue.

Habitat effects: Negligible

All fishing occurs over shallow sandy substrate. Near-shore sand habitats are naturally dynamic environments and resident infauna are adapted to cope with regular physical disturbances; thus the impact of the relatively small amount of very light fishing gear (fine gauge nets) would be negligible. Similarly, sandy beaches bear the traffic of fishers' vehicles but are subject to considerable natural cycles of erosion and accretion.

Social Effects

In 2007 a total of 23 boats, involving 59 crew, participated in the beach bait fishery.

Economic Effects

Estimated annual value (to fishers) for year 2007: \$400,000

The majority of whitebait landed were relatively small fish destined for the human consumption market, typically selling for approximately \$4.00/kg. Thus, in spite of the fall in catch, returns to fishers were on par with last year due to the increase in fish price/kg. A small amount of larger-sized fish from the managed fishery was utilised for recreational bait. Additionally, there was a large catch of high-value blue sprat this year.

Fishery Governance

Target catch range: Whitebait 60 – 275 tonnes

The target range remains the same as last year. The major portion of the whitebait catch is currently taken from the Bunbury sector, where the number of boats with access remains stable.

Current fishing (or effort) level: Acceptable

The catch of the fishery is within the acceptable range and, in combination with the adequate level of breeding stock, the current level of effort is considered to be acceptable.

New management initiatives 2008

The Department of Fisheries continues to progress the south-west beach seine fishing sector to more formal management arrangements, including initiatives raised in and resulting from submissions to the discussion paper, 'Management of the Proposed South-West Beach Seine Fishery' (Fisheries Management Paper No. 184).

External Factors

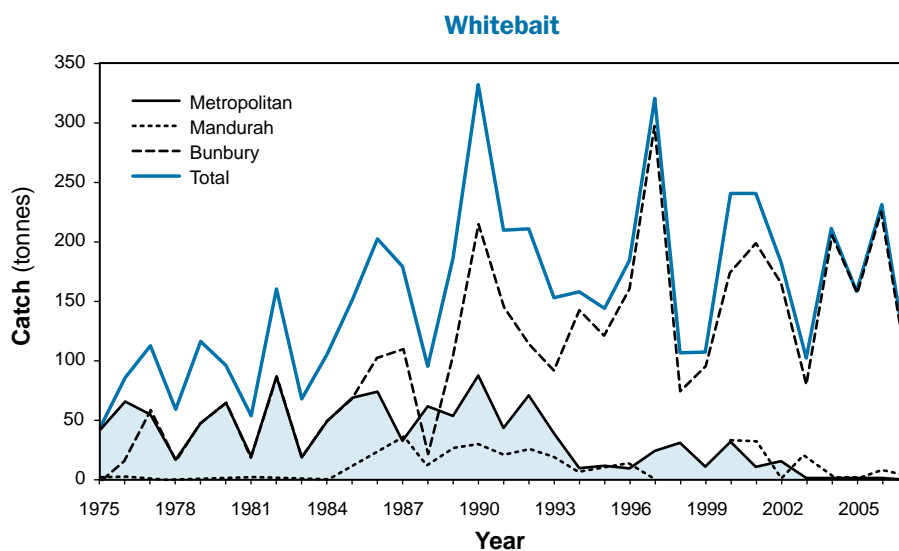
Annual catches in this fishery will most likely continue to exhibit large fluctuations under the influence of oceanographic factors. The fishery will therefore continue to be regulated through limited entry access and gear restrictions.

Increasing urbanisation of WA's south-west region continues to impact on both the fish and this fishery. The increasing trend toward ocean in-fill, marina development and higher use of small vessels in nearshore areas may be affecting fish behaviour. There remains a push for restricted vehicle access to beaches, including those used by commercial fishers, reducing access to fishing areas.

WEST COAST BEACH BAIT TABLE 1

Catches in 2007 of retained species other than whitebait from the West Coast Beach Bait Managed Fishery and south-west beach seining sector.

Species		Catch (tonnes)
Blue sprat	<i>Spratelloides robustus</i>	28
Western sand whiting	<i>Sillago schomburgkii</i>	9
Sea mullet	<i>Mugil cephalus</i>	8
Yellow-eye mullet	<i>Aldrichetta forsteri</i>	5
Anchovy	<i>Engraulis australis</i>	2
Trevally	Carangidae	1
Other fish varieties		1
Total		59



WEST COAST BEACH BAIT FIGURE 1

Annual catches of whitebait along the west coast coast, by fishing region.

West Coast Purse Seine Managed Fishery Status Report

T. Leary and B. Molony

Fishery Description

This fishery is based primarily on the capture of pilchards (*Sardinops sagax*) and the tropical sardine *Sardinella lemuru* (hereafter referred to as sardinella) by purse seine boats in the waters off the west coast of Western Australia. However, the management plan also covers the take of Perth herring (*Nematalosa vlaminghi*), yellowtail scad (*Trachurus novaezelandiae*), Australian anchovy (*Engraulis australis*) and maray (*Etrumeus teres*).

Governing legislation/fishing authority

West Coast Purse Seine Management Plan 1989
West Coast Purse Seine Managed Fishery Licence
Fisheries Notice no. 312 – Purse Seine Prohibition
Fisheries Notice no. 571 – Pilchard Fishing Prohibition
Fisheries Notice no. 476 – Net Hauling Restrictions
Condition 176 on a Fishing Boat Licence
Condition 93 on a Fishing Boat Licence (specific area)

Consultation process

Meetings between the Department of Fisheries and industry

Boundaries

The fishery operates between 33° S latitude and 31° S latitude (the Perth metropolitan fishery) and there are also two purse seine development zones currently operating north and south of this area. The Southern Development Zone, for which there are three operators, covers the waters between 33° S latitude and Cape Leeuwin. The Northern Development Zone covers the waters between 31° S latitude and 22° S latitude and consists of one active operator (whose catch is not currently reported for confidentiality reasons). The Perth metropolitan fishery mainly targets pilchards and sardinella, the Southern Development Zone targets pilchards and the Northern Development Zone targets sardinella.

Management arrangements

This fishery is managed through a combination of input and output controls incorporating limited entry, capacity setting and controls on gear and boat size.

Currently a combined total allowable catch (TAC), covering both the Perth metropolitan fishery and the Southern Development Zone, is set for pilchards and another for other small pelagic species. These TACs are divided amongst the fishery participants, but are not able to be traded. For the 2006/07 licensing period (1 April 2007 – 31 March 2008) there was a TAC of 2,328 t for pilchards, with another 672 t TAC allowed for the other small pelagic species (including sardinella) permitted to be taken by licensees. The Northern Development Zone has a separate TAC.

Research summary

Purse seine catches landed at Fremantle have previously been regularly sampled to estimate population age structure of

pilchards and sardinella. The age structure data is not available for this reporting period.

Retained Species

Commercial landings (season 2007): 139 tonnes

The combined catch of pilchards, sardinella and other minor species for the Perth metropolitan and Southern Development Zone fishery areas decreased 72% in the 2007 reporting season. Last seasons catch was 494 t and in 2005 the catch was 379 t. This year's metropolitan catch comprised of pilchards (46%) and sardinella (35%); and there was a small amount of anchovy and some yellowtail scad landed. Other species landed in the Southern Development Fishery by purse seine method, but reported in the West Coast Beach Bait Managed Fishery (see elsewhere in this document), included 14 t of blue sprat and 2 t of whitebait and nearly 1 t of 'combined other species'.

Recreational catch estimate (season 2007): N/A

Fishing effort/access level

Fishing effort for the Fremantle fleet comprised 168 days – a decrease in effort of 19% from the previous year's 207 days (see 'External Factors' below). It is not possible to estimate effort separately for the different species targeted.

The combined purse seine/beach seine fleet in the Southern Development Zone fished 170 days during 2007 – a doubling of the previous season's effort. However, it is not possible to apportion the amount of effort dedicated solely to purse seine due to the multi-method (and multi-species) nature of the reporting in that zone.

Stock Assessment

Assessment complete: Yes

Breeding stock levels: Adequate

Stock assessment is completed only for pilchards. The time series of 8 fishery-independent spawning biomass surveys conducted between 1993 and 2004 indicated that the pilchard stock off the west coast varies in size between 8,000 and 45,000 tonnes. However, the estimates of spawning biomass in the vicinity of 40,000 tonnes appear to represent exceptional years rather than the typical situation. Furthermore, these estimates have very wide confidence intervals and this level of uncertainty must be considered when using the stock assessment information.

Fluctuations in biomass level are driven by highly variable recruitment, along with environmental factors that may lead to 'replacement' in the Perth metropolitan fishing grounds of pilchards by sardinella in some years. It is believed that at times when both species are present, the pilchard spawning biomass can typify the 'carrying capacity' of the region. For 2007, the catch data, albeit biased by market preference, indicates pilchards and sardinella in roughly equal abundance.

The relatively small catch of pilchards in 2007, well below the accepted harvest rate of 10%, is likely to have negligible effect on the west coast pilchard stock. The small catches of sardinella, in the context of this species' predominantly tropical distribution, are also expected to have a minimal impact on the overall spawning stock for this species

WEST COAST
BIOREGIONGASCOYNE COAST
BIOREGIONNORTH COAST
BIOREGIONSOUTH COAST
BIOREGIONNORTHERN INLAND
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BIOREGION

STATE-WIDE

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Non-Retained Species

Bycatch species impact: Low

This fishery targets schools of small pelagic fish so incidental bycatch is insignificant, but may occasionally include fish that are predators of the target species or other fish species accidentally captured when the net contacts the benthos.

Protected species interaction: Low

There is no evidence to indicate any major interactions between protected species and the purse seine industry in the west coast region. Data from monthly catch returns now include mandatory wildlife interaction reports, but are not currently available for this reporting period and will be reported in future years

Ecosystem Effects

Food chain effects: Moderate

Ecosystem structure and function is reliant on flows of energy within an interconnected 'web'. Small pelagic fish occupy a pivotal role as a conduit between primary (phytoplankton) and secondary (zooplankton) production and the higher trophic levels. The characteristics of small pelagics mean they are available as food for a number of populations of larger animals including predatory fish, pinnipeds, cetaceans and bird species, including penguins.

Catches of small pelagics on the west coast are carefully constrained so as to leave a majority of the estimated biomass available to predators. The quota for pilchards and other small pelagic species is set at a maximum of 10% of the spawning biomass, leaving more than 90% of the total biomass available to natural predators. The current catch is also significantly lower than the 10% limit.

Habitat effects: Negligible

Purse seining generally has little direct effect on the habitat. Although the purse seine gear used in this fishery will contact the sea floor in some fishing areas, the relatively light construction of the gear suggests that there is no significant impact occurring to the benthos. Areas of hard reef are specifically avoided as it is hazardous to the fishing gear.

Social Effects

The Fremantle fishery employed approximately 10 full-time equivalent workers (crew and processors) – a drop of 45% over last season. The workforce required to catch, process and distribute the purse seine catch from the Bunbury region is difficult to separate from the workforce employed by the larger beach seine fishery. Operators from the combined Geographe Bay fishery employed 20 crew in the 2007 season.

Economic Effects

Estimated annual value (to fishers) for year 2007: \$149,000

Small pelagic fish caught on the west coast were destined for human consumption (as 'Fremantle sardines'), recreational bait, commercial rock lobster and finfish trap bait. The price paid to the boats in 2007 amounted to an average price per kilogram of \$1.20 for both pilchards and sardinella destined for human consumption and angling bait, while pilchards sold for rock lobster bait attracted a lower price of \$0.80/kg. The number and size of operators in the nationwide recreational bait market and the relatively lower cost of imported product have adversely affected the margin on bait and thus the viability of fishing operations.

Fishery Governance

Target catch (or effort) range: Not available

The acceptable maximum catch is governed by changes in the TACs for pilchards and other small pelagic fish. The combined TAC of 3,000 t for all species was set in 2004/05 and has been carried over in future years. The irregular behaviour of this fishery in recent years precludes estimation of a target effort range at this time.

The anticipated introduction of a formal quota system (see below) may, depending on market forces, bring some stability to the fishery, after which it may be appropriate to estimate an acceptable effort range.

Current fishing (or effort) level: Acceptable

The small catch of pilchards, well below the maximum accepted harvest rate of 10%, is likely to have negligible effect on the West Coast pilchard stock and therefore the current level of fishing activity is regarded as acceptable.

New management initiatives (2007/08)

A future management plan for the west coast incorporating the Southern and Northern Development Zones has received Ministerial approval. These two areas along with the Perth Metropolitan fishery, will be managed as three zones within the single West Coast Purse Seine Fishery, with all operators fishing under a managed fishery licence rather than under an endorsement on their fishing boat licence.

The implementation of the new management plan will move the fishery to a formal quota system with tradeable, individually transferable quota (ITQ) units and a TAC. The ITQ unit values will be reviewed annually and changed as required, depending on stock levels.

External Factors

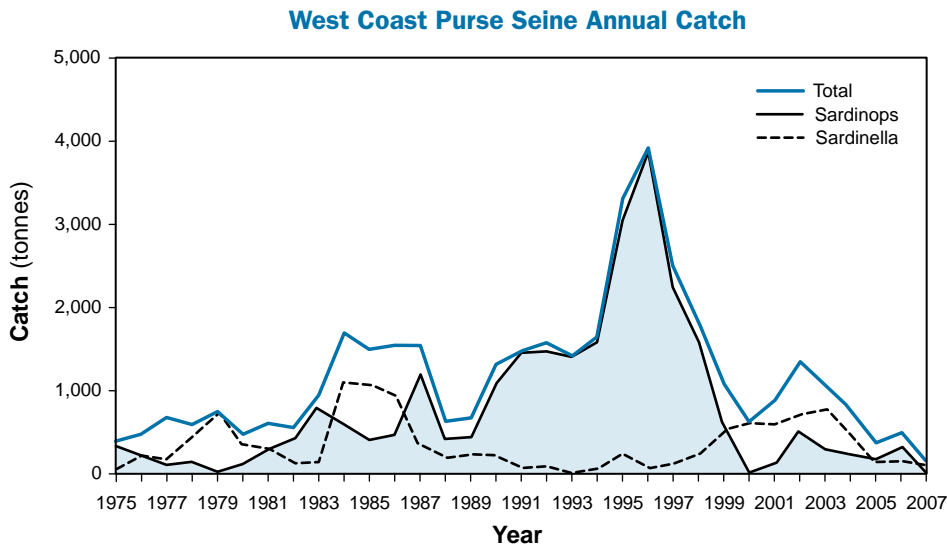
Market forces continue to have a large impact on the fishery. The South Australian purse seine fishery, which catches considerably larger quantities of pilchards than the WA purse seine fisheries, has taken up a significant part of the Australian bait market, thus reducing demand and prices for the Fremantle product. The rising Australian dollar has made it more competitive for bait wholesalers to import bait products at relatively lower prices.

Intra-state competition from the south coast (in particular Albany) has taken a share of the west coast market, due to an ability to supply pilchards on a consistent basis. A small

specialist market remains for human consumption products, most typically sold as ‘Fremantle sardines’. The demand for sardinella is also variable, predominately determined by the price and availability of alternative commercial trap and line baits.

Like other fisheries in WA, there is a problem with maintaining trained crew and processing staff.

The behaviour of both sardinella and pilchard populations are reported by fishers as being less predictable than in past decades. It appears that the influence of oceanographic variation plays a strong role in determining the relative availability and catchability of the pilchards and sardinella.



WEST COAST PURSE SEINE FIGURE 1

Annual catches of pilchards (*Sardinops*) and sardinella in the West Coast Purse Seine Fishery.

WEST COAST BIOREGION
GASCOYNE COAST BIOREGION
NORTH COAST BIOREGION
SOUTH COAST BIOREGION
NORTHERN INLAND BIOREGION
SOUTHERN INLAND BIOREGION
STATE-WIDE
REFERENCES AND APPENDICES

West Coast Demersal Scalefish Fishery Status Report

D. Fairclough, I. Keay, C. Johnson and E. Lai

Management input from N. Harrison and T. Nicholas

Fishery Description

The West Coast Demersal Scalefish Fishery (WCDSF) includes line fishing by commercial, charter and recreational sectors. Fishers in each sector primarily target West Australian dhufish (*Glaucosoma hebraicum*) and pink snapper (*Pagrus auratus*), but also catch substantial numbers of other species, such as emperors (*Lethrinus nebulosus*, *Lethrinus miniatus*), baldchin groper (*Choerodon rubescens*) and breaksea cod *Epinephelides armatus*.

Commercial

During the first six months of the 2007/08 financial year (1 July 2007 through 31 December 2007), commercial fishing in the WCDSF comprised open-access wetlining by both wetline-only vessels and the wetline activities of vessels with licences for other managed commercial fisheries. From 1 January 2008, the fishery ceased to be “open-access” and vessels operating in the West Coast Demersal Scalefish (Interim) Managed Fishery do so under a permit.

Handlines and droplines are the main fishing methods used in this fishery, although demersal species are also caught by demersal gillnet and demersal longlines used in other managed commercial fisheries, e.g. the West Coast Demersal Gillnet and Demersal Longline (Interim) Managed Fishery.

Fishing and Aquatic Tour Industry (Charter)

Demersal scalefish are targeted by the fishing activities of the charter boat industry in the West Coast bioregion. Line fishing is the main method used by operators in the charter industry.

Recreational

Recreational fishers that target demersal species in the WCDSF are almost exclusively boat-based. Line fishing is the main method used by recreational fishers, although spear fishing also occurs in relatively shallow waters, i.e. less than 20 metres deep.

Governing legislation/fishing authority

Commercial

Fish Resources Management Regulations 1995

Fishing Boat Licence

West Coast Demersal Scalefish (Interim) Management Plan 2007

West Coast Demersal Scalefish Interim Managed Fishery Permit

Fishing and Aquatic Tour Industry (Charter)

Fish Resources Management Regulations 1995 and recreational fishing regulations

Fishing Tour Operator Licence and/or Aquatic Eco-Tourism Licence

Recreational

Recreational fishing regulations

Consultation process

Commercial

Permit holders in the West Coast Demersal Scalefish Interim Managed Fishery

Fishing and Aquatic Tour Industry (Charter)

Recreational Fisheries Advisory Committee (RFAC) and Charter Boat Owners & Operators Association

Recreational

RFAC and a network of 12 Regional Recreational Fishing Advisory Committees

Boundaries

Commercial

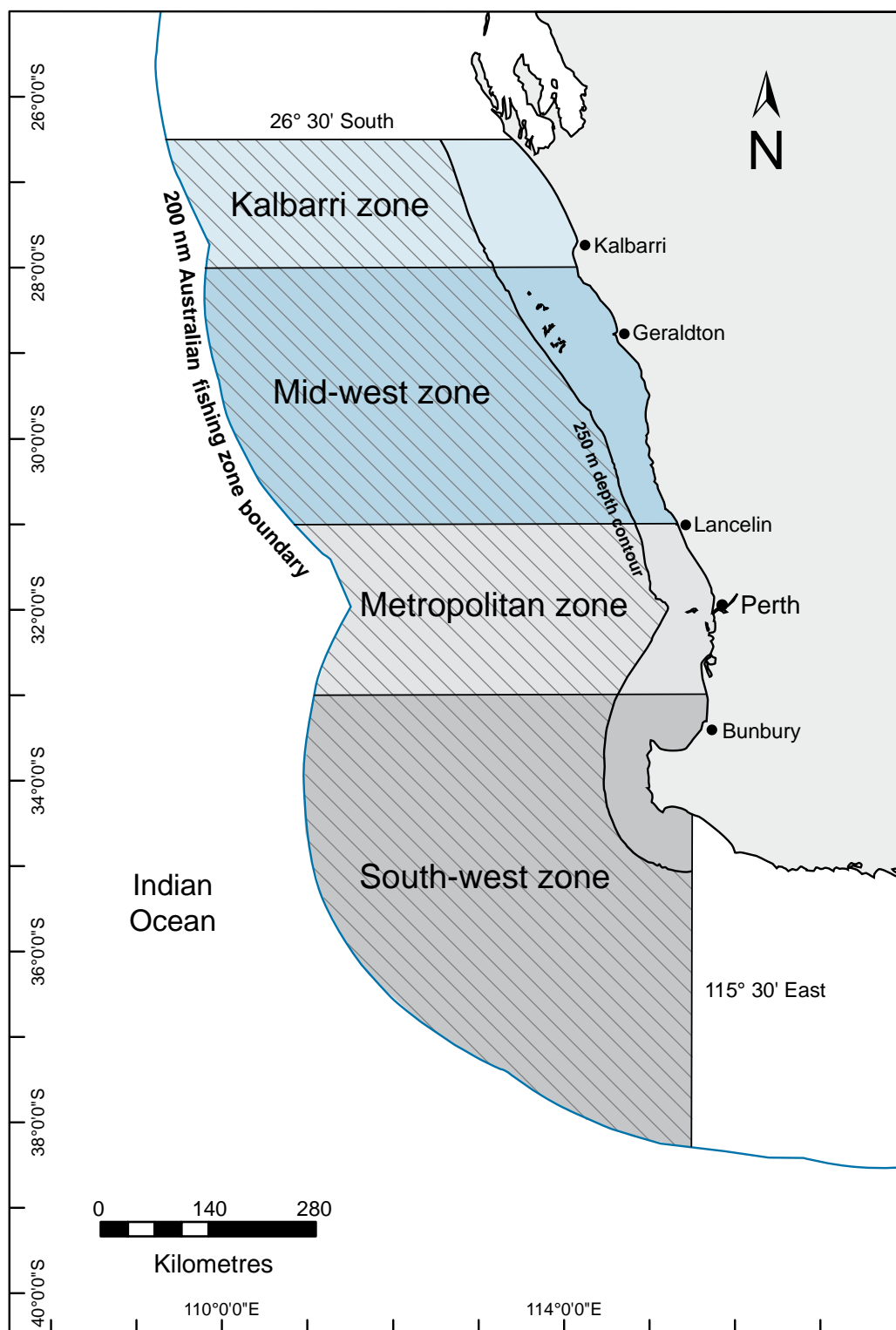
On 1 January 2008, the West Coast Demersal Scalefish (Interim) Management Plan 2007 commenced operation. This brought to a close the open-access wetline fishery in the West Coast bioregion. Since that time, only those persons authorised under a West Coast Demersal Scalefish Interim Managed Fishery Permit have been permitted to fish by line, store and transport demersal scalefish in, or sell demersal scalefish taken from, the waters of the fishery.

The commercial fishery encompasses the waters of the Indian Ocean on the west coast south of 26°30' S and west of longitude 115°30' E and extending seaward to the boundary of the Australian Fishing Zone (AFZ). The commercial fishery is divided into five management zones, comprising four inshore zones and one offshore zone. The inshore zones, i.e. Kalbarri (26°30' S to 28° S), mid-west (28° S to 31° S), metropolitan (31° S to 33° S) and south-west (33° S to 115°30' E), extend outwards to the 250-metre depth contour, while the offshore zone includes waters from 26°30' S to 115°30' E and from the 250-metre depth contour to the boundary of the AFZ (West Coast Demersal Scalefish Figure 1).

A closure to commercial fishing was introduced on 15 November 2007 in the Metropolitan Inshore zone (extending between 31° S and 33° S and between the shoreline and the 250-metre depth contour) to operators in the West Coast Demersal Scalefish Interim Managed Fishery and the West Coast Demersal Gillnet and Demersal Longline (Interim) Managed Fishery (West Coast Demersal Scalefish Figure 1).

Fishing and Aquatic Tour Industry (Charter)

The West Coast bioregion for the purposes of charter fishing currently encompasses the waters of the Indian Ocean south of latitude 27° S and west of longitude 115°30' E, although it is proposed to change the northern boundary to 26°30' S in line with the commercial sector. The bioregion is divided into four main management zones – Kalbarri, mid-west, metropolitan and south-west. Each zone extends from the coastline to the 200 nautical mile boundary of the AFZ (West Coast Demersal Scalefish Figure 1).



WEST COAST DEMERSAL SCALEFISH FIGURE 1

Map showing the boundaries of the West Coast Demersal Scalefish Fishery. Note the northern boundary of 26°30' S applies to the commercial fishery as at January 1 2008 and is the proposed future boundary for the charter and recreational fishery. The Kalbarri (□), Mid-west (□), Metropolitan (□) and South-west (□) zones applicable to the recreational and charter sectors extend from the coast seawards to the Australian Fishing Zone boundary, while for the commercial sector those four zones extend from the coast to the 250 m depth contour. The commercial fishery also comprises an offshore zone (▨), which encompasses the waters from the 250 m depth contour outwards to the boundary of the 200 nmile AFZ and from 26°30' S to 115°30' E.

WEST COAST
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STATE-WIDE

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Recreational

The boundaries and management zones applicable to the recreational sector of the WCDSF are the same as those for the charter sector.

Management arrangements

Commercial

In the years prior to the 2007/08 financial year and in the first half of 2007/08, catch in the WCDSF had been limited only by the overall ceiling on the number of fishing boat licences. This “open-access” arrangement allowed fishers in the WCDSF to operate under the authority of a Fishing Boat Licence and a Commercial Fishing Licence, rather than a managed fishery licence or other form of explicit authorisation (management plans, regulations and orders) to take species and use methods which are not otherwise prohibited under the *Fish Resources Management Act 1994*.

The management rules included minimum and maximum legal length limits, some gear limitations and closures to fishing for some or all species at specific locations, e.g. seasonal spawning closures for baldchin groper at the Houtman Abrolhos Islands and pink snapper in Cockburn Sound and “no-fishing” zones in marine parks.

On 29 May 2007, after considering the submissions and comments put forward by the community, the Minister announced his decisions for the future management arrangements of the west coast demersal wetline fishery (Fisheries Management Paper No. 224). The new management arrangements for the ‘West Coast Demersal Scalefish Fishery’ are being implemented in two stages. The first stage commenced at the beginning of 2008, with the introduction of the *West Coast Demersal Scalefish (Interim) Management Plan 2007*.

Under the management plan, fishing will be controlled through input controls (in the form of permits), which restrict access to the different management areas of the fishery, gear restrictions (in the form of maximum numbers of lines and hooks), and Vessel Monitoring System (VMS) requirements. In the second stage, which will occur at the beginning of 2009, transferable entitlement for each zone will be allocated to permits in the form of units that provide entitlement in “hours” and further VMS arrangements will be introduced to allow fishing effort to be monitored and entitlement acquitted accordingly.

Fishers are now required to report their catch using daily/trip statutory fishing returns, which provide the Department of Fisheries with fine-scale reporting (10nm x 10nm blocks) for enhanced catch and effort analyses.

Fishing and Aquatic Tour Industry (Charter)

There are three types of fishing and aquatic tour licence categories.

- **Fishing Tour Operators Licence:** The focus is on fishing, with fishers able to take their fish home at the end of the tour.
- **Restricted Fishing Tour Operators Licence:** The focus is on eco-tourism activities, with clients able to catch fish for a meal during a tour, but no fish are to be taken home at the end of the tour.
- **Aquatic Eco-Tourism Operators Licence:** The focus is entirely on eco-tourism activities and fishing is strictly prohibited.

Within each category, there is the provision for a boat-based operation, a combination land/boat (boat size less than 7.5 m) based operation and a land-based operation. There is a limited number of fishing tour operator licences, which is aimed at managing growing effort in this sector. All fishing is subject to recreational fishing regulations (see below).

In Fisheries Management Paper No. 231 ‘*A Strategy for Managing the Recreational Catch of Demersal Scalefish in the West Coast Bioregion*’, which was released in June 2008, the Minister stated that he is considering a ‘days fished’ regime to control effort, as opposed to reducing catch via a seasonal restriction for fishing of the “Vulnerable Five” species of demersal scalefish. This will help to maintain a viable charter industry. However, any decision will only be made following a consultation process.

Catches reported in this document are from records of fishing from all vessels operating under the Fishing Tour Operators Licence and those vessels that fished operating under the Restricted Fishing Tour Operators Licence.

Recreational

The recreational fishery for west coast demersal scalefish is currently managed through a mix of input controls (e.g. seasonal and spatial closures and size limits), and output controls (e.g. limits on the numbers of fish that can be taken by individuals and boats).

Modifications to existing management arrangements and the introduction of new management arrangements for the recreational sector of the WCDSF were proposed (Fisheries Management Paper Numbers 225 and 228). The aim of the new arrangements, in conjunction with the rationalisation of the commercial sector, was to reduce effort and thus catch in the WCDSF.

Following a public consultation process, the Minister’s decisions were released in June 2008, which are fully described in Fisheries Management Paper No. 231 and include a number of new fishing rules which, where applicable, were due to come into effect on 15 October 2008 for the West Coast bioregion.

These new rules represent an adaptive management approach that is being adopted for the WCDSF. The overall management package will be reviewed as to its effectiveness based on ongoing research that is being conducted to assess the stock recovery.

Research summary

The WCDSF is managed via the use of indicator species. In other words, the health of the stocks of those species is a reflection of the health of stocks in the WCDSF in general. In 2007, results of research identified that overfishing was occurring of the stocks of dhufish and pink snapper in the west coast bioregion and of baldchin groper at the Abrolhos Islands (Wise *et al.*, 2007). These results highlighted the increasing pressure on fish stocks on the west coast as a result of population growth and improving fishing efficiency via the use of modern technology, such as GPS.

A Fisheries Research and Development Corporation (FRDC)-funded project to investigate the variation in age compositions, growth, reproductive biology, mortality and stock structure of dhufish and pink snapper populations was completed in 2006. This detailed the stock assessments of the key indicator species dhufish, pink snapper and baldchin groper in the WCDSF (Wise

et al., 2007). A second part, which reports on the results of the biological studies, is being prepared (St John *et al.*, in prep.).

Monitoring of the age structure of dhufish and snapper from the commercial and recreational sectors in the different management zones of the West Coast bioregion (Kalbarri, Mid-west, Metropolitan and South-west) was conducted in 2006/07 and 2007/08. The age data will be used to update the stock assessments from the above FRDC project and assess the current levels of fishing effort on the stocks, following the range of management changes that occurred in 2007/08.

An FRDC-funded study of the effects of barotrauma on west coast demersal indicator species found that dhufish display high rates of post-release mortality, with almost 90% mortality of fish caught and released in ≥ 45 m of water (St John and Keay, submitted). Pink snapper are more resilient, with little mortality in waters ≤ 30 m deep. However, post-release mortality increased to $> 60\%$ of fish caught and released in 65 m of water.

Numerous anecdotal reports indicate that baldchin groper are highly susceptible to barotrauma. Post-release mortality is influenced not only by the depth of water in which demersal species are caught, but also by the speed at which fish are brought to the surface and by their physical handling and release.

The results of a 12-month recreational creel survey of boat-based fishing in the West Coast bioregion in 2005/06 were published in 2008 (Sumner *et al.*, 2008). The estimated catches of dhufish, pink snapper and baldchin groper caught in 2005/06 increased substantially from the catch in 1995/96 and the effort was more widely dispersed along the west coast. There was a 15.5% increase in nominal effort between the 1995/96 creel survey and this survey, but this result did not account for the increased efficiency of fishing derived over that 10-year period from improving technology, *e.g.* GPS and sounders.

A 12 month phone-diary survey was carried out during 2005/06 to clarify the recreational sector's catch share of the demersal finfish stocks. A follow-up creel and phone-diary survey in the West Coast bioregion commenced in 2008.

The results of a 12-month survey during 2006 of finfish caught by recreational fishers, tour operators, commercial lobster fishers and commercial wetline fishers in the Houtman Abrolhos Islands Fish Habitat Protection Area were published in 2008 (Sumner, 2008). The study found that the majority of fish taken at the islands are caught by commercial fishers, with pink snapper, sweetlip emperor and dhufish constituting a large proportion of that catch. Catches of baldchin groper by rock lobster fishers staying at the islands during the three month rock lobster fishing season are significant.

The collection of commercial wetline and charter catch and effort statistics continued in 2007/08. The 'West Coast Demersal Scalefish Fishery' changed from monthly catch records to daily/trip catch records at the beginning of 2008. A trial of the daily/trip logbooks was conducted in 2006/07 to identify any issues and to ensure that the information collected fulfils research needs for this fishery. The results of this trial are reported in Appendix 4.

Bycatch of demersal scalefish species in the rock lobster fishery was determined from logbooks and at-sea monitoring in 2006/07. Substantial numbers of demersal species, such as breaksea cod and baldchin groper were caught as bycatch in the rock lobster

fishery. Full details are reported in the West Coast Rock Lobster Fishery status report elsewhere in this document.

An FRDC-funded project on spawning aggregations of samson fish and other west coast species was completed (Mackie *et al.*, 2008). This documented the occurrence of spawning aggregations of demersal species such as dhufish, pink snapper and Bight redfish in the West Coast bioregion, which make these species highly susceptible to fishing during their spawning seasons. It also highlighted the importance of incorporating the dynamics of such aggregations into stock assessments and provided a basis for redefining monitoring programs for such species.

A research project funded by the Western Australian Marine Science Institution (Project 4.4.2) and involving the collaboration of the Department of Fisheries, the CSIRO and the Centre for Fish and Fisheries Research at Murdoch University commenced in 2008 to investigate the stock structure of West Australian dhufish, pink snapper and baldchin groper. This project will elucidate the spatial relationships between the different life history stages of those three species. Murdoch University and the CSIRO are using genetic techniques to assist in identifying any sources or 'sinks' of recruitment and how the Western Australian populations are subdivided, if at all, while the Department of Fisheries will use otolith microchemistry to investigate the environments occupied by individual dhufish and snapper during their life.

Retained Species

Commercial production (season 2006/2007):	725 tonnes
Pink snapper:	232 tonnes
Dhufish:	139 tonnes
Baldchin groper:	29 tonnes

Landings

Fishers in the West Coast Demersal Scalefish Fishery (WCDSF) catch a suite of demersal scalefish species, such as West Australian dhufish, pink snapper and baldchin groper. Note that the total catch reported for the WCDSF does not include seafood groups such as cephalopods, mackerels, tunas, sharks and rays that are reported within other managed fisheries and are no longer permitted to be retained by WCDSF wetliners.

In 2006/07, the total catch of demersal scalefish was 725 t, 250 t less than in 2005/06. This decrease in catch was due to the reduced effort in the fishery in 2006/07, as a result of the fewer number of boats fishing in that year (191) compared to the previous year (227).

More than 77 species are caught by wetliners in the WCDSF. Ten species or species groups comprise 91% of the total catch (tonnes) in 2006/07, which includes the three indicator species, *i.e.* dhufish, pink snapper and baldchin groper. Of those species/groups, four typically occupy relatively shallow waters (< 100 m deep), five occur in deeper waters (> 100 m) and one, the Samson fish, is pelagic, but has been recorded in waters up to approximately 200 m deep.

In 2006/07, pink snapper, dhufish and the emperor group (spangled emperor *Lethrinus nebulosus* and sweetlip emperor

Lethrinus miniatus), which primarily occur in shallow waters, contributed 231 t, 139 t and 123 t, respectively, to the total catch of the WCDSF and comprised the majority (68%) of the total catch for the year. Sweetlip emperor constituted 99 t of the catch in the emperor group. Redfish, which includes all of the reported *Centroberyx* species, Samson fish, baldchin groper and ruby snapper comprised 43 t, 36 t, 29 t and 25 t, respectively.

Although catches of most species were lower in 2006/07 as a result of the reduced effort, the catch of ruby snapper doubled from the 12 t reported for 2005/06. Of the other deep water species retained, the catches of hapuku declined approximately 50% from 18 t in 2005/06 to 9.5 t in 2006/07, while those of deepsea trevalla decreased slightly and grey-banded cod increased slightly. Catches of breaksea cod also declined slightly.

As procedures for validating new daily/trip logbook data from the West Coast Demersal Gillnet and Demersal Longline Fishery (WCDGDLF) and Joint Authority Southern Demersal Gillnet and Demersal Longline Fishery (JASDGDLF) have yet to be developed, demersal scalefish catches from those fisheries for 2006/07 are currently unavailable.

Dhufish: The reported total commercial catch of dhufish by the WCDSF in 2006/2007 was 139 t, close to the lower boundary of the target catch range of 125 t. The catch has continued to decrease from that of 2005/06 (181 t) and the recent maximum of 234 t recorded in 2002/2003. Furthermore, the total catch for 2006/07 is well below the average catch for the last 10 years (1997/98 to 2006/07) of 193 t and the long-term average of 171 t (since 1989/90).

In 2006/07, approximately 62 t (45%) of the commercial catch of dhufish was from the mid-west zone, while 35 t (25%) and 29 t (21%) was landed in the south and metropolitan zones, respectively. Only 9% of the catch, *i.e.* 12 t, was landed in the Kalbarri zone in 2006/07 (West Coast Demersal Scalefish Figure 2). Although catches in each of the four zones decreased from those of 2005/06, the largest decrease of 26 t occurred in the mid-west. In contrast, the catch in the south-west only decreased by 3 t.

The percentage of the total catch of dhufish in 2006/07 that was retained in the Kalbarri, mid-west, metro and south-west zones were similar to the long term averages (since 1989/90) for those zones, *i.e.* approximately 10%, 50%, 20% and 20%, respectively. However, since 1989/90, the percentage of the total catch has gradually increased in the Kalbarri zone, while it has decreased in the mid-west and remained relatively stable in the metro and south-west zones.

Pink snapper: The total commercial catch of pink snapper reported in 2006/07 (232 t) decreased from 2005/06 (278 t), a further decline from the high catches of 2003/04 (340 t) and 2004/05 (333 t). The catch in 2006/07 was within the target total catch range of 153 – 254 t, but below the 10 year average of 252 t (1997/98 to 2006/07) and the long-term average since 1989/90 of 250 t (West Coast Demersal Scalefish Figure 3).

Historically, the majority of pink snapper have been caught in the Kalbarri and mid-west zones. In 2006/07, 111 t were retained from the Kalbarri zone and 71 t from the mid-west, representing 48% and 31% of the total catch, respectively. Catches in each of the four zones were between 75% and 85% of the 2005/06 catch.

While the percentage of the total catch of pink snapper in 2006/07 that came from the Kalbarri zone was close to the long-term average of 47% for that zone, there has been an increasing trend since 1989/90. In contrast, the percentage of the total pink snapper catch from the mid-west has been gradually decreasing since 1989/90 and was below the long-term average of 38%. The percentage of the total catch derived from the metropolitan and south-west zones, while still relatively low, has gradually increased.

Baldchin groper: The commercial catch of baldchin groper in 2006/07 was 29 t – a decline from the previous year's catch of 34 t, but which was within the target catch range of 27.5 – 35.5 t. The catch in 2006/07 has continued to decrease since the maximum recorded catch of approximately 41 t in 2002/03 (West Coast Demersal Scalefish Figure 4).

Recreational catch estimate (2006/07): Not available

Last available recreational catch estimate (2005/06):
(including charter) Dhufish 207 tonnes
Pink snapper 57 tonnes
Baldchin groper 38 tonnes

Estimates of recreational catch via creel surveys were not determined during 2006/07, but in terms of the relative importance in catches of commonly targeted species, *e.g.* dhufish and pink snapper, they are likely to have been similar to those of the 2005/06 year. The creel survey of recreational boat-based fishing conducted in 2005/06 demonstrated that catches of the demersal species dhufish, wrasse/gropers (as a group), breaksea cod, pink snapper and baldchin groper retained by recreational fishers ranked 6th, 7th, 9th, 10th and 11th, respectively in terms of numbers (Sumner *et al.*, 2008). Dhufish, pink snapper, baldchin groper, samson fish, breaksea cod and blue morwong ranked 1st, 3rd, 6th, 7th, 9th and 11th, respectively, in terms of weight (tons) in that year.

An estimated 186 t of dhufish were retained during that survey, much greater than the 40 t of pink snapper and 28 t of baldchin groper retained. The majority of the catches of dhufish (78 t) and baldchin groper (19 t) were reported from the mid-west zone, with substantial catches of dhufish (≥ 50 t) in both the metro and south zones. Between 10 t and 15 t of pink snapper was retained from each of those three zones. For the majority of species, there was an increase in the numbers of fish released in comparison to the 1996/97 boat-based fishing survey, which presumably reflects the increased effort in the fishery as a result of increases in the number of people fishing.

Estimated catches of target species by the charter sector in 2006/07 from logbooks submitted were similar to those of 2005/06. Thus, approximately 24 t and 18 t of pink snapper and dhufish were caught, respectively, while 11 t of baldchin groper, 7 t of emperors and 4 t of breaksea cod were taken in that year.

Fishing effort/access level

Commercial

Annual fishing effort by the demersal wetline sector is estimated from the monthly CAES (Catch and Effort Statistics) returns from fishers. This system does not distinguish between 'effort' as time spent targeting or fishing for individual species, but is reported as the number of days when each of those species was

caught. Therefore, the number of effort days for each species can overlap due to the method of recording. For this reason, effort days can only provide a year-to-year comparison of wetline activity for each species.

In the West Coast bioregion during 2006/07, 191 licensed fishing boats line-fished for demersal finfish and 44 of these boats were licensed as 'wetline-only' boats. This represents a decrease from the 227 boats fishing in 2005/06 and the 51 "wetline-only" boats. The lower number of boats fishing in 2006/07 is reflected in the total number of days fished in that year, i.e. a decrease from 10,665 (2005/06) to 8,486 days (2006/07). In 2006/07, 174 boats reported catching dhufish, 181 caught pink snapper and 122 caught baldchin groper.

Dhufish: The number of effort days reported for dhufish (days when dhufish were caught) has steadily increased in each year from 1991/92 until 2002/03, after which, the number of effort days has been declining. In 2006/07, the number of effort days reported was 6,654, a decrease of almost 1,950 fishing days from 2005/06 (West Coast Demersal Scalefish Figure 4).

Pink snapper: Effort days for pink snapper gradually increased from 1991/92 until 2000/01, after which the number of days increased rapidly and have remained elevated at approximately 10,000 days per year until 2005/06 (West Coast Demersal Scalefish Figure 4). In 2006/07, the number of days when pink snapper were caught (effort days) was 7,680, a similar decrease in effort (1,859 days) from 2005/06 as for that of dhufish.

Baldchin groper: The number of days on which catches of baldchin groper were reported gradually increased between 1991/92 and 2002/03, after which the number of days that catches were made has declined. A closure to fishing for baldchin groper during its spawning period, which was introduced in the Abrolhos Islands Fish Habitat Protection Area in 2003, has been partially responsible for the decrease in effort. The number of days fished for baldchin groper decreased from 5,165 in 2005/06 to 3,938 in 2006/07 (West Coast Demersal Scalefish Figure 4).

Fishing and Aquatic Tour Industry (Charter)

Fishing effort for the charter sector in the West Coast bioregion during 2006/07 was 25,787 fisher days, which is similar to previous years.

Recreational

Total recreational fishing effort for the West Coast bioregion was not estimated in 2006/07.

Stock Assessment

Assessment complete: Yes

Breeding stock levels Pink snapper: Low
Dhufish: Declining

The results of recent research on the levels of exploitation of both dhufish and pink snapper in the WCDSF demonstrates that those levels are above international benchmark standards across all zones of the West Coast bioregion (Wise *et al.*, 2007). This is also the case for baldchin groper at the Abrolhos Islands, which, coupled with declining catch rates, indicated that localised over-fishing of this species was occurring. Thus, the stocks of dhufish and pink snapper

in the WCDSF and of baldchin groper at the Abrolhos Islands are currently experiencing over-fishing and are depleted to levels below those necessary to ensure their long-term sustainability.

The breeding stock levels of dhufish and pink snapper in 2006/07 were based on the fact that catches of dhufish are dominated by only a few strong year classes while those of pink snapper have a truncated age distribution, i.e. there are few older and thus larger fish in the population. The decreasing numbers of dhufish in the dominating year classes indicates that the breeding stock is also declining, while the lack of older pink snapper indicates that their spawning stock would be low.

Stock assessments have not been conducted on shallow water species such as sweetlip emperor and spangled emperor in the West Coast bioregion, which form an important part of the WCDSF catch, or on deepwater, long-lived, demersal species, such as grey-banded cod, hapuku and redfish.

Non-Retained Species

Bycatch species impact: Negligible

Line fishing is a highly selective fishing method that targets demersal species using baited hooks. Only a small proportion of the overall catch is discarded and includes inedible species (e.g. silver toadfish) or small fishes (e.g. wrasses). While some of these bycatch species are unlikely to be affected by this fishery, other demersal species, such as wrasse, suffer from the effects of barotrauma (D. Fairclough, pers. obs.).

Protected species interaction: Negligible

Owing to the high selectivity of the fishing gear, commercial line fishing is highly unlikely to interact with protected species. New logbooks for commercial and charter fishers were introduced at the end of 2007 that include specific sections for recording protected species interactions. No protected species interactions were reported by the recreational or charter sector in 2006/07.

Ecosystem Effects

Food chain effects: Not assessed

Habitat effects: Negligible

The main fishing method used in the commercial and recreational fishery for demersal species (line fishing), has little physical impact on the benthic environment. The loss of fishing rigs, i.e. line, sinkers and hooks, is currently not quantified but is likely to have a negligible effect on habitat.

Social Effects

Commercial

Employment in this fishery is difficult to assess as 77% (147) of the boats in the wetline fleet are also licensed to fish in other fisheries. Only 44 boats in the wetline fleet hold no other licences and thus are 'wetline-only'. On average, each boat fished for 44 days during 2006/07 and employed two crew members.

Fishing and Aquatic Tour Industry (Charter)

There are 161 charter operators who are licensed to operate in the West Coast bioregion via a Fishing Tour Operators Licence,

Restricted Fishing Tour Operators Licence or an Aquatic Eco-Tourism Operators Licence. The number of people employed in the charter industry has not been estimated.

Economic Effects

Estimated annual value (to commercial fishers)

for year 2006/07: **\$4.8 million**

The estimated value of the West Coast Demersal Scalefish Fishery in 2006/07 includes all demersal scalefish species caught by handlines and droplines in the West Coast bioregion. West Australian dhufish and pink snapper comprised 39% and 24% of the total value of the fishery (\$4.8m), contributing \$1.9m and \$1.2m, respectively. Other important species include the lethrinids, which comprised 13% of the total value of the fishery in 2006/07, where baldchin groper comprised 6% and Bight redfish 4%.

Prices used to calculate the value of the fishery in 2006/07 were \$13.50/kg for dhufish \$4.95/kg for pink snapper and \$10/kg for baldchin groper. At \$12.50/kg, coral trout commanded the second highest average price of all species in the fishery.

Prices vary as demand and supply for popular fish species fluctuate greatly; prices used to calculate estimated value are likely to be conservative.

Fishery Governance

Target catch (or effort) range: **558 – 798 tonnes**

Commercial

The target catch range for the WCDSF in 2006/07 was based on the mean from catches in the decade 1990/91 to 1999/2000 using 80% confidence limits around that 10-year mean and was thus calculated to be 558 – 798 t. For the indicator species, target catch ranges were 125 – 179 t for dhufish, 153 – 254 t for pink snapper and 27.5 – 35.5 t for baldchin groper.

The total commercial catch of 725 t in 2006/07 fell just below the upper boundary of the target catch range, primarily reflecting a reduction in effort in the WCDSF. Catches of dhufish (139 t), pink snapper (232 t) and baldchin groper (29 t) were within their target catch ranges.

As the stock assessments conducted on dhufish, pink snapper and baldchin groper by Wise *et al.* (2007) revealed that over-fishing of those indicator species was occurring and recommended that there be at least a 50% reduction in catch and effort, the target catch range in 2006/07 is inappropriate and the catches and fishing effort in 2006/07 are unacceptable.

Current fishing (or effort) level:

Unacceptable

New management initiatives (2007/08)

The West Coast Demersal Scalefish Fishery (WCDSF) became a managed fishery at the beginning of 2008, following the outcomes of the Wetline Review process. The management arrangements include limited entry to the fishery and restrictions on the areas each permit holder can operate. In 2009 each boat will be allocated a share of the total effort. This will allow the fishery to be managed to catch settings for each area.

Recent stock assessments on the major indicator species – dhufish, pink snapper and baldchin groper – demonstrated that their stocks have been experiencing over-fishing due to increasing catch and effort. Thus, monitoring of stock status will continue in order to evaluate the impacts of the new management regime and the effective reductions in catch and effort that will occur.

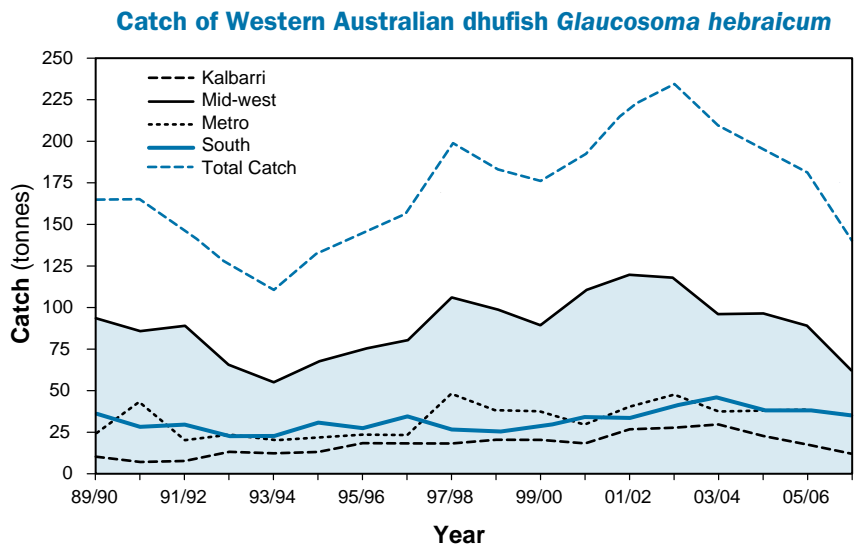
External Factors

The productivity of the West Coast Demersal Scalefish Fishery (WCDSF) relies on the maintenance of both the snapper and dhufish populations. The recent research on dhufish found evidence of high recruitment in only 4 consecutive years in the last 20 years; these four age classes are currently supporting the entire fishery for dhufish.

A correlation is evident between higher salinity and stronger recruitment, which may indicate that recruitment along the west coast may be influenced by the strength and timing of the Capes Current. The Capes Current flows during the spring and summer months, when dhufish spawn. Studies of the reproductive biology of dhufish suggest that the spawning of individual females may not have been as successful in recent years. Dhufish spawn in pairs (i.e. one female and one male) and thus with the reduction in the size of the stock that is evident from research, females may not be encountering males as frequently as they once did, resulting in a reduction in spawning events.

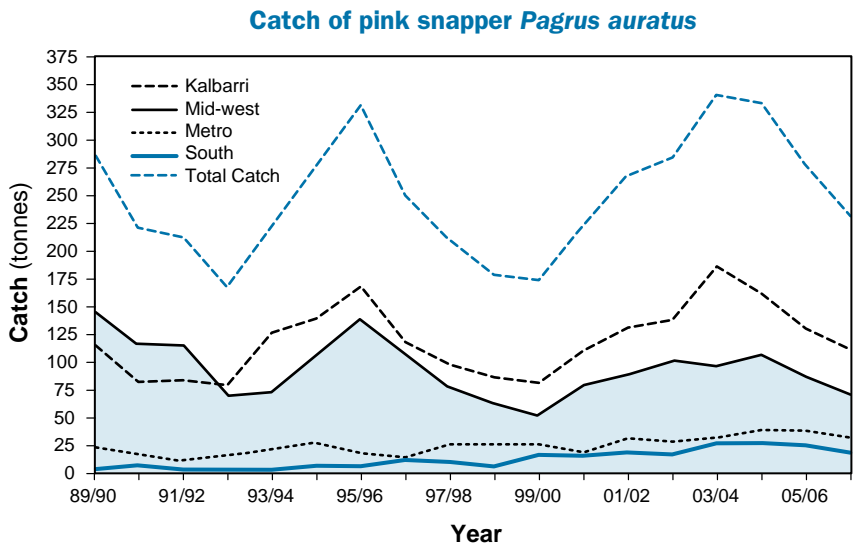
In contrast to the recruitment spikes of dhufish, no such strong recruitment events are evident in the snapper stocks, but this may not be as pronounced, due to the limited number of age classes in the population.

The spawning aggregation of pink snapper in Cockburn Sound contains the largest and most fecund pink snapper in the West Coast bioregion and is thus considered to be the most important spawning and nursery location for the productivity of this species in this fishery.



WEST COAST DEMERSAL SCALEFISH FIGURE 2

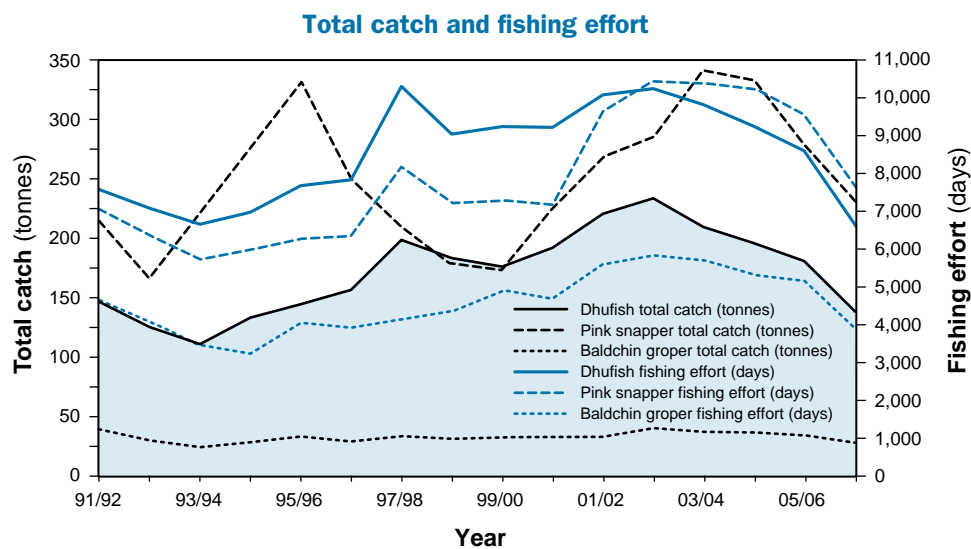
Total commercial catch of Western Australian dhufish *Glaucosoma hebraicum* in the West Coast Demersal Scalefish Fishery and commercial catch of dhufish in each zone in each year between 1989/90 and 2006/07.



WEST COAST DEMERSAL SCALEFISH FIGURE 3

Annual commercial catch of pink snapper in the 4 zones of the West Coast Demersal Scalefish Fishery from 1989/90 to 2006/07.

WEST COAST BIOREGION
GASCOYNE COAST BIOREGION
NORTH COAST BIOREGION
SOUTH COAST BIOREGION
NORTHERN INLAND BIOREGION
SOUTHERN INLAND BIOREGION
STATE-WIDE
REFERENCES AND APPENDICES



WEST COAST DEMERSAL SCALEFISH FIGURE 4

Total annual commercial catch and days fishing for dhufish, pink snapper and baldchin groper in the West Coast Demersal Scalefish Fishery from 1991/92 to 2006/07.



Baldchin groper (*Choerodon rubescens*). Photo: David Fairclough

West Coast Tailor Fishery Status Report

K. Smith, J. Brown and M. Hammond

Management input from N. Harrison

Fishery Description

Tailor (*Pomatomus saltatrix*) is a key target species for recreational anglers in estuaries, along beaches and around coastal reef systems on the lower west coast. This accessible distribution, coupled with strong schooling behaviour, makes the stock relatively vulnerable to growth over-fishing and potentially also to recruitment over-fishing. These risk factors, together with naturally variable recruitment and growing inshore fishing pressure, were first recognised in the early 1990s. Since that time, daily bag limits have been reduced twice – from unlimited to 20, then from 20 to 8 per person.

The majority of the recreational catch of tailor in WA is taken from the metropolitan area in the west coast region, while the bulk of the commercial catch comes from Shark Bay in the Gascoyne region. Minor commercial and recreational catches are also taken on the south coast.

Governing legislation/fishing authority

Fish Resources Management Act 1994 and subsidiary legislation

Consultation process

Recreational Fishing Advisory Committee
Regional Recreational Fishing Advisory Committees
Meetings between the Department of Fisheries and industry

Boundaries

Tailor inhabit coastal and offshore waters. The species is mainly found between Shark Bay and the lower west coast, but also occurs in smaller numbers along the south coast. Tailor can be taken commercially throughout this range by holders of an unrestricted Fishing Boat Licence. Recreational fishing for tailor can occur in all WA waters except in areas closed to recreational fishing, i.e. marine reserves.

Management arrangements

Tailor is assigned to the 'medium risk' category. The daily bag limit for recreational fishers is 8, with a condition in the west coast and south coast regions that only 2 of these fish may be over 600 mm.

Tailor may 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.

The legal minimum length of tailor is 300 mm for recreational and commercial fishers.

As tailor is considered a prime recreational species, resource-sharing issues are a major consideration in future management arrangements for this fishery, particularly on the west coast.

Research summary

Tailor populations are genetically homogeneous along the west coast of WA, between Shark Bay and Cape Naturaliste. However, otolith carbonate analysis has suggested that the inner Shark Bay populations remain separate after recruitment from populations outside of Shark Bay. Thus, tailor located south of Shark Bay and within Shark Bay are managed as two separate stocks.

Following concerns about increasing recreational fishing pressure on tailor in the greater Perth metropolitan area in the early 1990s, two research studies were instigated (a tagging and a short-term hooking mortality study). The tagging study established that tailor from the Swan River estuary interchange freely with those in marine waters of the lower West Coast.

After this finding, a volunteer angling survey program was commenced to monitor the relative abundance of 0+ and 1+ juvenile year-classes in the Swan River. Angler catch rates are an indicator of the strength of annual recruitment to the lower west coast population. The program began in 1995 and is ongoing at Point Walter from February to April each year. Since 1995, the Department of Fisheries' Research Division has also been undertaking annual netting surveys of juvenile fish on ocean beaches, which yield another recruitment index for tailor on the lower west coast.

Recruitment indices have proven useful as predictors of commercial catch rates. Data emerging from recently introduced recreational angler logbooks (RAP) suggest that recruitment indices will also be useful to forecast recreational catch rates on the West Coast.

While commercial catch levels are determined annually from data reported in compulsory commercial returns, recreational catch levels are estimated only occasionally when recreational fishing surveys are conducted. Recent estimates of recreational tailor landings in ocean waters are available from a boat-based creel survey on the west coast in 1996/97 (Sumner and Williamson 1999), a national phone survey in 2000/01 (Henry and Lyle 2003) and a boat-based creel survey on the west coast in 2005/06 (Sumner *et al.* 2008).

Recent studies by the Department of Fisheries and Murdoch University indicated that tailor larvae off the west coast are restricted to surface waters over the middle and outer continental shelf. Therefore, variations in surface currents (including the southward-flowing Leeuwin Current and the northward-flowing Capes Current) that disperse eggs and larvae influence the patterns of juvenile recruitment along the west coast.

Tailor spawn within a restricted range of temperatures and salinities, but these conditions occur at various times along much of the west coast, suggesting that recruits to the lower West Coast could be spawned both locally and from distant sites, either north or south. Samples of tailor in spawning condition provided by recreational anglers have confirmed that spawning aggregations do occur within the Perth metropolitan Region.

As part of the Research Angler Program (RAP), a recreational fisher daily logbook was implemented in 2004. Logbook anglers now provide important annual information about the size structure of the recreational tailor catch and logbook catch rates provide a relative index of abundance in various regions. These data will be used in future stock assessments, in conjunction with other data from recruitment surveys, biological studies and creel surveys.

WEST COAST
BIOREGIONGASCOYNE COAST
BIOREGIONNORTH COAST
BIOREGIONSOUTH COAST
BIOREGIONNORTHERN INLAND
BIOREGIONSOUTHERN INLAND
BIOREGION

STATE-WIDE

REFERENCES AND
APPENDICES

Retained Species

Commercial landings (season 2007): **26.3 tonnes**

In 2007, the total state commercial catch of tailor was 26.3 t – up 2.3 t from 2006. The vast majority of landings occurred in the Gascoyne region (92.5% of total landings), with the West Coast and South Coast bioregions contributing 6.7% and 0.8%, respectively.

In the West Coast Bioregion, 83.9% (1.5t) of the total 2007 commercial catch was reported from the West Coast Estuarine Managed Fishery. The remainder was reported by wetline fishers in coastal areas between Kalbarri and Cape Naturaliste (15.6%) and within the Cockburn Sound (Line and Pot) Managed Fishery (0.5%).

Recreational catch: **76% of total State catch**
94% of total West Coast catch

An estimate of the total recreational tailor catch for WA is not available for the current year (2007). The most recent state-wide estimate (all areas, all methods) is available from the National Recreational and Indigenous Fishing Survey conducted between May 2000 and April 2001 (Henry and Lyle 2003). An estimated 587,000 tailor were caught in WA by recreational fishers during this 12-month survey.

The average weight per tailor measured during the survey was 0.319 kg. Therefore, the recreational catch for the state was calculated to be 187 t during the survey period. This quantity was 76% of the total state-wide tailor catch (estimated recreational catch plus commercial catch) in 2000/01.

In 2000/01, the vast majority (182 t or 97%) of recreational landings of tailor were reported in the West Coast bioregion, with minor quantities taken in the Gascoyne and South Coast bioregions. An estimated 88% of the West Coast recreational catch during the survey was from shore-based fishing.

In the boat-based creel survey undertaken by the Department in 2005/06, the number of tailor retained by boat-based recreational fishers in the West Coast region was 4,826 fish during the 12-month survey period. This was significantly less than the 24,251 fish that were estimated to have been retained by boat-based recreational fishers in 1996/97 during a similar creel survey by the Department.

The legal minimum length for tailor was raised from 250 to 300 mm between these two creel surveys, resulting in a higher proportion of fish being released in 2005/06 (42.6%) compared to 1996/97 (12%). Though a higher proportion of fish were released in 2005/06, the boat-based catch rate of tailor on the West Coast still appears to have declined significantly since 1996/97.

Fishing effort/access level

Commercial

In 2007, the majority (86.4%) of the State's commercial catch of tailor was caught in the Shark Bay Beach Seine and Mesh Net Managed Fishery – see the separate report on this fishery for further details.

In the West Coast bioregion, the West Coast Estuarine Managed Fishery, the Cockburn Sound (Line and Pot) Managed Fishery and the wetline fishery in coastal waters took minor quantities of tailor. Tailor is not a primary target species in these fisheries and landings are mostly bycatch.

Recreational

The 2000/01 National Recreational and Indigenous Fishing Survey, which included all methods and regions, provides the most comprehensive information on recent recreational fishing effort. In inshore waters of the West Coast bioregion, where most recreational tailor landings are reported, the estimated line fishing effort (either bait or lure) totalled 946,841 shore-based and 308,673 boat-based 'fishing events' during the 12-month survey period.

Two 12-month creel surveys undertaken by the Department of Fisheries in 1996/97 and in 2005/06 estimated the total fishing effort expended by boat-based recreational fishers in the West Coast bioregion. The boat-based recreational line fishing effort estimate increased 15.5% from 1996/97 (1,348,000 fisher hours) to 2005/06 (1,557,000 fisher hours). Recent estimates of shore-based recreational effort, which accounts for the majority of tailor landings, are unavailable for the West Coast bioregion.

Stock Assessment

Assessment complete:

Preliminary

Breeding stock levels:

Uncertain

Tailor become susceptible to capture by line fishing at 150 to 200 mm total length and ~1 year of age, but do not attain the legal minimum length of 300 mm until ~3 years (Ayvazian *et al.* 2001, K. Smith unpubl. data). Tagging studies have found that these sub-legal sized fish are subject to high fishing pressure, especially in the Perth metropolitan region (Young *et al.* 1999). Survival rates by small tailor after hooking appear to be relatively high ($\geq 90\%$), except if fish have suffered deep (gut) hooking or undergone excessive handling (Ayvazian *et al.* 2001, 2002). These results indicate that size limits and bag limits are effective tools for managing this species.

Juvenile tailor tagged in the Perth metropolitan area have been recaptured as adults at locations northwards or immediately offshore, suggesting that at least some fish spawn locally and contribute to local recruitment (Young *et al.* 1999). About 21% of the West Coast stock is thought to occur offshore (i.e. >500 m from shore); this component of the stock is dominated by large, reproductively-active fish (Ayvazian *et al.* 2001). If local spawners are a major source of recruitment to the Perth metropolitan fishery, then high levels of targeting of offshore fish by recreational fishers is likely to result in local depletion. Recent creel surveys of boat-based fishing indicate that the recreational catch levels of tailor in West Coast offshore waters declined significantly between 1996/97 and 2005/06.

The recruitment indices from the Swan River estuary and lower west coast, which now span 14 continuous years up to 2008, have revealed highly variable levels of annual recruitment to the lower West Coast tailor population. Relatively high recruitment occurred in 1995, 1996, 1997 and 2005, but was low in other years.

Logbook data and anecdotal evidence from recreational fishers suggest poor catches of mature fish in the Perth metropolitan region over recent years, which is consistent with the lower recruitment estimated between 1998 and 2004. Recreational catch rates reported by logbook fishers have been relatively stable since the RAP logbook program commenced in 2004.

The longer-term status of the tailor stock remains of concern due to continuing high fishing pressure and lack of data that would enable a more formal stock assessment.

On the West Coast, where tailor are subject to relatively heavy fishing pressure, adults are caught predominantly on offshore reefs. Anecdotal evidence suggests that boat-based recreational fishers have been increasingly targeting large breeding individuals along the lower West Coast in recent years.

A decline in the catch of tailor by boat-based fishers suggests that the abundance of offshore, reproductively-active tailor on the West Coast has declined significantly in the last 10 years. It is important to note, however, that the boat-based share of the recreational tailor catch is minor. Therefore, the recent boat-based catch estimates cannot be used with confidence to infer anything about the recent catch of shore-based fishers, who account for the vast majority of recreational tailor landings in the West Coast bioregion. A survey of shore-based recreational catch levels in the West Coast is urgently required to estimate the total catch of tailor.

While the breeding stock on the West Coast appears to have declined, it is not known whether the breeding stock is above or below 30% of virgin biomass, which is the minimum level generally accepted for this type of fish. Further research to better understand stock structure, spawning activity and recruitment dynamics is needed in order to estimate the size of the breeding stock on the lower west coast.

Non-Retained Species

Bycatch species impact: Low

The line fishing methods used to fish for tailor result in catches of other finfish species that are generally sought after by recreational fishers. Very limited discarding of unwanted species occurs.

Protected species interaction: Negligible

Recreational fishers angling for tailor are unlikely to capture any protected species.

Ecosystem Effects

Food chain effects: Low

Excessive removal of tailor from the food chain could potentially allow for some increase in the numbers of its prey species.

Habitat effects: Negligible

The line fishing methods used to fish for tailor have a negligible impact on the bottom substrate of estuaries or the ocean.

Social Effects

The annual spring – summer appearance of tailor along Perth metropolitan beaches has historically been targeted by thousands of shoreline anglers each year. However, recent low catch rates have resulted in fewer fishers participating in this activity.

Fishery Governance

Current fishing level (Commercial): Unacceptable

Current fishing level (Recreational): Unacceptable

Shore-based recreational fishers catch the vast majority of tailor in the West Coast region. The current recreational fishing level in the region is uncertain, due to the lack of recent estimates of shore-based catch and effort levels. Control of the recreational exploitation rate is managed through a daily bag limit and a legal minimum size limit. However, there is effectively no limit on the overall catch taken by this sector.

Available evidence (anecdotal reports of low shore-based catch rates, a significant decline in boat-based catch, ongoing low annual recruitment) suggests that, despite recent changes to bag and size limits, the recreational exploitation rate of tailor in the West Coast region remains at an unacceptable level.

Commercial fishing levels are considered acceptable. The commercial catch of tailor in the West Coast region is minor. Landings are essentially limited to south-west estuaries, Cockburn Sound and inshore wetline fisheries, which are subject to strict licence and gear limits.

New management initiatives (2007/08)

A review of recreational fishing in the South Coast bioregion was completed and new rules implemented on 1 January 2006. As one of the outcomes of this review, the Minister for Fisheries determined that a limit of only two fish over 600 mm should apply to the South Coast.

In late 2005, the Metropolitan Region Recreational Fishing Advisory Committee proposed a further reduction in the maximum legal size limit from 600 mm to 500 mm and that the limit be introduced to the Gascoyne region. This proposal was considered by the state Recreational Fishing Advisory Committee (RFAC) who supported further consultation. The RFAC recommended that the proposal be referred to the next regional review of recreational fishing on the west coast. The future management of tailor and nearshore species will be considered in 2009.

External Factors

It is likely that annual variation in coastal currents influences the settlement patterns of juvenile tailor and thus their subsequent recruitment into the fishery.

AQUACULTURE

Regional Research and Development Overview

Aquaculture production statistics are compiled at the Western Australian Fisheries and Marine Research Laboratories (WAFMRL) at Hillarys.

In 2006/07, the value of aquaculture increased by around 9% and aquaculture tonnage decreased by 9% compared to equivalent data for 2005/06 (excluding marine algae and all pearl oysters). This is the third consecutive annual period during which aquaculture production has dropped, from a peak in 2003/04.

The results of previous research indicate there may be commercial potential for the grow-out of wild-caught western rock lobster pueruli. During 2007, the Ministerially-appointed Western Rock Lobster Puerulus Aquaculture Working Group met to progress the development of a policy framework to allow for the collection and grow-out of western rock lobster pueruli. An Interim Policy Paper was forwarded to the Minister for Fisheries in December 2007 for his information. Over the last six months, a Fisheries Research and Development Corporation (FRDC)-funded project considering the economics and market implications of rock lobster aquaculture has been underway. Two separate reports have been received which, once endorsed, will inform the working group in its deliberations. It is hoped the final policy may be complete by the end of 2008.

The framework to allow for the granting of leases for aquaculture has progressed significantly in 2007-08. Currently, the Minister has granted 16 leases for the mussel growers in Cockburn Sound, with another application in progress. It is hoped that the final policy, incorporating the process for granting and renewal of leases as well as setting out the fees and charges, should be finalised by July 2008.

The Department's review of aquaculture licence conditions is continuing. The outcome of the review will see more consistent, streamlined and meaningful licensing and enforcement arrangements across all aquaculture industry sectors.

The Western Australian Shellfish Quality Assurance Program, which ensures that mussels are harvested only when water quality is appropriate for safe consumption of the product, continued to operate effectively. Arrangements with the Department of Health regarding the ongoing management of the program and its links to the new Food Bill are progressing.

The Department of Fisheries' marine finfish aquaculture research team continued its work on the development of microdiets for larval fish nutrition. The automated feeding system (patent registration completed) developed in an earlier stage of the project is being manufactured by the Department, with several systems already sold overseas, and was promoted by the team at the World Aquaculture Society Conference 2006 (in Italy). The control box for the automated feeding system has now been contracted to an external company.

With financial support from the FRDC, the current microdiet research is focusing on easily-digested proteins, feed attractants, and the physical and chemical properties of the particles. The research team is collaborating with research and development centres in Tasmania, Spain, Portugal, Japan, Malaysia and Mexico.

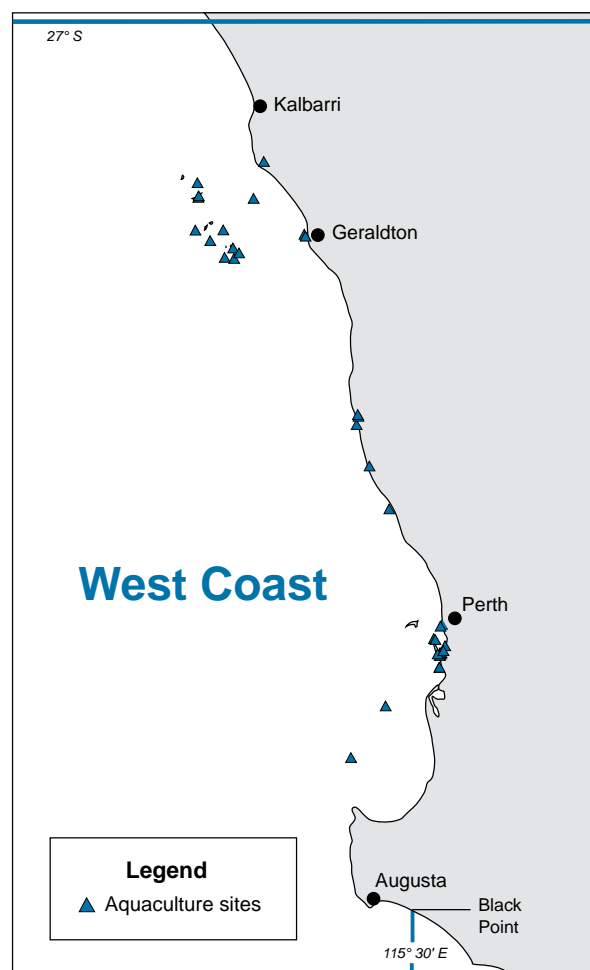
Work also continued on the commercialisation of *Artemia* (brine shrimp) production at Hutt Lagoon, Port Gregory. This project, also supported by the FRDC, is a collaboration between the

Department of Fisheries and a multi-national industry partner that farms red algae (*Dunaliella salina*) at Hutt Lagoon.

Current work is building on the outcomes of previous research that tested the commercial viability of *Artemia* cysts and biomass through a pilot-scale system. The system is now being developed into a commercial-scale system, including developing new rearing protocols. It is anticipated that 'domestic-grown' *Artemia* products will be available commercially during 2008, reducing the reliance on unpredictable supplies of imported product for aquaculture feeds.

The Aquaculture Development Council is determining the feasibility of open-ocean production systems for growing marine finfish in unsheltered, WA coastal waters. In co-operation with the Department and industry, it is also planning a major project to determine the environmental carrying capacities of several locations on the WA coast.

A number of new aquaculture projects have been, or are in the process of being, established off the west coast. These include a project off Jurien, which is presently licensed to grow 200 tonnes of fish, and one near the Abrolhos Islands, licensed to grow 270 tonnes per annum. The former operator has been issued a Ministerial Exemption to collect a small number of rock lobster pueruli for research purposes. A proponent has applied for a licence and lease in Cockburn Sound to undertake octopus aquaculture.



WEST COAST AQUACULTURE FIGURE 1

Map showing the major licensed aquaculture sites of the West Coast bioregion.

COMPLIANCE AND COMMUNITY EDUCATION

Compliance and community education in commercial and recreational fisheries in the west coast bioregion is undertaken by Fisheries and Marine Officers (FMOs) based at the Busselton, Bunbury, Mandurah, Rockingham, Fremantle, Hillarys, Lancelin, Jurien, Dongara and Geraldton offices, as well as aboard the large ocean-going patrol vessels *Hamelin*, *McLaughlan*, and *Walcott*.

Specific education programs are delivered by Community Education Officers based in Busselton and Fremantle with the assistance of Volunteer Fisheries Liaison Officers based in Busselton, Bunbury, Mandurah, Fremantle, Hillary's, Dongara, Geraldton and Kalbarri.

Services provided by land-based officers include processing inspections, landing and gear inspections, licensing checks, wholesale/retail checks and inshore sea-based patrols, utilizing vessels ranging in length from 5 metres to 12 metres. They also give support to seagoing personnel and provide a wide variety of educational and extension services through formal and informal media to commercial fishers, fishing operations, other resource management agencies and community members.

The Department of Fisheries also delivers at-sea marine safety compliance services on behalf of the Department for Planning and Infrastructure in the Perth metropolitan region, extending from Mandurah to Lancelin (excluding the Swan/Canning Rivers). Outside of this area marine safety is unfunded and inspections are carried out in combination with fisheries compliance inspections.

Activities during 2006/07

During 2006/07, FMOs delivered a total of 14,518 hours of compliance and community education services in the field (West Coast Bioregion Compliance Figure 1). A major component of this time was focused on the West Coast Rock Lobster Managed Fishery. A continuing emphasis was placed on employing risk-based and intelligence-based approaches to compliance planning and prioritization.

The 12-metre patrol vessel *Chalmers* was a welcome addition in undertaking compliance operations and research projects at the Abrolhos Islands. The *Chalmers* was used extensively throughout the year and proved valuable in accessing the shallow water areas of the Abrolhos Islands, as well as patrolling the associated Reef Observation Areas.

Compliance planning for the West Coast Rock Lobster Managed Fishery focused on the Compliance Risk Assessment conducted with industry members in 2005. Compliance operations targeted one of the major risks of fishers interfering with other fishing gear, which resulted in a number of apprehensions.

Targeted operations were also conducted to address other issues, which included illegal fish sales, over-potting, failing to release totally protected rock lobsters, and pulling rock lobster pots prior to the prescribed starting time each day.

In the Mid-west region, FMOs undertook several successful compliance operations targeting commercial western rock lobster fishers. A number of offences were detected ranging from fishing in closed waters to obstructing escape gaps in rock lobster pots. Of considerable concern was the apprehension of two fishing

operations operating more pots than their pot entitlement. The *PV Chalmers* was a great asset in conducting these operations.

In the Perth metropolitan region, a number of covert operations were conducted targeting interference with gear, with one commercial fisher being prosecuted for interfering with another commercial fisher's gear.

Compliance in commercial fisheries was similar to previous years, although the 25 prosecutions for the second year running is a positive sign, down on the 49 prosecutions from 2004/05. Similar numbers of infringement notices and warnings were issued compared to previous years, with a total of 325 warnings, and 78 notices being given out.

Within the West Coast Rock Lobster Managed Fishery, each vessel had its catch inspected by FMOs on at least one occasion, with an average of six checks per vessel throughout the fishery (West Coast Compliance Table 2). On average, 17 baskets were inspected per vessel, which is similar to the number in 2005/06 of 21 baskets per vessel.

The percentage of total catch inspected was almost identical to the previous season with approximately 2.4 to 3.0% of the catch inspected (compared to 2.4 to 3.1% in 2005/06). The observed per-animal non-compliance rate for the catch remained stable, with an estimated range of 0.0013 to 0.0019 – that is an estimated 1.3 to 1.9 illegal animals for every 1,000 rock lobster checked. This range has been used to estimate that between 10.8 and 16.7 tonnes of illegal rock lobster were consigned during 2006/07.

In addition to the rock lobster fishery, FMOs focused their activity on ensuring high levels of compliance in other commercial fisheries such as abalone, wetline, crab, shark, scallop, pilchard and estuarine fisheries.

Considerable compliance activity was directed towards recreational fisheries within the West Coast bioregion, with FMOs achieving 35,465 field contacts with recreational fishers – a slight decrease on the previous year. The majority of the compliance effort focused on rock lobster, abalone, marine finfish and crabs.

Throughout the West Coast bioregion, a total of 467 infringement warnings, 172 infringement notices and 90 prosecutions were instigated for recreational offences during 2006/07. This is similar to 2005/06 and still represents a significant decrease in warnings and infringement notices, (from 676 and 235 respectively in 2004/05) and a drop in prosecutions from 103 in 2004/05. This sustained decrease is likely due to the continuing high presence of FMOs at boat ramps, as recreational fishers become more educated about fishing regulations.

The Department continues to work collaboratively with the Department of Environment and Conservation (DEC) in delivering compliance services to marine parks throughout the bioregion. The levels of non-compliance encountered in these parks is low and is likely a testament to the efforts of FMOs and DEC officers in educating marine park visitors about the new regulations in the marine parks.

This collaborative approach has worked very effectively, particularly during the Perth metropolitan abalone season that occurs predominantly within the Marmion Marine Park, where DEC officers undertake joint patrols with FMOs, thereby

WEST COAST
BIOREGIONGASCOYNE COAST
BIOREGIONNORTH COAST
BIOREGIONSOUTH COAST
BIOREGIONNORTHERN INLAND
BIOREGIONSOUTHERN INLAND
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STATE-WIDE

REFERENCES AND
APPENDICES

increasing the effectiveness of compliance service delivery within that fishery.

As part of the collaborative approach towards marine park compliance service delivery, additional officers from DEC have undertaken fisheries compliance training and are now authorized as Honorary Fisheries Officers. The Department has also extended the commitment to maximize efficiency of fisheries compliance service delivery across government by providing training to other agencies including the Water Corporation and the Rottnest Island Authority. Many of the field staff of these agencies are now also authorized as Honorary Fisheries Officers.

Throughout the year, FMOs continued to undertake joint patrols with other agencies including the Department for Planning and Infrastructure, the Australian Customs Service and the WA Police Service.

The VFLO program continued to play a vital role in educating fishers about fishing rules, catch care and fishing techniques, as well as in other education and research activities. Volunteers in the West Coast bioregion conducted beach patrols, school talks, fishing workshops, and attended various boat shows and festivals.

VFLOs, together with FMOs, attended the Mandurah Crab Fest and the Mandurah Boat Show respectively, to provide advice regarding fishing regulations to the large number of boating enthusiasts and recreational fishers attending these very popular events.

VFLOs and FMOs visited the Abrolhos Islands in May 2007 and conducted school talks and patrols, as well as assisting with carrying out a clean-up and maintenance around Big Rat Island.

Initiatives in 2007/08

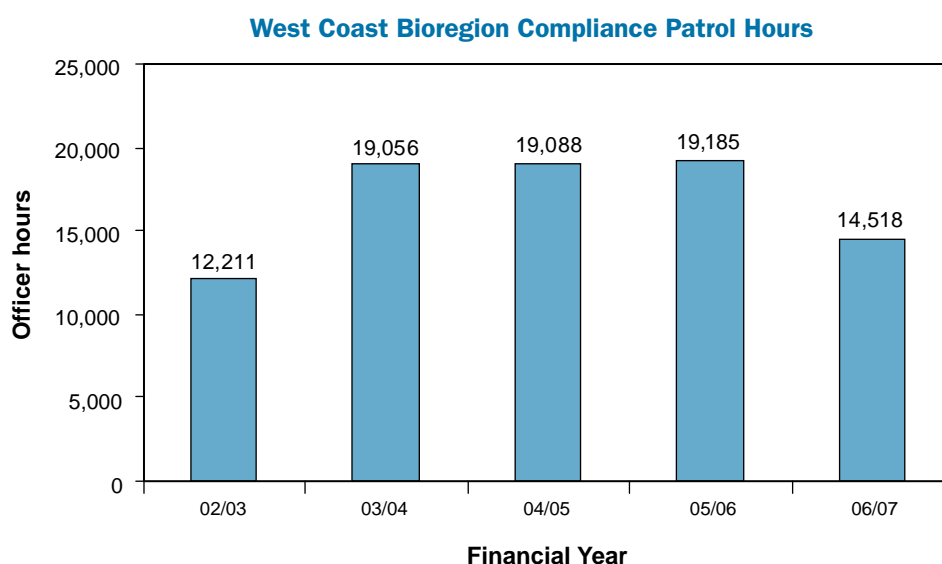
Drawing on an improved intelligence capacity, a number of targeted rock lobster compliance operations are planned during the 2007/08 rock lobster season, with a focus on over-potting and gear-related offences.

The Department of Fisheries continues to improve its at-sea patrol capability with the design of a new 12-metre rigid inflatable boat (RIB) being constructed. The RIB will be based at the Hillarys district and used to deliver fisheries and marine safety compliance services throughout the Perth metropolitan area, including the Marmion Marine Park.

The construction process is well underway for the new multi-agency Marine Operations Centre for the Mandurah District. This building will house over fifty staff from the Department of Fisheries, Water Police and the Department of Environment and Conservation. Approval is expected to be granted early in the 2007/08 year. This facility will provide further capacity to increase compliance services in the Peel region in future years.

A major maintenance project was undertaken on the Abrolhos Islands' three airstrips. A full risk assessment for the Abrolhos Islands estate is planned with the outcomes expected to assist in mapping of work priorities at the Abrolhos.

The introduction of the limited-entry West Coast Demersal Scalefish Interim Managed Fishery is expected to keep FMOs busy throughout the West Coast bioregion ensuring that only licensed wetline fishers are taking fish for a commercial purpose.



WEST COAST COMPLIANCE FIGURE 1*

'On Patrol' Officer Hours showing the level of compliance patrol activity delivered to the West Coast bioregion over the previous 5 years. The 2006/07 total gives the patrol hours in the bioregion that resulted in the contacts detailed in Table 1 and Table 2. The totals exclude time spent on other compliance related tasks, e.g. travel time between patrol areas, preparation and planning time, etc.)

* This does not include 2,980 'on-patrol' hours delivered in 2006/07 by the PV Hamelin and the PV MacLaughlan. In the version of Figure 1 published in the previous edition of State of the Fisheries, the hours patrolled by PV Hamelin and PV MacLaughlan were included in the West Coast totals, leading to consequent higher totals for each financial year.

The total on-patrol hours for each of the Department's three large patrol vessels is reported in the compliance summary of the most relevant bioregion: PV Walcott in the North Coast bioregion, and PV MacLaughlan and PV Hamelin in the West Coast bioregion.

WEST COAST COMPLIANCE TABLE 1

Summary of compliance and educative contacts and detected offences within the west coast bioregion during the 2006/07 financial year.

Patrol Hours Delivered to the Bioregion	14,518 Officer Hours
CONTACT WITH THE COMMERCIAL FISHING COMMUNITY*	
Field contacts by Fisheries & Marine Officers	429
District Office contacts	2,771
Infringement warnings	325
Infringement notices	78
Prosecutions	25
CONTACT WITH THE RECREATIONAL FISHING COMMUNITY	
Field contacts by Fisheries & Marine Officers	35,465
District Office contacts	10,867
Infringement warnings	467
Infringement notices	172
Prosecutions	90
OTHER FISHING-RELATED CONTACTS WITH THE COMMUNITY**	
Field contacts by Fisheries & Marine Officers	300
District Office contacts	7,665
Fishwatch reports***	414

* Commercial West Coast Rock Lobster contacts are excluded from these totals and detailed in West Coast Compliance Table 2.

** 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 Parks), 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 table includes contacts made by PVs Hamelin and MacLaughlan. Contacts made by PV Walcott are included in the North Coast Compliance Table 1.

*** This represents the total number of Fishwatch reports, both commercial and recreational, since the service provider reporting mechanism cannot differentiate between sectors. It also includes any calls relating to the Southern Inland bioregion that were referred to Busselton, Bunbury, Mandurah, Rockingham, Fremantle, Hillary's, Lancelin, Jurien, Dongara and Geraldton district staff.

WEST COAST COMPLIANCE TABLE 2

Summary statistics for commercial West Coast Rock Lobster Fishery compliance in all bioregions in the 2006/07 fishing season.

Total compliance hours*	23,309 Officer Hours
Field contacts by Fisheries & Marine Officers	3,411
District Office contacts	1,877
FACTORY INSPECTIONS OF CONSIGNMENTS	
Number of unique vessels checked	Entire fleet at least once
Average number of inspections per vessel	6
Average number of baskets checked per vessel **	17
Proportion of total commercial catch inspected	2.4 – 3.0%
Non-compliance rate (per-animal basis) ***	0.0013 – 0.0019
Total consigned commercial catch ('000 kg)	8,609
Estimated total illegal catch consigned ('000 kg)	10.8 – 16.7

* Includes all time spent on compliance related tasks, e.g. investigations, prosecutions, etc.

** Calculated as the total baskets checked per vessel divided by total inspections per vessel.

*** A rate of 0.001 indicates 1 illegal animal detected in every 1,000 animals checked.

