

WEST COAST BIOREGION

ABOUT THE BIOREGION

The marine environment of the West Coast Bioregion between Kalbarri and Augusta is predominantly a temperate oceanic zone, but it is heavily influenced by the Leeuwin Current, which transports warm tropical water southward along the edge of the continental shelf. Most of the fish stocks of the region are 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 Coast and even into the South Coast.

The Leeuwin Current system, which can be up to several hundred kilometres wide along the West Coast, flows most strongly in autumn/winter (April to August) 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 (shoreward of the Leeuwin Current), 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 protected coastal waters of the West Coast Bioregion, generally in depths of 20 m (but up to 30 m), and act as major nursery areas for many fish species and particularly for the 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. Further offshore, the continental shelf habitats 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 within the Abrolhos Islands, the leeward sides of some small islands off the Midwest Coast, plus behind Rottnest and Garden Islands in the Perth metropolitan area.

The two significant marine embayments in the West Coast are Cockburn Sound and Geographe Bay. 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.

Southward of Cape Naturaliste, the coastline changes from limestone to predominantly granite and becomes more exposed to the influences of the Southern Ocean

SUMMARY OF FISHING AND AQUACULTURE ACTIVITIES

The principal commercial fishery in this region is the western rock lobster fishery, which is Australia's most valuable single-species wild capture fishery. There are also significant commercial fisheries for other invertebrates including scallops, abalone, blue swimmer crabs and octopus that use trawl, diving and potting methods. Commercial fishers also take a range of offshore finfish species including sharks, dhufish, snapper, baldchin groper and emperors using demersal line and net methods. Beach based methods such as beach seining and near-shore gillnetting, and hand-hauled nets are used to capture whitebait, mullet and whiting in a very restricted number of locations.

The West Coast Bioregion, which contains the state's major population centres, is the most heavily used bioregion for recreational fishing (including charter based fishing). The range of recreational fishing opportunities includes estuarine fishing, beach fishing and boat fishing either in embayments or offshore for demersal and pelagic/game species often around islands and out to the edge of the continental shelf.

The principal aquaculture development activities in the West Coast Bioregion are the production of blue mussels (*Mytilus galloprovincialis*) 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. Initiatives to expand the number of aquaculture sectors in this bioregion currently include those for octopus, live rock/coral and finfish.

ECOSYSTEM MANAGEMENT

The marine benthic habitats and their associated biodiversity are largely protected along most of the West Coast from any physical impact of commercial fishing due to the extensive closures to trawling. These closures inside 200m depth were introduced in the 1970s and 1980s, in recognition of the significance of extensive areas of seagrass and reef as fish habitat (West Coast Ecosystem Management, Figure 1). The extent of these areas means that over 50% of the West Coast Bioregion inside 200 m depth could be classified as a marine protected area with an IUCN category of IV (Ecosystem

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Management Table 1; as per Dudley, 2008)¹.

Protection of fish habitat and biodiversity is also provided by marine protected areas consistent with IUCN categories of I, II and III 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 s.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 Ngari Capes Marine Park between Cape Leeuwin and Cape Naturaliste; and the Rottnest Island Marine Reserve. (West Coast Ecosystem Management, Figure 2).

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

ECOSYSTEM BASED FISHERIES MANAGEMENT

Identification of Ecological Assets/Resources using the EBFM framework

Utilising the Integrated Marine and Coastal Regionalisation for Australia (IMCRA V. 4.0)² scheme, the West Coast Bioregion has been divided into 3 meso-scale regions: the Abrolhos Islands, the Central West Coast and the Leeuwin–Naturaliste (West Coast Ecosystem Management Figure 3). This sub-regional scale of management has now been adopted by the Department through the implementation of an Ecosystem Based Fisheries Management (EBFM) framework (Fletcher, *et al.*, 2010)³ see How to Use section for more details. EBFM is a risk based management approach, which recognizes the social, economic and ecological values at a regional level and links between exploited fish stocks and the broader marine ecosystem, to ensure the sustainable management of all fisheries resources into the future. EBFM

identifies these individual ('lower level') values, and provides a mechanism for reporting on their status and the fisheries management arrangements that are being applied.

The West Coast was the first bioregion where the EBFM process, including the comprehensive risk assessment of each of the ecological assets, was applied (see West Coast Ecosystem Management Table 2). In terms of ecological assets (= resources), the Department utilises the following categories for the three IMCRA regions within the West Coast Bioregion:

Ecosystem structure and biodiversity (on a meso-scale basis – subdivided into marine, estuarine/embayments);

Captured fish species

Protected species (direct impact – capture or interaction);

Benthic habitat; and

External impacts.

For some issues a finer level of division of the IMCRA ecosystems is used by the Department. This relates to recent management initiatives necessary to recognise different suites of exploited fish and invertebrates across the continental shelf. These sub-components are defined by depth contours (Estuarine/Nearshore 0-20m; Inshore 20-250m; Offshore >250m). The full set of ecological assets identified for ongoing monitoring are presented in West Coast Ecosystem Management Figure 4.

Risk Assessment of Regional Ecological Assets

The EBFM process identifies the ecological assets in a hierarchical manner such that the assets outlined in Figure 4 are often made up of individual components at species or stock level. The risks to each of the individual stock or lower level components are mostly detailed in the individual fishery reports presented in this document. The following table (West Coast Ecosystem Management Table 2) provides an overview and cumulative assessment of the current risks to the ecological assets of the West Coast Bioregion, at a bioregional level and provides a mechanism for reporting on their status and the fisheries management arrangements that are being applied. These bioregional level risks are now used by the Department as a key input into the Department's Risk Register which, combined with an assessment of the economic and social values and risks associated with these assets, is integral for use in the annual planning cycle for assigning priorities for activities across all Divisions in this Bioregion.

Summary of Monitoring and Assessment of Ecosystem Assets

The Department of Fisheries Research Division's Biodiversity and Biosecurity Branch have a number of research and monitoring initiatives underway.

Ecological risk assessments undertaken on the western rock lobster fishery identified that the ecological impacts of removing rock lobster biomass could be a moderate risk for deeper water reef community structure. A suitable reference area in deep water was identified and closed to lobster fishing

1 Dudley, N. (editor) (2008) Guidelines for applying protected area management categories. IUCN, Gland, Switzerland.

2 Commonwealth of Australia (2006). A Guide to the Integrated Marine and Coastal Regionalisation of Australia Version 4.0. Department of the Environment and Heritage, Canberra, Australia.

3 Fletcher, W.J., Shaw, J., Metcalf, S.J. & D.J. Gaughan (2010) An Ecosystem Based Fisheries Management framework: the efficient, regional-level planning tool for management agencies. Marine Policy 34 (2010) 1226–1238

in March 2011 as part of a project funded by the Fisheries Research and Development Corporation (FRDC) and Western Australian Marine Science Institution (WAMSI). Continued monitoring will provide the contrast required to enable the potential impacts of lobster fishing on deep water ecosystems to be quantified. Recent work has concentrated on identifying relationships between lobster size, abundance and key habitats.

Research focusing on the Abrolhos Islands FHPA has been expanded. A holistic research and monitoring program examining key habitats and their associated finfish and invertebrate assemblages is now underway. The Department, independently and through collaborations with other institutes, such as the University of Western Australia, is establishing long term monitoring programs to assess and monitor both key finfish and invertebrates species as well as monitoring shallow water (<30m) coral reef habitats. The establishment of larger scale habitat maps across the shallow water environments (<30m) of the Abrolhos is also being undertaken to provide important baseline information on marine communities. The first detailed habitat map, focussing on the Wallabi Group and funded by the state NRM in 2009/10 is now complete. This biological information is complemented by environmental data loggers, to assist researchers in quantifying the effects of natural (i.e. climate change) and anthropogenic (i.e. fishing activities, tourism, aquaculture) impacts on the habitats and marine communities of the Abrolhos Islands FHPA.

The Department is establishing an ongoing ecosystem monitoring and research program to underpin management of the Ngari Capes Marine Park. The research and monitoring program within the Ngari Capes Marine Park represents one tool (and forms part of the “weight-of-evidence”¹) to assess the effectiveness of the overall management strategies being applied to Western Australia’s fish resources in the wider West Coast Bioregion.

In the West Coast Bioregion, the Department continues to undertake research, and facilitate research by other agencies (e.g. DPaW, CSIRO) and universities (e.g. Curtin, Murdoch and the University of Western Australia), to assess the impacts on fisheries from other anthropogenic activities and environmental processes in order to determine appropriate management responses. The Department also inputs into the Western Australian Environmental Protection Authority’s environmental impact assessment process when a development proposal has the potential, if implemented, to impact on the aquatic environment.

The Department actively engages with natural resource management groups within the West Coast to promote sustainable use of the aquatic environment. It has implemented emergency-response measures in a number of risk areas, including the development of ‘introduced aquatic organism incursion’ and ‘fish kill incident response’ programs to minimise risks to the marine environment

1 Wise, B. S., J. St John, and R. C. Lenanton. 2007. Spatial scales of exploitation among populations of demersal scalefish: implications for management. Part 1: Stock status of the key indicator species for the demersal scalefish fishery in the West Coast Bioregion. Final report to Fisheries Research and Development Corporation on Project No. 2003/052. Department of Fisheries, Western Australia, Perth.

through the introduction of exotic aquatic pests and diseases.

The Marine Biosecurity Research and Monitoring Group continue to implement a series of biosecurity related projects initially developed in 2010 as well as developing new initiatives during 2012 – 2013. These projects aim to rapidly detect the presence of introduced marine pests (IMPs) using a suite of tools and sampling techniques. Early detection of IMPs is vital if any attempt at eradication or other management strategies are to be successful. The Marine Biosecurity Research and Monitoring Group has developed Commonwealth approved marine pest monitoring designs for Geraldton Port and HMAS Stirling and undertaken surveillance at both locations in 2012/2013. A large-scale, nationally approved survey of Fremantle Port was also completed in early 2013. In addition the Marine Biosecurity Research and Monitoring Group, with financial and *in-kind* assistance from Fremantle Port Authority and the Defence Services Group is running an Early Warning System program using *in-situ* settlement arrays to provide a mechanism for the early detection of marine pests in Fremantle Port and HMAS Stirling waters. Other biosecurity activities include surveillance for the invasive Asian paddle crab *Charybdis japonica* detected in 2012 by members of the public in the Swan River estuary. Since detection, the Marine Biosecurity Research and Monitoring Group have conducted extensive trap-based and diver surveillance of the target area in the lower reaches of the estuary. To date no further specimens of *C. japonica* have been detected by either the Department or the general public.

A project that was supported by WAMSI 4.4, developed a bycatch risk assessment method to rapidly assess the cumulative risk to sustainability of multiple fisheries². The Ranked Risk Assessment of Multiple Fisheries (RRAMF) allowed ranking of bycatch species within each fishery and to accumulate the ranks across multiple fisheries incorporating the relative impact of each fishery. The RRAMF method was tested on the West Coast and Gascoyne Coast Bioregions of Western Australia using fishery independent data for general teleost and elasmobranch bycatch; and fishery dependent data for endangered, threatened and protected species (ETPS). The RRAMF analyses reveal all bycatch species received low to moderate risk scores in these bioregions. The RRAMF for the ETPS showed that while most species have high biological risk, the low interaction rates reported by fisheries maintained low to moderate risk categories for most species groups. A trial has also been conducted using a camera placed on a demersal gillnet vessel to investigate the efficacy of electronic monitoring to (a) identify protected species interactions, and (b) determine byproduct and target species catches.

2 Evans, R. and Molony, B. W. 2010. Ranked Risk Assessment for Bycatch in Multiple Fisheries: a Bioregional Risk Assessment Method. Fisheries Research Report No. 212. Department of Fisheries, Western Australia. 88pp.

WEST COAST ECOSYSTEM MANAGEMENT TABLE 1

The areas and proportions of the West Coast Bioregion making up continental shelf waters (< 200 m depth) where habitats are protected from the physical disturbance of trawl fishing. The areas which are formally closed to trawling would be equivalent to meet the IUCN criteria for classification as marine protected areas as category IV. The area of habitat effectively protected refers to the area where trawling doesn't occur.

Total Area of Shelf	Area of shelf equivalent to IUCN marine protected area <= category IV (%)	Maximum area of actual trawling activity	Total area of habitat effectively protected (%)
19600 sq nm	11000 sq nm (56%)	300 sq nm	19300 sq nm (98%)

WEST COAST ECOSYSTEM MANAGEMENT TABLE 2

ANNUAL UPDATE OF RISK LEVELS FOR EACH WEST COAST ECOLOGICAL ASSET.

Risk levels in this Table are developed by combining the risks of lower level elements (usually indicator species) that make up each of these higher level (regional) components. Low and Moderate values are both considered to be acceptable levels of risk, whereby Moderate Risks will generally have some level of directed management actions associated with these which will be outlined in the detailed reports in the rest of the West Coast section. High and Significant risks indicate that the asset is no longer in a condition that is considered acceptable and additional management actions are required by the Department except where the value is followed by (non-fishing) this indicates that all, or the majority of the risk value, was not generated by fishing or related activities but by activities managed by other agencies.

Ecosystem Structure and Biodiversity

Ecosystem	Aquatic zone	Risk	Status and Current Activities
Abrolhos Islands	Marine	MODERATE	The Abrolhos Islands are protected within a 'Fish Habitat Protection Area', and are not considered to be at unacceptable risk from fisheries related activities. The first significant bleaching of corals was observed during the marine heat wave event along the Western Australian coast in 2011 (Abdo <i>et al</i> 2012) ¹ , with the impact of this event being monitored as part of an ongoing monitoring program run by the Department. The program also includes monitoring of key invertebrate species, and the community structure of finfish within and outside of non-fishing areas.
Central West Coast	Marine	MODERATE	An assessment of the community structure and trophic level of all commercially caught fish species over the past 30 years found no evidence of systematic changes that could be evidence of an unacceptable impact on this ecosystem (Hall and Wise, 2011) ² . Continued monitoring of a deep water closed area will aim to quantify potential ecosystem impacts of lobster fishing in these deeper water ecosystems.
	Estuaries/ Embay.	SIGNIFICANT (non-fishing)	The estuaries and embayments within this area have been identified as being at significant risk, due to external factors (water quality issues due to high nutrient runoff from surrounding catchment) which have the potential to affect fish and other communities. Poor water quality within the Peel – Harvey and Swan – Canning estuaries, and to a lesser extent Cockburn Sound are of particular concern.

1 Abdo, D.A., Bellchambers, L.M., Evans, S.N. (2012) Turning up the Heat: Increasing Temperature and Coral Bleaching at the High Latitude Coral Reefs of the Houtman Abrolhos Islands. PLoS ONE 7(8): e43878.

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

Ecosystem	Aquatic zone	Risk	Status and Current Activities
Leeuwin Naturaliste	Marine	LOW	The impacts from fishing and other sources on the marine communities are relatively low in this region. In collaboration with the Department of Parks and Wildlife (DPAW), the Department has established a EBFM stepwise, risk-based research and monitoring program within the Ngari Capes Marine Park. This represents one tool used by the Department to assess the effectiveness of its overall management strategies in the management of the fish resources within the wider West Coast Bioregion.
	Estuaries	HIGH (non-fishing)	External factors such as water quality issues in the Blackwood Estuary, due to high nutrient run-off from surrounding land, as well as acid-sulphate soil contamination are of concern to sustainable fish stocks and the ecosystem in general.

Captured fish species: Details of the analyses for these scores are located in the individual fishery reports.

Captured Species	Aquatic zone	Risk	Status and Current Activities
Finfish	Estuarine	SIGNIFICANT (non-fishing)	There is concern for some indicator fish stocks within estuaries in the West Coast Bioregion mainly due to external (non-fishing) factors (poor water quality).
	Nearshore (0-20m depth)	HIGH	With the increasing concerns for Australian herring, tailor and whiting in the nearshore regions, research projects are underway to assess these stocks and to develop methods to measure shore based fishing catch and effort.
	Inshore demersal (20-250m depth)	MODERATE	Following assessments of the demersal indicator species (dhufish, pink snapper, baldchin groper), management actions designed to reduce both the commercial and recreational catch levels by 50% have now been implemented. Determining catch shares for commercial and recreational users has been underway and a review in late 2010 confirmed that the catch levels have been reduced to desired levels. These stocks are now therefore considered to be in a recovery phase. An updated assessment is planned for 2013.
	Offshore demersal (>250m depth)	LOW	While the indicator species in this deepwater location are vulnerable to overfishing the current catch levels are low and therefore the stocks are not at risk. Long term management arrangements for fishing in these depths, particularly for the recreational sector are still being finalised.
	Pelagic	LOW	There is still minimal capture of pelagic fish in this bioregion.
Crustaceans	Nearshore/ Estuarine	MODERATE	The stocks of crabs in Cockburn Sound have now recovered and the fishery has re-opened. Research on the other stocks of crabs in this region (e.g. Peel/Harvey) has been completed and the stocks are all considered to be in an adequate state and fishing levels are acceptable.
	Shelf (Lobsters)	MODERATE	The stock levels of western rock lobster and prawns are both currently at appropriate levels. The strong management that was applied to the rock lobster fishery has ensured that the lobster spawning stock is currently at record high levels despite on-going relatively low puerulus recruitment over the past 6 seasons.
Molluscs	Nearshore	MODERATE	The stocks of abalone are conservatively managed with strong management controls on both commercial and recreational fishers but the heat wave in 2010/11 caused the almost total loss of Roes abalone in the Kalbarri region. Scallops are managed to acceptable levels using an input controlled system and a catch rate threshold.

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Protected species: Details on the analyses for these scores are either located within the individual fishery reports or in the bioregional level analyses documented in the EBFM report for this Bioregion (Fletcher et al., 2012¹).

Protected species	Species	Risk	Status and Current Activities
Protected non 'Fish' species	Turtles/ Seabirds	LOW	There is minimal impact from fishing activities on any turtle species within this bioregion and the small trawl fishery has to operate using grids. Little Penguins are considered most at risk from boat strikes and non-fishing activities. Few other issues were identified.
	Mammals	MODERATE	Sea lion exclusion devices have now been implemented for rock lobster pots near sea lion breeding islands which has reduced the risk to low levels. The reduction in fishing effort for lobsters had considerably reduced potential entanglement of whales but the extension of the season post June has required a re-assessment of this risk due to increased entanglements in the winter season.
Protected 'Fish' Species	Fish	LOW	Blue groper (Rottnest Island), cobbler (Swan Canning) and white sharks are within this category and are already unable to be landed by commercial or recreational fishers.

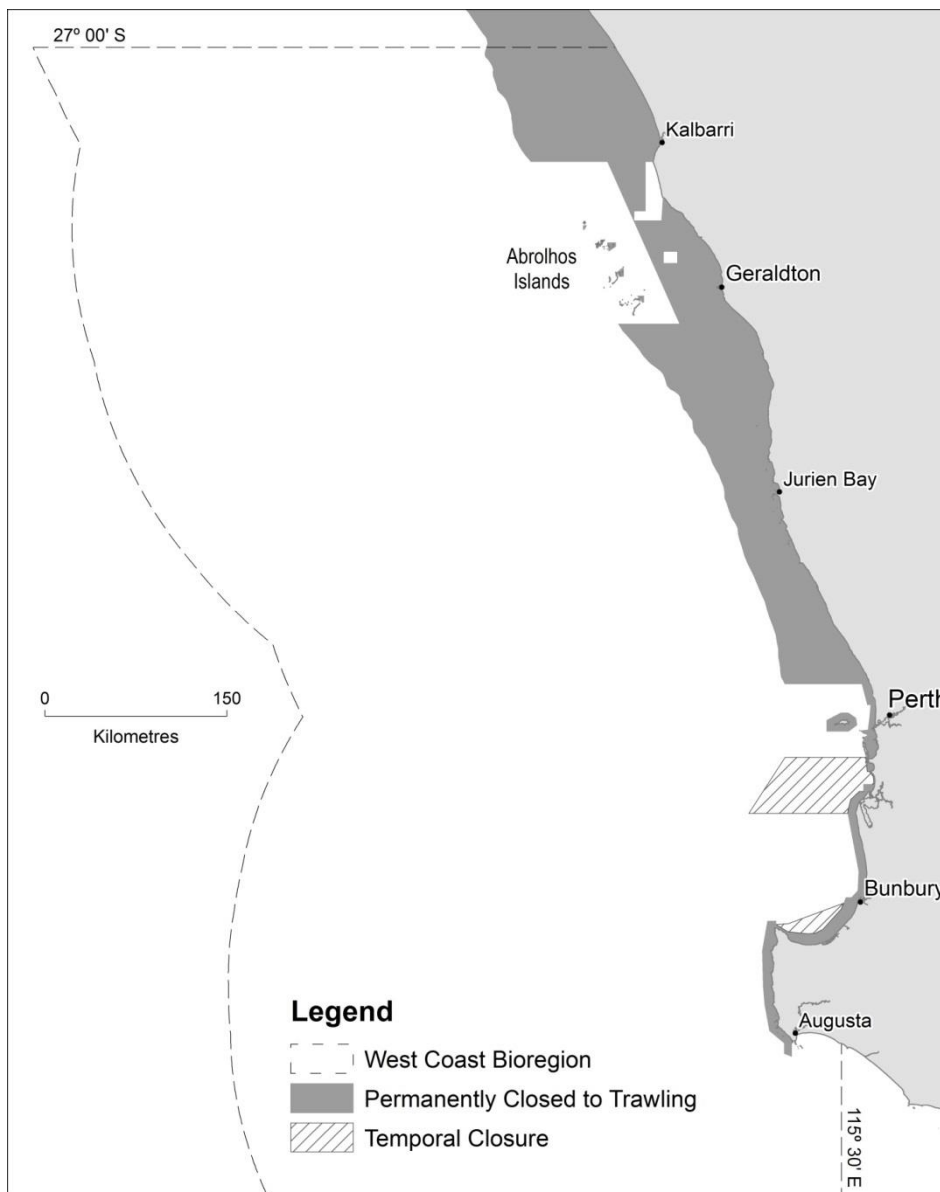
Benthic habitat: Details on the analyses for these scores are located in West Coast Ecosystem Management Table 1 above and in the individual fishery reports.

Benthic Habitat	Category	Risk	Status and Current Activities
Estuaries and Embayments	Sand	SIGNIFICANT (non-fishing)	Estuarine and embayment habitats are threatened by various non-fishing factors (poor water quality, direct loss of habitat through coastal infrastructure and physical disturbance, e.g. dredging), sedimentation and smothering by algae. There are minimal impacts of fishing on these habitats
	Seagrass	MODERATE (non-fishing)	Seagrass habitat is threatened from non-fishing related activities (coastal infrastructure and associated dredging (direct habitat loss, turbidity), eutrophication. Strong controls exist for direct destruction of seagrass.
Nearshore (0-20 m depth)	Sand	LOW	Minimal direct impacts (see Table 1) and high recovery rates.
	Seagrass	LOW	No destructive fishing methods allowed in these areas.
	Mangroves	LOW	No destructive fishing methods allowed in these areas
	Rocky Reef	LOW	Minimal direct impacts and high recovery rates.
	Coral Reef (Abrolhos)	LOW MODERATE	Minimal direct impacts. Regular monitoring of corals at the Abrolhos Is. Reduced levels of pot fishing effort in this area are likely to have reduced the risk and this should be reviewed.
Inshore demersal (20-250 m depth)	Sand/ Seagrass/ Rocky Reef/ Coral Reef/ Sponge	LOW	Minimal direct impacts. See Ecosystem Table 1 for details
Offshore demersal (>250 m depth)	Sand/ Rocky Reef/ Sponge	LOW	Minimal direct impacts. See Ecosystem Table 1 for details

¹ Fletcher, W.J., Gaughan, D.J., Shaw, J. and S.J. Metcalf (2012) Ecosystem Based Fisheries Management: Case Study Report West Coast Bioregion. *Fisheries Research Report No. 212, Department of Fisheries, Western Australia* 104 pp.

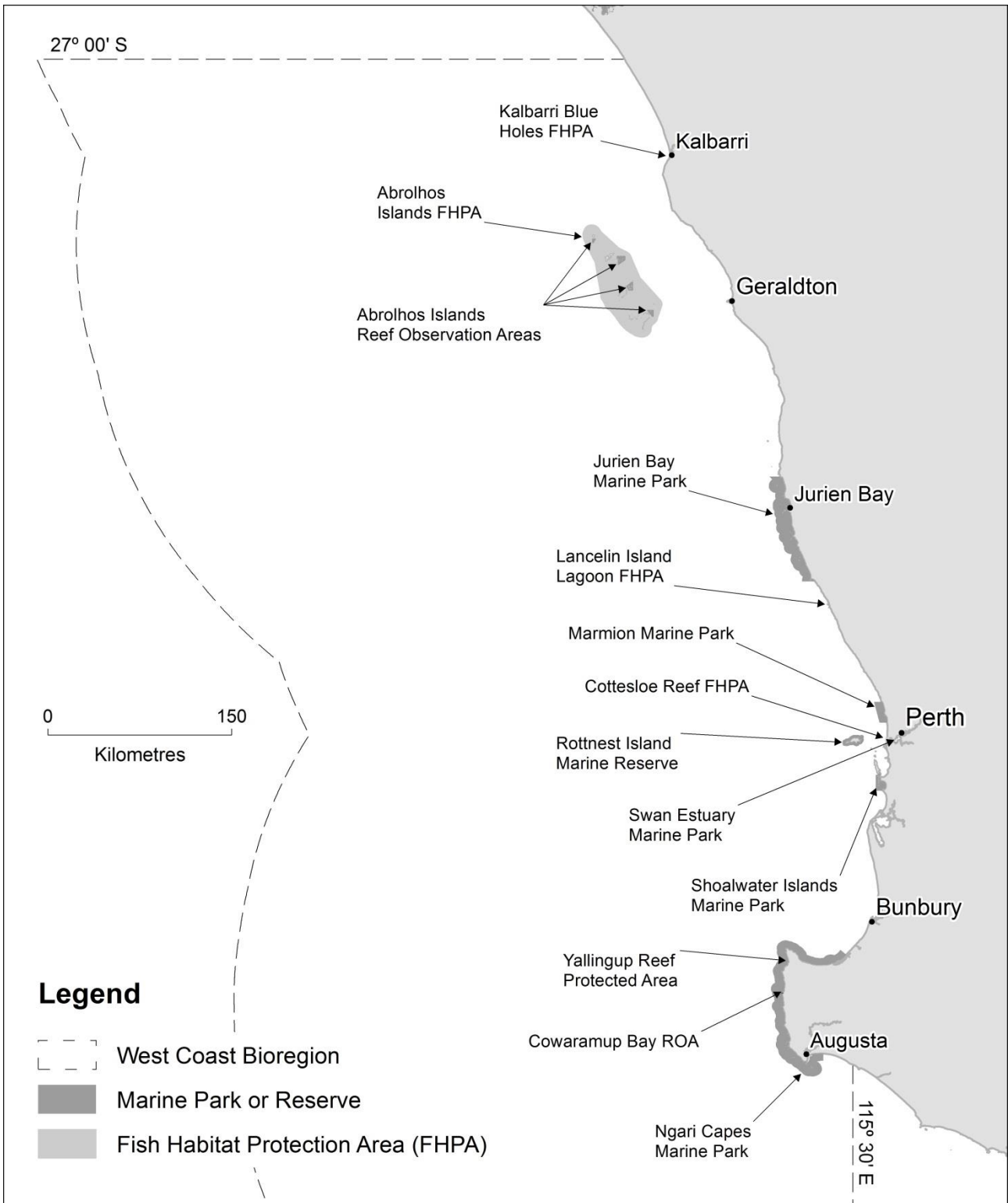
External Drivers: Details on some of the analyses used for these scores are located in the individual fishery reports plus there were whole of region assessments completed in the draft West Coast EBFM report.

External Drivers	Risk	Status and Current Activities
Introduced Pests and Diseases	MODERATE in short term	Port monitoring plans have been implemented targeting high risk port locations. These designs have been developed in line with the National System for introduced marine pest monitoring. The extent and findings of monitoring activities in this bioregion are detailed in the Introduced Pests Status Report at the end of this chapter.
	HIGH in medium term	
Climate	MODERATE in short term	Projects to examine potential impacts on this bioregion are now underway or planned. Some climate change impacts on rock lobster biology had already been taken into account in the stock assessment process.
	HIGH in medium term	



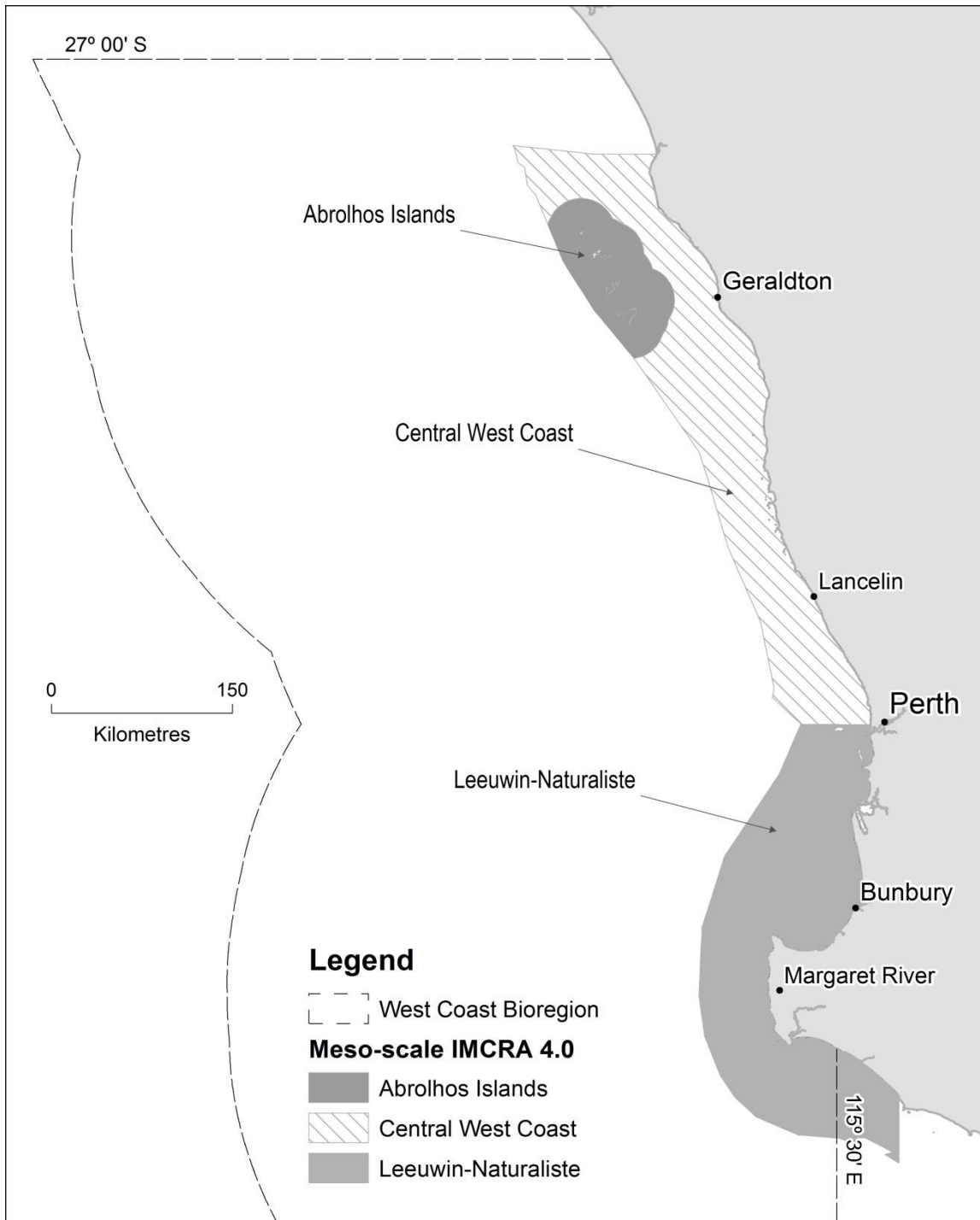
WEST COAST ECOSYSTEM MANAGEMENT FIGURE 1

Map showing areas of permanent and extended seasonal closures to trawl fishing in the West Coast Bioregion. The areas permanently closed are consistent with IUCN marine protected area category IV.



WEST COAST ECOSYSTEM MANAGEMENT FIGURE 2

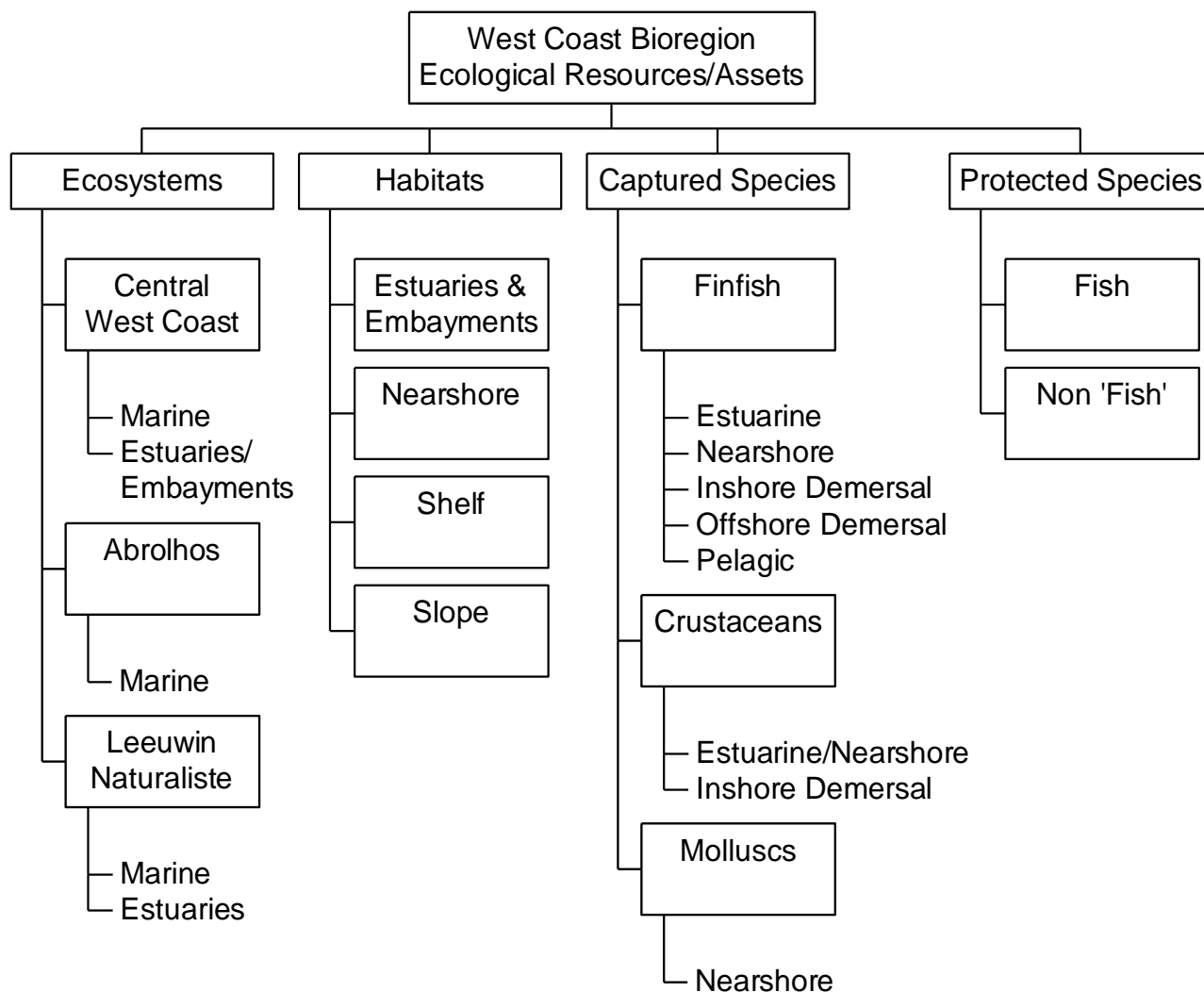
Map showing current and proposed formal marine protected areas in the West Coast Bioregion various areas of which are either consistent with IUCN categories I, II, III, IV or V.



WEST COAST ECOSYSTEM MANAGEMENT FIGURE 3

Map showing the three main IMCRA ecosystems in the West Coast Bioregion: the Abrolhos Is.; the Central West Coast; the Leeuwin-Naturaliste.

Note- This is based on Map 2 in IMCRA v4.0.



WEST COAST ECOSYSTEM MANAGEMENT FIGURE 4
 Component tree showing the ecological assets identified and separately assessed for the West Coast Bioregion.

Introduced Pests Status Report

Regional Monitoring and Research Update

The introduction and spread of marine pests in WA waters poses a serious threat to native biodiversity and can have widespread effects on both our economy and health. To this end the Marine Biosecurity Research and Monitoring (MBRM) group are actively involved in developing and implementing targeted marine pest monitoring and research programs in two ports in the West Coast Bioregion. The aim is to detect the presence of introduced marine pests (IMPs) using a suite of tools. Early detection of IMPs is vital if any attempt at eradication or other management strategies is to be successful. In support of this objective, the MBRM group has implemented a biennial IMP surveillance program which adheres to the Australian Marine Pest Monitoring Guidelines and is endorsed by the Commonwealth. As part of this program, the group has conducted approved large-scale marine pest monitoring programs in Fremantle Port (2011 and 2013) and in Geraldton Port (2013). To complement

these surveys, the MBRM group has developed targeted supplementary monitoring designs to be completed in the intervening years at selected ports. A supplementary survey was completed in Fremantle in 2012 and is planned again for early 2014.

In addition, the Marine Biosecurity Research and Monitoring group, with financial and in-kind assistance from Fremantle Port Authority and the Defence Services Group is running an Early Warning System program using *in-situ* sampling equipment to provide a mechanism for the potential early detection of marine pests in Fremantle Port and HMAS Stirling waters.

Through this combined surveillance the introduced marine pest species that have been detected in this bioregion are reported in Introduced Pests Table 1.

The Marine Biosecurity Research and Monitoring group are

currently conducting five main research projects in the West Coast Bioregion as follows:

- Assessment of the likelihood of a marine pest being introduced into the ports of this bioregion;
- Determination of the efficacy of wrapping a recreational vessel hull to eliminate/kill biofouling on the wet areas of the hull;
- Quantification of the risk associated with recreational vessels for the introduction and translocation of marine pests along our coast;
- Evaluation of the efficacy of new sampling methods

(crab condos) to sample for non-aggressive pest crab species – this project is now completed and has been published in a peer reviewed journal and recommendations for its inclusion into the National System methodologies are being forwarded to the Commonwealth; and

- Determination of the growth, physiology, reproductive strategies, response to stress and impacts of the invasive ascidian *Didemnum perlucidum*.

While conducted in this bioregion, the research outputs are designed to be applicable to biosecurity management across the state.

INTRODUCED PESTS TABLE 1

Introduced marine species detected during MBRM activities in this bioregion.

Common name	Scientific name	Type of organism	IMS/IMP listing
Mediterranean fanworm	<i>Sabella spallanzanii</i>	Polychaete	Pest
Scallop	<i>Scaechlamys livida</i>	Mollusc	Introduced species
Aeolid nudibranch	<i>Godiva quadricolor</i>	Mollusc	Introduced species
	<i>Alexandrium catanella</i>	Dinoflagellate	Pest
Ciona	<i>Ciona intestinalis</i>	Ascidian	Introduced species
	<i>Didemnum perlucidum</i>	Ascidian	Introduced species – likely pest
Asian paddle crab	<i>Charybdis japonica</i>	Crab	Pest
Ivory barnacle	<i>Balanus improvisus</i>	Barnacle	Pest
	<i>Balanus pulchellus</i>	Barnacle	Introduced species
Asian green mussel	<i>Perna viridis</i>	Mussel	Pest
Asian date mussel	<i>Arcuatala senhousia</i>	Mussel	Pest

FISHERIES

West Coast Rock Lobster Fishery Status Report

S. de Lestang, A. Thomson, M. Rossbach and G. Baudains

Main Features

Status		Current Landings (Season 2011/13)	
Stock level	Adequate	Commercial catch	6647 t
Fishing Level	Acceptable	Recreational catch (2011/12)	118 t

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). This fishery was one of the first limited entry fisheries in the world and utilised a sophisticated Individual Transferrable Effort based system for over 20 years. In 2010/11, the fishery began the transition to quota management with a nominal Total Allowable Commercial Catch (TACC). In 2012/13 the fishery moved to an Individually Transferable Quota (ITQ) fishery. With annual production historically averaging about 11,000 t this has been Australia's most valuable single species wild capture fishery and was the first fishery in the world to achieve Marine Stewardship Council (MSC) certification. In early 2012 the fishery was re-certified by MSC for the third time.

Recreational

The recreational rock lobster fishery primarily targets western rock lobsters using baited pots and by diving.

Governing legislation/fishing authority

Commercial

Fish Resources Management Act 1994

Fish Resources Management Regulations 1995

West Coast Rock Lobster Management Plan 1993

West Coast Rock Lobster Managed Fishery Management Plan 2012

Other subsidiary legislation

West Coast Rock Lobster Managed Fishery Licence

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

Recreational

Fish Resources Management Act 1994

Fish Resources Management Regulations 1995

Recreational Fishing Licence

Other subsidiary legislation

Consultation processes

Commercial

The Department undertakes consultation with the Western Rock Lobster Council (WRLC) on operational issues. The WRLC is also the body that must be consulted prior to amending or revoking the management plan for the fishery. Industry Annual Management Meetings are convened by the Western Australian Fishing Industry Council (WAFIC) under a Service Level Agreement (SLA) with the Department. Also under this SLA, Statutory consultation with the WRLC is also undertaken by WAFIC under the SLA.

Recreational

Recfishwest

Boundaries

Commercial

The fishery is situated along the west coast of Australia between Latitudes 21°44' to 34°24' S. The fishery is managed in three zones: Zone A – Abrolhos Islands, north of latitude 30° S excluding the Abrolhos Islands (Zone B) and south of latitude 30° S (Zone C).

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. The majority of recreational lobster fishing occurs in the Perth metropolitan area and Geraldton.

Management arrangements 2011/13 Season

Commercial

The WCRLF is divided into three zones. Historically, this has enabled effort to be distributed across the entire fishery (to prevent concentration of effort and exploitation in localised areas) and has also permitted the implementation of management controls which addressed zone-specific issues.

In 2011/2013, management for the fishery continued the transition toward the implementation of a full ITQ based management system. One element of the transition to a full quota management system was to change the licensing period from 1 October to 30 September (historically fishing between 15 November and 30 June) to a licencing period commencing on 15 January and concluding on 14 January the following

year. The change to the licensing period from October/September to January/January was made to allow fishers to commence their “quota season” just prior to the Chinese New Year, which has previously been a period of very high market demand and correspondingly high beach prices. It was expected that fishers would concentrate their fishing effort during the higher value “reds” part of the season and finish fishing during the highly catchable but lower value “whites” part of the season in November/December.

To achieve this, the 2011/2013 fishing season was extended, permitting fishing in Zones B and C of the fishery from 15 November 2011 to 30 September 2012 and from 15 November 2012 to 14 January 2013. Zone A of the fishery remained open between 15 March and 30 September. To reflect the extended fishing season, the TACC for the 2011/2013 season was set at 6,938 tonnes. This TACC takes into account the previously approved TACC of 5,500 tonnes for the 2011/12 season, plus an additional 1,438 tonnes for the period between 15 November 2012 and 14 January 2013.

Biological controls for the fishery remained in place for the 2011/13 season with restrictions on size limits and protection of females in breeding condition; i.e. in tarspot, berried or setose condition.

Further management arrangements for the 2011/13 season were as follows:

- TACC of 6,938 tonnes
- Individual catch limits with the following number of kilograms per unit:
 - Zone A (from 15 November 2011 – 14 March 2012 and 1 July 2012 – 14 January 2013 noting closure from 1 October – 14 November) 52 kg in the waters of Zone B.
 - Zone A – 48 kg from 15 March 2012 to 30 September 2012 (fishing in Zone A waters)
 - Zone B – 96 kg for entire season
 - Zone C – 102 kg for entire season
- Fishing permitted in Zones B and C of the fishery from 15 November 2011 to 30 September 2012 and from 15 November 2012 to 14 January 2013
- Zone A licence holders permitted to re-enter Zone B after 30 June 2012, but not permitted to return to the Abrolhos Islands once fishing has recommenced in Zone B.
- Big bank to remain closed
- Catch and disposal records (CDR) books simplified, with new books issued for the 2011/13 season. Ongoing use of crate tags, authorised receivers, holding over books, and catch weighing procedures (including the use of landing areas) to monitor fishers’ catch.
- Minimum unit holding required to operate in the fishery reduced from 63 to 60 units of usual and current entitlement.

The use of the Department’s Interactive Voice Response (IVR) catch monitoring system became mandatory from the 15 November 2011. IVR records pre fishing, pre landing and post landing (including the landed catch) nominations which assist in maintaining the compliance integrity of the quota system.

The new management arrangements for the 2011/2013 season were designed to provide western rock lobster fishers with increased flexibility in their fishing operations, as well as to provide the opportunity to maximise the prices they receive for their product by fishing during periods where the market price for lobsters is high.

Recreational

The recreational component of the western rock lobster fishery is managed under fisheries regulations and other subsidiary legislation. A combination of input and output controls are used to ensure that the recreational sector enjoys the amenity of its access to the rock lobster resource, while fishing to their 5% allocated share (western rock lobster). In order to assist the recreational sector attain their full allocation the minimum size for western rock lobster was reduced from 77 to 76mm.

Recreational input controls include:

- Maximum of two pots per licence holder (no limit on total number of licences)
- Pots must meet specific size requirements and have gaps to allow under-size rock lobsters to escape
- Divers can only catch by hand, snare or blunt crook to prevent lobster damage
- Fishing for rock lobsters at the Abrolhos Islands is restricted to potting
- The season runs from 15 November to 30 June each year on the coast, 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
- Minimum size reduced from 77 to 76mm
- Regulations relating the protection of breeding females and the maximum size of females that can be taken are the same as those for commercial fishers

Output controls in 2011/13 were unchanged, allowing a bag limit of six lobsters per person per day, a boat limit of 12 lobsters and a possession limit of 24 lobsters. 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. Within the recreational fishery between North-West Cape and Cape Leeuwin the requirement remains in place for pots to be equipped with escape gaps with a minimum height of 55mm and minimum width of 305mm.

Integrated Fisheries Management

In March 2008, through the Integrated Fisheries Management process, the Minister determined that the allocated shares to the sectors of the West Coast Rock Lobster resource would be 95% to the commercial sector, 5% to the recreational sector and one tonne to customary fishers. The 2009/10 season was the first season where these shares were formally allocated to each sector.

Because of the extended commercial season in 2011/13 the comparison with recreational catch was based on November to June only which equated to 2.5 %, the same as the previous year.

Research summary

Research activities focus on assessing stock sustainability, forecasting future recruitment and breeding stock levels. This involves fishery-dependent and independent monitoring of breeding stock levels and puerulus settlement. Industry performance is monitored through compulsory catch and effort records from both fishers and processors, comprehensive data from voluntary logbook information, and a commercial monitoring program, 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 Ecological Sustainable Development (ESD) and MSC certification. This strategy includes research into the ecosystem effects of rock lobster fishing in deep water.

The latest ecosystem-based Fisheries Research and Development Corporation (FRDC) funded project aims to examine the effects of western rock lobster fishing on the deep-water ecosystem off the west coast of Western Australia. This was started in 2009, using a comparison between fished and unfished deep water areas. A report from this project is due in 2013.

Another project examining lobster populations in fished and unfished zones is ongoing at Rottne Island. This project consists of annual sampling using pots and underwater dive surveys at Armstrong Bay and Parker Point sanctuary zones. Results from the first five years after the no-take regions were implemented have shown a slight increase in lobster numbers within the protected areas. This study also aims to provide additional information on growth, natural mortality and size/sex-specific catchability.

Concern about the status of the breeding stock in the Big Bank region resulted in this area being closed to lobster fishing. Additional independent breeding stock survey sites have been sampled in this area since 2009 to generate baseline information to assess the effects of this closure.

The fishery has experienced below average puerulus settlement for a number of years, with a record low settlement being recorded in 2008/09. A risk assessment workshop to examine the low puerulus settlement was held in April 2009 and a report on this workshop can be found on the Department's website (<http://www.fish.wa.gov.au/docs/op/op071/fop71.pdf>).

A significant amount of research has been focused on the cause of these low settlement levels in recent years. Six projects have been developed and funded by the Fisheries Research and Development Corporation (FRDC):

- Project 1. Identifying factors affecting the low western rock lobster puerulus settlement in recent years.
- Project 2. Evaluating source-sink relationships of the Western Rock Lobster Fishery using oceanographic modelling.
- Project 3. Evaluating the use of novel statistical techniques for determining harvest rates and efficiency increases in the Western Rock Lobster Fishery.
- Project 4. Evaluation of population genetic structure in the western rock lobster.
- Project 5. Assessing possible environmental causes behind the reduced colonization of puerulus collectors by a wide suite of species.

Project 6. A joint funded project between the FRDC and the Marine National Facility - RV Southern Surveyor. Biological Oceanography of the Western Rock Lobster – Winter / Spring Dynamics.

These projects have added to the current knowledge of western rock lobster larvae and settlement and the relationships these have with the environment. The FRDC Project 1 above (in collaboration with CSIRO) identified earlier lobster spawning (from warmer waters) and reduced winter storms as two key factors that may be associated with this trend in lower settlement.

A project to assess the economic performance of the fishery has been funded by the Seafood CRC. This project is examining maximum economic yield assessment, in light of the recent move towards a quota management system, and ways to incorporate the economic assessment into the outputs generated by the stock assessment model.

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. The trends generated by these data, 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 also been undertaken in some years. Estimates of recreational catch using this method have been compared to the estimates from mail surveys. Phone diary surveys are considered to be more accurate than those from mail surveys because they reduce the recall bias in the annual mail surveys and have a higher participation rate. Sample sizes for the phone diary surveys were increased after the 2006/07 survey to improve the accuracy of the estimates.

Retained Species

Commercial landings (season 2011/13):

6647 tonnes

Lobsters: Trends in the annual catches from the West Coast Rock Lobster Managed Fishery are shown in West Coast Rock Lobster Figure 1. Due to the extended season length (14 months) incorporated to allow future seasons to change their start date from the traditional start of 15 November to 15 January, the catch landed by the WCRLF over this extended season of 2011/13 (6647 t) was higher than in 2010/11 (5501 t). In 2011/13 catches in A, B and C Zones were 894, 2397 and 3356 t, respectively with Zone A 5.9% lower, Zone B 27.8% higher and Zone C 25.4% higher than the previous season. The catch taken represented about 96% of the Total Allowable Commercial Catch of 6938 t.

Octopus: Octopus are also caught in rock lobster pots within shallow water (<40 m). The catch rate of 0.02 octopus per pot lift recorded in 2011/13 from the new Catch and Disposal Records (CDR) data was within the historical range of 0.02 – 0.045 per pot lift (1985/86 to 2009/10) previously based on logbook data which represented both retained and returned octopus. The catch levels reported in CDRs only represent the octopus retained but given the value of octopus has increased in recent years, anecdotal evidence indicates that most octopus are now retained.

The catch rate of octopus (incidental landings) is an indicator for this fishery, and at 0.02 octopus per pot lift achieved the performance measure of being within 10% of the historical range \pm 10% (0.020–0.043 octopus per pot lift).

Recreational catch estimate (season 2011/12):

118 tonnes

Since the 1986/87 season, a mail survey has been used to estimate the total catch of the recreational sector. At the end of each fishing season, approximately 10% of people licenced to fish recreationally for rock lobster have been randomly sent a survey asking about their retained catch and level of effort for the season just completed. Typically, 40 – 60% of these surveys have been returned. It is well recognised that this survey method suffers from a recall bias (the inability of people to remember exact details of what fishing they may have completed as long as 7.5 months prior) and due to not all survey recipients returning the survey, a non-response bias (the possibility of non-respondents having different fishing behaviour and success than respondents). To reduce the impact of these biases on mail survey estimates of catch and effort, a phone-diary survey - considered to be less biased (Baharthah, 2007)¹ - has also been run for a number of seasons. Comparison of the two surveys has identified correction factors to standardise the catch rate and effort estimates from the far cheaper mail survey, to that of the phone-diary survey, compared to previous years where only the presented total catch estimate was adjusted.

The recreational catch of western rock lobster for 2011/12 was estimated at 118 t based on the adjusted mail survey, with 79 t taken by potting and 39 t by diving. This represents close to 2.5% of the total catch of lobsters taken during the period 15 November – 30 June, the period when the recreational fishing season is open.

Comparative catch estimates for this period during 2010/11 were 129 t, with 85 t by potting and 44 t by diving. The estimated recreational catch in 2011/12 was therefore 9% below the 2010/11 catch estimate. This is consistent with the forecast of a lower recreational catch in 2011/12 due to low puerulus settlement four years previously.

Fishing effort/access level

Commercial

In 2011/13 the numbers of vessels fishing for lobster were 74 in Zone A, 67 in Zone B and 132 in Zone C. Thus, in comparison to the 279 active boats in 2010/11, a fleet of 273 vessels fished in 2011/13, which was a reduction of 2%.

Under the new management arrangements (TACC), the maximum number of pots allowed to be used to catch rock lobsters is based on 50% of a vessel's unit entitlement. In 2011/13, the fishery recorded 3,602,555 potlifts a 52%

increase on the previous season's potlifts of 2,376,794. This increase at least partly reflects the increased season length but it also reflects the changing behaviour of fishers as they adapt to the new management arrangements that allow fishing in lower catch rate periods when the beach price is higher.

Recreational

A total of 37,335 licenses were sold that permitted fishing for lobsters during some part of the 2011/12 season with an estimated 13,110 (35%) utilised for lobster fishing. Sales of licenses and associated usage figures are substantially higher in years of anticipated 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 2011/12 was 6% lower than the number of active licences in 2010/11 (14,000).

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 6 days, respectively during the 2011/12 fishing season. These rates were similar in the 2010/11 fishing season. Finally, the average catch taken by active pot and diving fishers were 19 and 13 lobsters, respectively during the 2011/12 fishing season. In the 2010/11 season the average numbers of lobsters caught by pot and dive fishers were similar at 20 and 13, respectively.

Stock Assessment

Assessment complete: **Yes**

Assessment method:

Size-structured population model

Breeding stock levels: **Adequate**

Targeted commercial catch next season

(2013/14): **5554 tonnes TACC²**

IFM allocated maximum recreational catch next

season (2012/13): **322 tonnes**

The stock assessment process for this fishery utilises the broad range of fishery and fishery-independent monitoring data as outlined in the research summary.

Indices of egg production are the main indicators for assessing the health of the lobster stock. Prior to 2008/09 these were empirically-based measures presented as the north and south coast fishery-dependent breeding stock indices based on commercial monitoring data and the fishery-independent breeding stock survey (IBSS) indices. Since 2008/09 the development of a fully integrated stock-assessment model that incorporates these data sources along with other information has enabled more robust and spatially comprehensive estimates of egg production to be generated. These model-based indices are now used for assessing the health of this stock and their continued use was a key recommendation from the stock assessment review of the fishery completed in May 2010.

¹ Baharthah, T. 2007. Comparison of three survey methods applied to the recreational rock lobster fishery of Western Australia. Master of Science Thesis. School of Engineering and Mathematics. Edith Cowan University, Western Australia.

² Note this TACC covers a 12 month season.

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The current focus for stock assessment is to determine what effects the current years of low puerulus settlements will have on future catches and breeding stock levels and to assess the effects of different management measures in mitigating any negative impacts.

The management arrangements implemented in recent years include reductions in the pot usage rate, increases in maximum size limit for females, the closure of Big Bank and use of a TACC, are designed to ensure that the overall breeding stock is above, and is projected to remain above, the threshold levels based on the early to mid 1980s with a probability greater than 75% (West Coast Rock Lobster Figures 2, 3 and 4). These model-estimates of breeding stock are supported by fishery-independent surveys that have been undertaken since the early 1990s and show that the breeding stock has been at record-high levels in the last two years.

A performance measure for the fishery is that the egg production index for three breeding stock management areas are projected to be above their respective threshold levels (that estimated to be the early-mid 1980s levels) five years into the future with a probability greater than 75%. The fishery has therefore met this performance measure.

Catch per Unit Effort (CPUE)

A secondary assessment measure is the catch per unit of effort (CPUE) achieved annually by the commercial fishery (West Coast Rock Lobster Figure 1). With the change in management from input (effort controlled), to output (TACC) based on individual catch limits in 2011/13, commercial fishing behaviour has changed dramatically. Under effort controls, fishers were driven to utilise and maximise (through improved behaviour) all available effort to maximise their catches. Under a TACC fishery, fishers are driven to maximise profits through catching the most valuable grades of lobsters during the most profitable periods of the season, while using as little effort as possible. This has resulted in an increase in pot soak times and a move to fishing more in lower catch rate periods when beach prices are generally at their highest. This impacts the relativity of commercial catch rates between the pre and post TACC phases of the fishery, therefore these two periods cannot be compared directly.

Commercial

The downward trend from the 1970s to the 1980s reflects increasing effort during this period (West Coast Rock Lobster Figure 1), which automatically led to a 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).

Typically short-term fluctuations in abundance resulting from the cyclical nature of puerulus settlement were reflected in the legal-sized lobster abundance (CPUE) 3 to 4 years later. The increase in CPUE to 1.68 kg/pot lift (around 52% higher than the previous year) for the 2008/09 fishing season, however, relates more to the significant reduction in effort levels during that season. The low TACC set for the subsequent two fishing seasons (2009/10 and 2010/11) of 5500 t, about half the long-term average annual landing of 11

000 t successfully maintained high levels of legal biomass and high catch rates in these two seasons. It should be noted that the catch rate does not directly reflect the overall abundance of lobsters, because legal catches do not include the large biomass of under-size animals and breeding females, which are both fully protected. Currently catch rates within the fishery are close to record highs, well above the historical long term levels in each zone.

Recreational

The average recreational pot and diving diary-adjusted catch rates were 1.2 and 2.3 lobsters per person per fishing day in the 2011/12 fishing season. These catch rates are similar to the 1.3 lobsters for potting and 2.1 lobsters for diving calculated for the 2010/11 fishing.

Juvenile Recruitment and Recruitment Prediction

Post-larval (puerulus) recruitment to the fishery is monitored on a lunar monthly basis. Recruitment levels are 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. Investigations into additional factors that may be affecting these levels have been underway since the record lows occurred in in 2008 (see Research Summary above).

The annual indices of puerulus settlement for 2012/13 were similar to 2011/12 and while still at relatively low levels compared to historical averages at nearly all sampling sites they represent significant improvements compared with the previous four seasons (West Coast Rock Lobster Figure 5). The 2012/13 settlement will mainly affect catches during the 2016/17 fishing season.

Non-Retained Species

Bycatch species impact:

Low

Commercial western rock lobster fishers were not allowed to retain finfish bycatch during the 2011/13 fishing season.

Protected species interaction:

Sealions (Low)

Whale Entanglements (Moderate)

Previously, the WCRLF interacted with the Australian sea lion, *Neophoca cinerea*, resulting in the accidental drowning of an estimated small number of sea lion pups in rock lobster pots, as the pups attempted to retrieve from the traps the bait or rock lobsters contained in them. Such 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 November 15, 2006 all pots fished in waters less than 20 m 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). SLEDs have also been required to be fitted to all pots fishing in areas less than 20 m in depth around the Easter and Pelsaert Groups in the Abrolhos Islands since 15 March 2011. Video trials have indicated that this device is successful in stopping sea lion pups from entering lobster pots and potentially 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 132 mm. 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 2007/08 – 2008/09 showed that over 95% of pots checked had an approved SLED.

The performance measure for this fishery is that no increase in the rate of capture of sea lions occurs. During the 2011/13 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. Given the significant reductions in effort and hence pot ropes in the water since this assessment was completed, the current risk is probably now even lower.

The performance measure for the fishery is that there is no increase in interactions with turtles. In 2011/13, no leatherback turtles were reported to have been entangled in lobster fishing gear. This incident rate is below the historical range of between two and five entanglements per season over the preceding five seasons. The fishery has therefore met this performance measure.

There were occasional reports of a whale becoming entangled with pot ropes. The humpback whale is the predominant species that interacts with the WCRLF, during both its northward migration to the North West Shelf breeding grounds in June to August and then during its subsequent southward migration in October/November. Owing to the fishery's historical closed season, there was a limited period for interaction. The combination of an increasing population of whales and the extension of the fishing season to 10.5 months in 2012 and 12 months in 2013, interactions have increased to 13 in 2011/13.

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 WRLC 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. The Commonwealth government expressed concern about the increase in whale entanglements in 2011/13 and has placed a number of conditions relating to mitigating the risk of entanglements on the fishery's current

export approval (Wildlife Trade Operation). Research is currently underway to examine ways to reduce the number of entanglements of whales with lobster gear.

The 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 (1989–2009), commercial lobster fishing has resulted in zero to four whale/dolphin interactions per season. Thirteen whale entanglements with lobster gear were recorded during the 2011/13 lobster season. The fishery has therefore not achieved this performance indicator.

Ecosystem Effects

Food chain effects:

Low

Overall, the fishery has previously been found to be unlikely to cause any significant trophic ('food web') cascade effects within shallow waters, 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. A rock lobster-specific ecological risk assessment completed in 2013 considered that, using the data generated from the considerable additional research that has been conducted on this issue over the past six years, the removal of lobster in deep-water regions are unlikely to be having a significant impact on the surrounding ecosystem. This forum subsequently classed this as a low risk.

Habitat effects:

Low

The legislated design of rock lobster pots, the materials they are made from and the strict control of replacement pots prevent '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 Islands. 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. The significant recent reductions in fishing effort will have reduced these risks even further.

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 \$241 million. Employment is seasonal, the fishing season covering ten and a half months from 15 November 2011 to 30 September 2012 and open again 15 November 2012 until 14 January 2013.

A total of 273 vessels and approximately 764 people were

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engaged directly in fishing for rock lobsters in 2011/13. During the year, 6 main processing establishments, located in the Perth metropolitan area (3) and Geraldton (1), Ledge Point (1) and Cervantes (1) serviced practically every location where fishing occurred.

Recreational

With around 20,000 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 2011/13: \$241 million

The price that commercial fishers received for the western rock lobster in 2011/13 was an estimated average of \$36.33/kg in all zones of the fishery. This was 3.1% increase on the \$35.20/kg paid in 2010/11, with the increase due partly to fishers only landing catch when the advertised beach price was high. The overall value of the fishery increased from the previous season's value of \$194 million as a result of more product being caught due to increased season length and because of the higher price paid by overseas buyers.

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

Fishery Governance

Commercial

Current Fishing (or Effort) Level: Acceptable

Commercial catch target (2013): 5554 tonnes

Between 1975/76 and 2011/13 commercial catches averaged 10,092 t including 14,523 t in 1999/2000. More recently, (post 2008/09) the annual catch levels have been based on much lower levels (down to 5,500 t). These variations in catches result primarily from varying levels of recruitment, which have been largely associated with the environmental conditions experienced by western rock lobster larvae and post-larvae, and levels of fishing effort. The record low puerulus settlement in 2008/09 and poor settlement in 2009/10 followed a series of already low recruitment levels. This resulted in a series of catch limits for this period being imposed to generate a carry-over of legal biomass rather than continuing the historical strategy of catching a similar proportion of the available stock each year to ensure sufficient catch rate and breeding stock was available in what would have otherwise been low catch years (2010/11 – 2013/14). For the 2008/09 season this involved restricting the catch to below 7,800 t which required significant effort reductions for both the whites (ca. 35%) and reds (ca. 60%) portions of the season. A similar strategy was adopted for the 2009/10 season where a catch limit of 5,500 tonnes +/- 10% was introduced with effort levels being adjusted throughout the season to maintain the catch within this limit.

A different strategy was adopted from the 2010/11 season as the fishery began the transition to quota. A total catch limit of 5,500 tonnes applied for the fishery with this being allocated to individual licensees. The 2011/13 season was a 14 month season therefore the catch target (TACC) was increased in

proportion to what previously would have been taken at the start of following season (less 25%). The 2013 season represents the first season when industry, through the Western Rock Lobster Council, was provided with a range of biologically acceptable TACCs, which also represented a level of fishing similar to that which took into account the assessment of maximum economic yield. From this range, the WRLC was able to recommend their preferred TACC.

Recreational

Current Fishing (or Effort) Level Acceptable

Target recreational catch limit (2011/12):

290 tonnes

Between 1986/87 and 2010/11 recreational catches have varied between 98 t in 1987/88 to 360 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. From 2009/10 onwards the commercial and recreational sectors have been managed under the principles of Integrated Fisheries management (IFM), which allocates the commercial and recreational sectors 95 and 5% of the total catch, respectively. Under this arrangement the recreational catch limit for 2011/12 based on a commercial catch of 5500 t was 290 t.

The recreational catch estimate for the 2011/12 season was 118 ± 10 t (95% confidence interval of the mean) which was well below their limit catch of 290 t.

New management initiatives (2012/13)

In the final transition to a full ITQ management system, a new management plan, the West Coast Rock Lobster Managed Fishery Management Plan 2012, will be drafted and come into effect on 15 January 2013. This new management plan will result in significant changes to licenses, fishing periods and catch reporting arrangements with a view to providing industry with a more flexible management system to allow fishers to focus on maximising their profitability. Some of the expected changes include:

- 12 month fishing season for all zones
- Grant of discrete Zone B units to Zone A fishers, representing their historical take of lobster from Zone B
- Allowance for the implementation of Fish Eye; an electronic data management system managed by the Department for submitting and recording information related to operating in, and catch taken from, the Fishery

External Factors

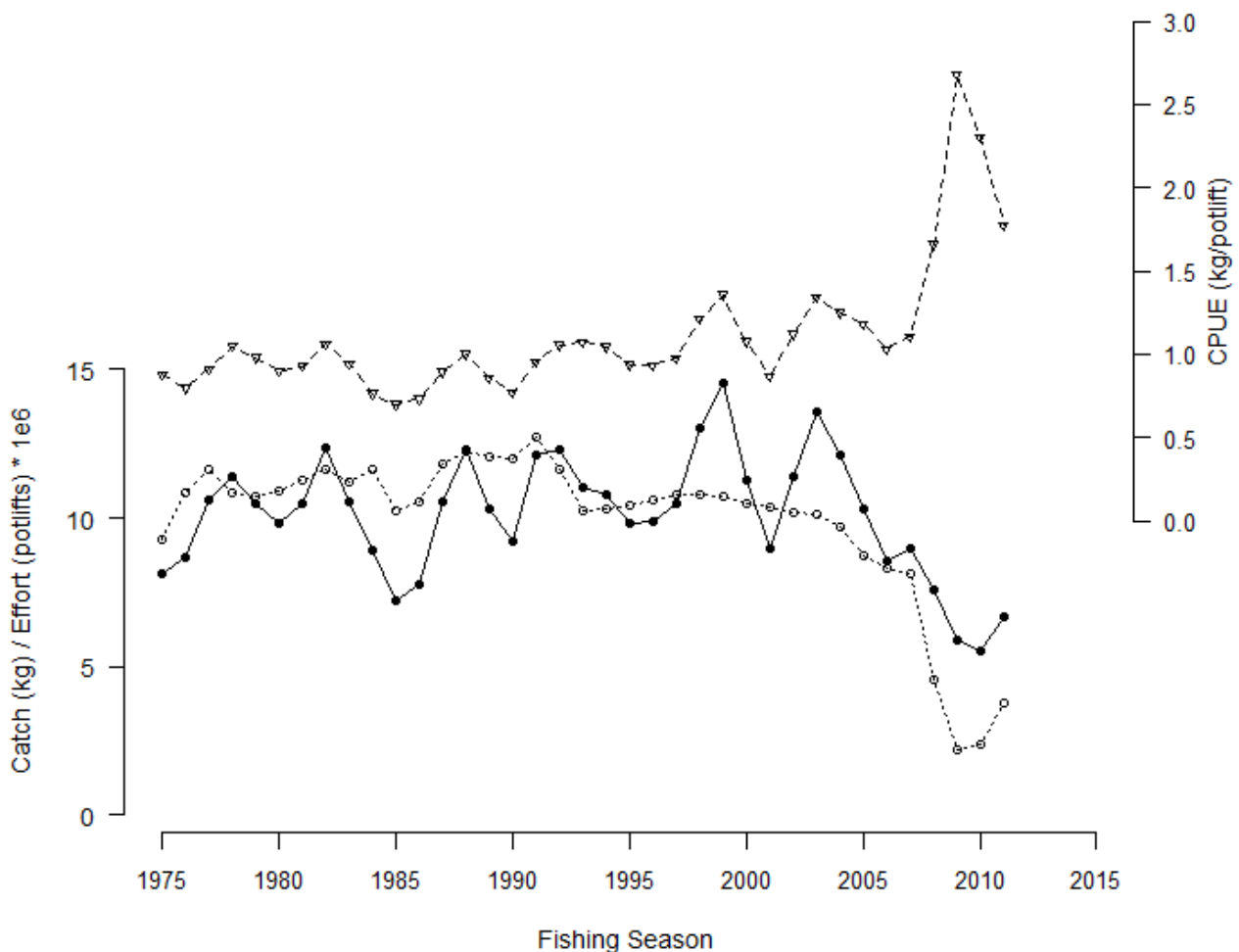
As outlined above, the variations in western rock lobster catches both commercially and recreationally are largely a result of variable levels of puerulus settlement due to changes in the Southern Oscillation (El Niño or La Niña events in the Pacific Ocean) and their effect on the Leeuwin Current. A positive relationship has historically existed 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 combined 2012/13 settlement levels were similar to the previous year and while both were improvements on the series of very low levels, they are still below the long-term average. Factors that may be contributing to this low settlement are currently being examined. There appears to be a change in the timing of the peak of settlement, traditionally the peak occurred in August/September now the peak appears in November/December. At this stage the earlier onset of spawning (which is influenced by water temperatures) and the reduced winter storms provides the best explanation of the downturn in settlement and this is being investigated further (see Research Summary).

Increases in sea-water temperatures over the last 30-40 years,

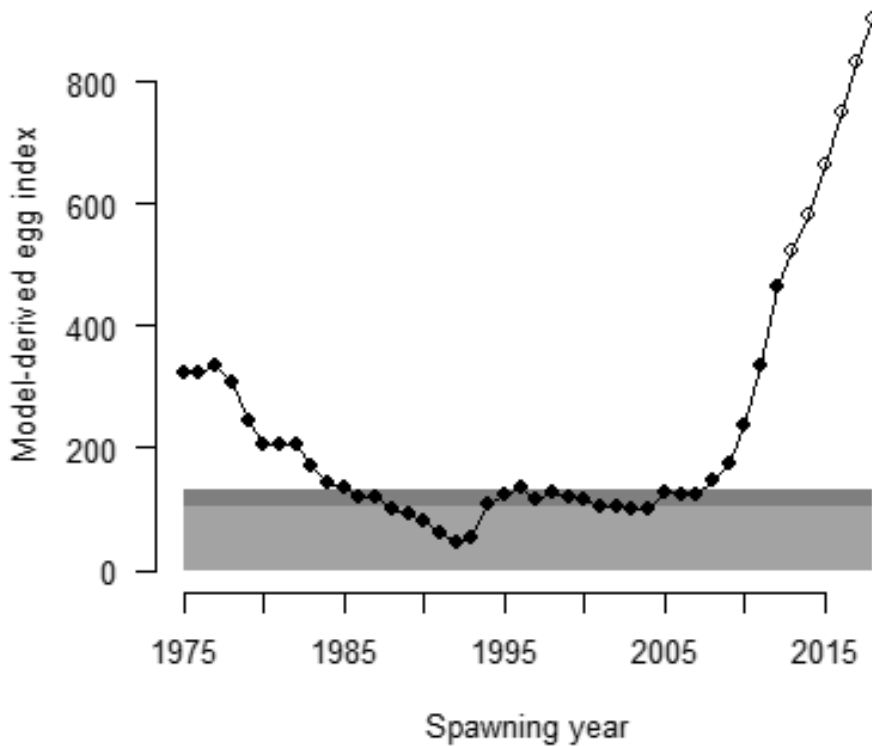
which may be related to climate change, appear to be affecting some of the biological parameters such as size at maturity and size of migrating lobsters. These changes are being taken into account in the stock assessment model and therefore in the future stock assessment of the fishery. An FRDC project examining climate change effects on fisheries will continue work in this area.

The economic performance of the fishery is being strongly affected by the value of the Australian dollar (affecting the price of lobsters), fuel and labour costs as well as the changes to the management of the fishery including the introduction of individual catch limits.



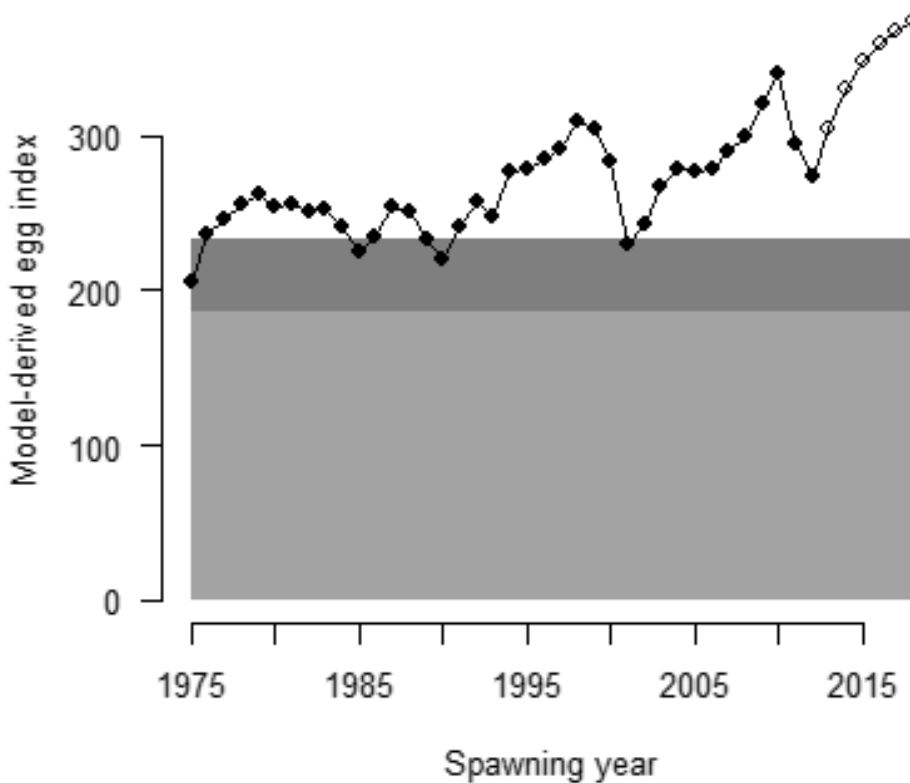
WEST COAST ROCK LOBSTER FIGURE 1

Annual catch (millions of kg), nominal fishing effort (millions of pot lifts) and catch rate (kg / pot lift) from fishers' compulsory monthly returns (pre 2010 season) and daily Catch Disposal Records for the West Coast Rock Lobster Managed Fishery from 1975/76 to 2011/13.



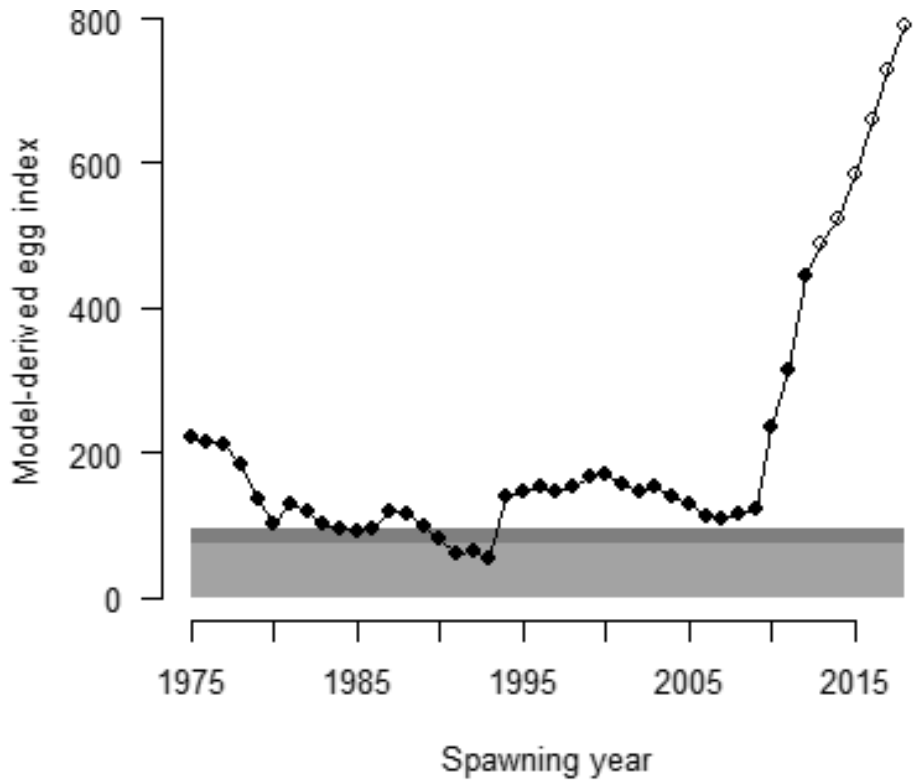
WEST COAST ROCK LOBSTER FIGURE 2

Egg production in the central Breeding Stock Management Area (deep water (> 40 m) Kalbarri, Dongara and Abrolhos Islands). Solid and open points represent historic and future levels of mean egg production under continued levels of commercial catch. The dark grey region represents the 1980's threshold and the light grey region the limit reference area.



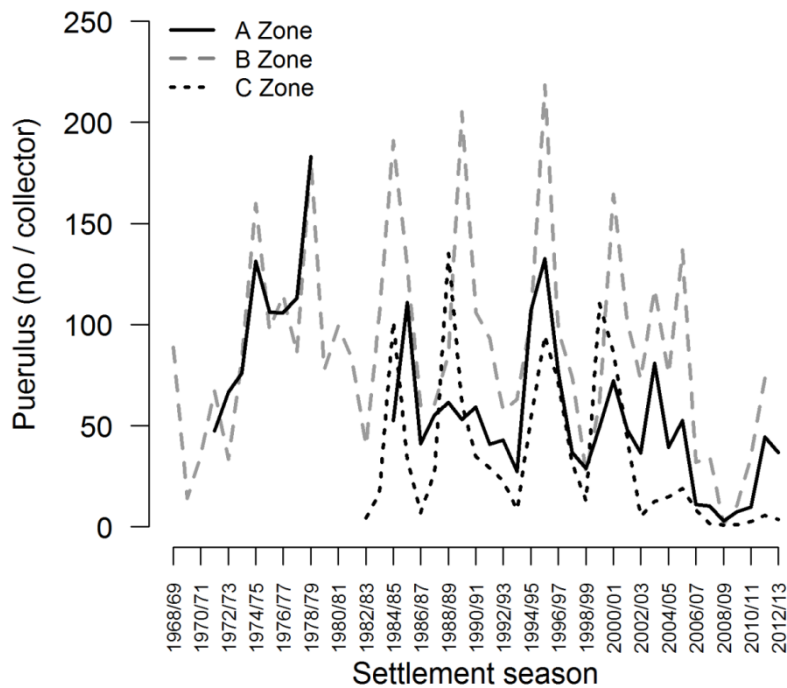
WEST COAST ROCK LOBSTER FIGURE 3

Egg production in the off shallow (<40 m) Breeding Stock Management Area (Abrolhos Islands). Solid and open points represent historic and future levels of mean egg production under continued levels of commercial catch. The dark grey region represents the 1980's threshold and the light grey region the limit reference area.



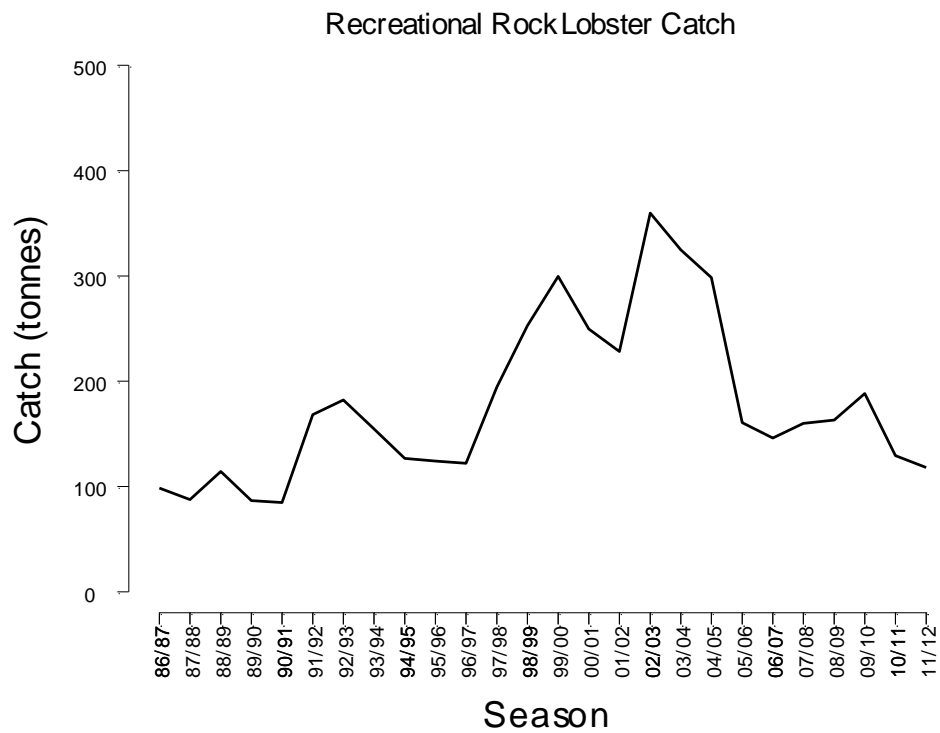
WEST COAST ROCK LOBSTER FIGURE 4

Egg production in the southern Breeding Stock Management Area (deep water (> 40 m) Fremantle, Lancelin and Jurien). Solid and open points represent historic and future levels of mean egg production under continued levels of commercial catch. The dark grey region represents the 1980's threshold and the light grey region the limit reference area.



WEST COAST ROCK LOBSTER FIGURE 5

Annual indices of puerulus settlement from 1968/69 to 2012/13 for A (Abrolhos, solid line), B (Seven Mile Beach, dashed line) and C (Alkimos, dotted line) zones.



WEST COST ROCK LOBSTER FIGURE 6

Estimates of the recreational rock lobster catch since 1986/87 using adjusted mail survey results.

Roe's Abalone Fishery Status Report

A. Hart, J. Brown and J. O'Malley

Main Features

Status		Current Landings	
Stock level	Adequate	Commercial Catch	
		West Coast	28 t
		Other	39 t
Fishing level	Acceptable	Recreational Catch	
		West Coast	18 t
		Other	14 t

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 snorkelling, with the main area of focus for the fishery being the Perth metropolitan stocks (West Coast Fishery).

Governing legislation/fishing authority

Commercial

Abalone Management Plan 1992

Abalone Managed Fishery Licence

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

Recreational

Recreational Abalone Fishing Licence

Consultation process

Commercial

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

Recreational

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

Boundaries

Commercial

The Abalone Management Plan covers all Western Australian coastal waters, which are divided into 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 and includes the metropolitan 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 individually transferable quotas (ITQs).

The overall TACC for 2012 was 92.8 t whole weight (note this small species is generally landed in the whole condition). This was the same TACC as 2011 with the Area 8 fishery still closed as a result of catastrophic mortalities resulting from exceptionally high water temperatures in early 2011 (Pearce *et al.* 2011)¹. 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.

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

WEST COAST BIOREGION

The legal minimum length for Roe's abalone is 60 mm shell length in most parts of the fishery. However, industry initiated commercial minimum length for Area 1 (WA/South Australia border to Point Culver) and Area 7 (Cape Bouvard to Moore River) of 70 mm are applied.

A comprehensive Ecologically Sustainable Development assessment of the commercial fishery has been undertaken to identify any potential sustainability risks requiring direct management under the Commonwealth's EPBC Act requirements for export fisheries. The only issue identified as requiring ongoing management to ensure acceptable performance was the breeding stock levels of Roe's abalone. Boxed text in this status report provides the annual assessment of performance for this issue.

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. The West Coast zone (Perth) of the recreational fishery is managed to an average total allowable recreational catch (TARC) of 40 t.

The fishing season in the Northern and Southern Zones extends from 1 October to 15 May. However, the Northern Zone has been closed to fishing since 2011 due to large-scale stock mortalities resulting from exceptionally high water temperatures in early 2011 (Pearce *et al.* 2011). The West Coast Zone was open the first Sunday of each month from November 2012 to March 2013, five days in total. This was changed from the previous arrangement of 5 consecutive Sundays from the first Sunday in November. The daily allowed fishing time is 60 minutes (between 7.00 a.m. and 8.00 a.m.). Prior to 2006, daily fishing time was 90 minutes.

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.

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.

The main abundance index is an annual standardized catch per unit effort (CPUE) model that takes into account diver, sub-area and month of fishing, as well as technological improvements that aid fishing efficiency. The standardized CPUE data are used in a decision-rule framework for quota setting for each area of the fishery.

Current research is focused on stock assessment using catch and effort statistics, and fishery-independent surveys of Perth metropolitan stocks. Size and density of Roe's abalone across the near-shore sub-tidal reef habitat is measured annually at 13 indicator sites between Mindarie Keys and Penguin

Island. Eleven of these are fished while the other 2 are the Waterman's Reserve Marine Protected Area (MPA), and the Cottesloe Fish Habitat Protection Area (FHPA).

Research translocation trials with funding assistance from the Seafood CRC are underway to see whether they can assist the recovery of abalone stocks in the Kalbarri region affected by the marine heatwave in 2011.

Recreational

Current annual recreational catch and effort estimates are derived from an annual field survey (West Coast Zone / Perth metropolitan fishery), and occasional telephone diary surveys covering all licence holders in the state (last completed in 2007).

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 700 interviews in 2012), 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-which was available at that time) 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.

Research is progressing on an in-season catch prediction model based on environmental conditions, for the Perth metropolitan fishery. This model will assist the Department in managing a summer season for the fishery should this option be adopted in the future.

Retained Species

Commercial production

Season 2012: 67 tonnes whole weight

Metro only: 28 tonnes whole weight

The TACC for the 2012 quota year was 93 t whole weight for Roe's abalone. The 2012 catch of 67 t whole weight (Roe's Abalone Table 1) was 14 tonnes lower than 2011 and about 72% of the TACC. Catch was 25 t less than the quota due to significant reductions in commercial effort (days fished) in all regions except Area 2. The effort reductions in effort driven primarily by economic reasons and a difficult weather conditions, and in the case of the Perth metro fishery (Area 7), there was also concern over potential negative effects on growth resulting from the 2011 marine heatwave. The Area 1 and Area 8 of the fishery were not fished in 2012 (Roe's Abalone Figure 1)

Recreational catch

Season 2012: Roe's Metro Fishery 18.6 tonnes

**(Season 2007): Roe's rest of state 14 tonnes
(31% of total catch)**

The recreational catch for Roe's abalone from the Perth metropolitan area in 2012 was 18.6 t (Roe's Abalone Table 2). This was a decrease of about 17% from 2011, and occurred as a result of the extremely poor weather conditions and a consequent large reduction in effort.

Based on the Perth recreational fishery for 2012 (18.6 t), and using the 2007 phone diary estimate for the rest of the state (14 t), recreational fishing represented about 33% of the total (commercial and recreational) Roe's abalone catch (100t) across the state in 2012.

Fishing effort/access level

Commercial

Total effort for dedicated Roe's abalone divers in 2012 was 372 diver days, lower than last year's effort of 426 diver days (Roe's Abalone Table 1). Reductions in effort in 2012, as outlined above, were driven by primarily economic reasons, and concern over potential negative effects on growth in the Perth metro fishery, resulting from the 2011 marine heatwave.

Recreational

For the 2012 season, 15,561 licences were issued allowing abalone fishing (Roe's Abalone Figure 3). This was the second year in which only abalone specific licenses were available to those wishing to fish for abalone. Umbrella recreational licenses, which allow for the catch of multiple species, have been phased out (Roe's Abalone Figure 3).

Effort in the Perth fishery for 2012 was 7,972 hours, a 30% reduction from 2011 effort of 11,396 hours (Roe's Abalone Table 2) and the lowest in the 14 years of data collection. This was primarily due to poor weather conditions and a 10% drop in licenses issued. The new summer season was part of ongoing adjustments in management as part of the IFM process. Since 2006, daily season length has been shortened from 1.5 hours to 1 hour, and number of fishing days from 6 to 5. The new monthly Sunday fishing day coincided with high tide on most Sundays this year which contributed to the lower catch rate and effort.

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

Assessment level and method:

Level 4 - Catch Rates / Direct Survey

Breeding stock levels: Adequate

CPUE and TACC assessment: The standardised CPUE (SCPUE) for the Roe's abalone fishery is the main performance indicator for the abundance of legal-sized abalone. This indicator replaces the raw CPUE data used historically, however the raw CPUE data has been provided for comparative purposes.

The SCPUE for dedicated Roe's abalone divers in 2012 was

27.3 kg/hr, which was slightly lower than the 2011 catch rate (Roe's Abalone Table 1). The exception is Area 8 commercial (Northern Region for recreational), which has been closed to all fishing to promote stock recovery following an environmentally induced mass mortality (Pearce *et al.* 2011).

The catch rate of recreational fishers in the Perth metropolitan fishery of 25 abalone/hour in 2012 was greater than the 2011 catch rate of 23 abalone per hour (Roe's Abalone Table 2).

Stock surveys: Densities of sub-legal animals (less than 60mm in size) on the platform habitat of the fished stocks in 2013 were 40 abalone m⁻², a drop of 9 m⁻² compared with 2012 (Roe's Abalone Table 4). Within the subtidal habitat, densities of sub-legal animals have also decreased and are back to densities recorded in 2009. Densities of legal-sized animals (60+ mm) on the platform habitat have increased in 2013 (11 m⁻²), compared to 9 m⁻² in 2012 (Roe's Abalone Table 4). With the significant decline in recreational catch in 2011 and 2012, legal-size densities are recovering towards historical levels.

In the subtidal habitat, legal-sized densities were 12 abalone m⁻² in 2013, which is an increase from 2011 (10 m⁻²) and close to their long-term average (Roe's Abalone Table 4).

Densities of legal-sized Roe's abalone in the MPA are about 40% higher on the platform habitat, compared with the fished stocks (Roe's Abalone Table 4). For sub-legal animals, densities have significantly declined and are now 25% lower than in the fished stocks (Roe's Abalone Table 4). There have been major declines in 2013 from 2012 in subtidal stocks of both legal and sub-legal sized stocks of 55% and 40% respectively at the MPA. This is indicative of environmentally related mortality.

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 2012 the standardised CPUE were within the agreed ranges in all areas fished, indicating that overall breeding stock levels were adequate (Roe's Abalone Table 5). However the total catch indicator was only met in the Area 2 fishery. The low catch was due to poor economic and adverse weather conditions.

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 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.

The recreational fishery provides a major social benefit to those sectors of the community that appreciate the abalone as a delicacy, and 15,500 licenses were issued that would have allowed fishers to participate in the recreational abalone fishery (Roe's Abalone Figure 3).

Economic Effects

Estimated annual value (to fishers) for 2012:

Level 2 - \$1 -5 million (\$2.1 million)

The estimated average price for Roe's abalone in 2012 was \$25.50/kg. This value was the same as the value in 2011. On the basis of the average price, the fishery was worth approximately \$2.1 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 increased from \$US0.6 in 2000 to >US\$1.00 in 2011. The other factor in the decline in prices is competition from abalone produced by aquaculture.

Fishery Governance

**Commercial
Target SCPUE range:**

28 – 33 kg per hour (all areas combined)

Target effort range: 530 – 640 diver days

To assess whether the catch quota set is appropriate (sustainable) relative to the stock available, Roe's abalone catches should be taken within the range of SCPUE recorded over the 1999 – 2006 fishing years (28 – 33 kg per hour; Roes Abalone Table 1). This range reflects the acceptable variation in catch rates due to weather and recruitment cycles. Roes Abalone Table 5 shows performance measures of each individual area.

The effort value of 372 diver days and SCPUE of 27 kg per hour (Roes Abalone Table 1) both fall below the expected effort ranges. In both cases the main reason was poor economic and adverse weather conditions which altered diver behaviour rather than stock sustainability issues.

Recreational (West Coast)

Target Catch range:

5 year moving average - 40 ± 2 tonnes

The governance range is based on the 5 year moving average of catch in the West Coast Fishery. This range takes in the permitted maximum variations of ± 2t around the TARC (Total Allowable Recreational Catch) of 40 t.

The 5-year (2008-2012) moving average for 2011 was 36 t. This was outside the governance range, and was caused by significant reductions in effort in 2011 and 2012, due primarily to poor weather conditions coupled with a new fishing season.

New management initiatives (2012/13)

The second year of the trial of a summer season for the West Coast Zone of the recreational fishery was undertaken for the 2012/13 summer. The season began on the first Sunday of November 2012 and extended till the first Sunday of March 2012, with fishing taking place between 7 and 8 am on the first Sunday of each month. The trial will continue for one more years. Evidence from the first two seasons indicates a considerable drop in effort.

The Northern Zone of the recreational fishery (Roes Abalone Figure 2), and the Area 8 commercial fishery (Roes Abalone Figure 1) were closed indefinitely for the 2011/12 season and beyond. This was to facilitate stock rebuilding following mass mortality from an environmental event (see External Factors).

External Factors

During the summer of 2010/2011, the West Coast experienced a marine heatwave with sea surface temperatures of up to 3 degrees above average¹. This was widespread with fish kills being recorded across many fish species, however the Area 8 Roe's abalone fishery, particularly in the area around Kalbarri, were the most severely impacted. Mortalities on roe's abalone were estimate at 99.9%+ and a complete closure of the commercial and recreational fisheries

was implemented. Research translocation trials are underway to see whether they can assist the recovery.

Apart from that the main external factor influencing the Roe's commercial abalone fishery has been the decline in beach price and overall economic value over the last decade.

The small size of Roe's abalone means that, as a fishery product, it is in direct competition with small hatchery-produced greenlip abalone. In the recreational fishery, weather conditions have a significant effect on catch rates and total catch of recreational fishers.

ROE'S ABALONE TABLE 1

Roe's abalone catch and effort¹ by quota period with raw and standardised catch per unit effort (SCPUE)

Quota period ²	Roe's TACC kg whole weight ³	Roe's caught kg whole weight	Diver days ⁴ (Roe's divers only)	Raw CPUE (roei divers) kg per day)	SCPUE (kg per hour)
1990	105,000	116,447	936	112	
1991	101,000	109,489	832	118	
1992	105,000	111,341	735	134	26.9
1993	128,000	115,281	832	123	29.3
1994	125,960	117,835	908	113	27.2
1995	125,960	114,501	1,047	98	24.9
1996	125,960	118,715	1,004	106	28.2
1997	126,790	118,738	855	120	29.8
1998	93,960 ⁵	86,425	695	108	27.6
1999 ⁶	119,900	112,949	659	149	29.0
2000	115,900	107,735	647	144	28.3
2001	107,900	99,174	685	126	29.4
2002	107,900	100,471	700	125	27.9
2003	110,900	96,005	723	118	28.5
2004	110,900	107,593	736	126	27.6
2005	112,700	96,496	672	131	30.7
2006	112,700	98,370	625	136	32.4
2007	109,700	90,750	585	132	28.6
2008	106,700	93,197	580	133	28.4
2009	101,800	92,838	554	140	28.3
2010	101,800	91,418	567	134	29.3
2011	92,800	81,607	426	157	29.8
2012	92,800	67,029	372	147	27.3

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), average catch per fisher, 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.

Year	Effort (hours)	Catch rate	Field Survey			
			Catch per fisher	Catch (number)	Catch (tonnes)	Mean weight (g)
1999	16,449	23	17.4	383,600	35.3	92
2000	15,818	21	16.7	330,300	30.2	91
2001	17,727	27	18.8	481,300	44.1	92
2002	18,127	22	17.9	401,500	36.0	90
2003	17,963	26	18.6	442,400	42.6	96
2004	14,614	24	19.0	342,900	31.7	93
2005	12,328	21	17.8	262,700	24.3	92
2006	10,435	29	18.9	297,000	30.2	101
2007	12,433	28	18.4	338,000	34.4	102
2008	14,490	29	18.2	420,000	44.4	106
2009	19,718	27	17.8	517,000	48.6	94
2010	18,010	26	18.7	468,000	43.9	94
2011	11,396	23	17.0	266,000	22.4	84
2012	7,972	25	17.9	205,493	18.6	90

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 13 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.

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	40	29	44	26	4.9	14.0	9.2	21
1998	49	28	51	37	5.3	11.3	13.5	37
1999	55	29	52	26	4.3	6.9	12.0	27
2000	52	25	29	35	2.9	9.9	8.6	31
2001	51	26	38	34	4.2	10.1	7.8	28
2002	42	29	42	39	3.5	9.8	6.9	31
2003	33	27	34	41	5.0	11.2	4.1	25
2004	34	21	33	53	3.9	9.0	4.5	20
2005	35	19	43	40	5.2	8.7	8.7	22
2006	36	19	49	38	6.8	9.5	5.7	20
2007	39	17	42	35	5.3	11.0	6.7	19
2008	42	18	69	37	6.7	12.3	7.3	19
2009	51	16	67	38	8.7	12.0	10.8	24
2010	53	14	77	32	11.8	13.3	8.4	23
2011	51	11	66	26	9.8	12.2	6.4	22
2012	49	9	62	17	10.2	10.3	8.8	23
2013	40	11	30	18	8.8	12.3	3.8	14

ROE'S ABALONE TABLE 5

Assessment against agreed performance measures for 2012.

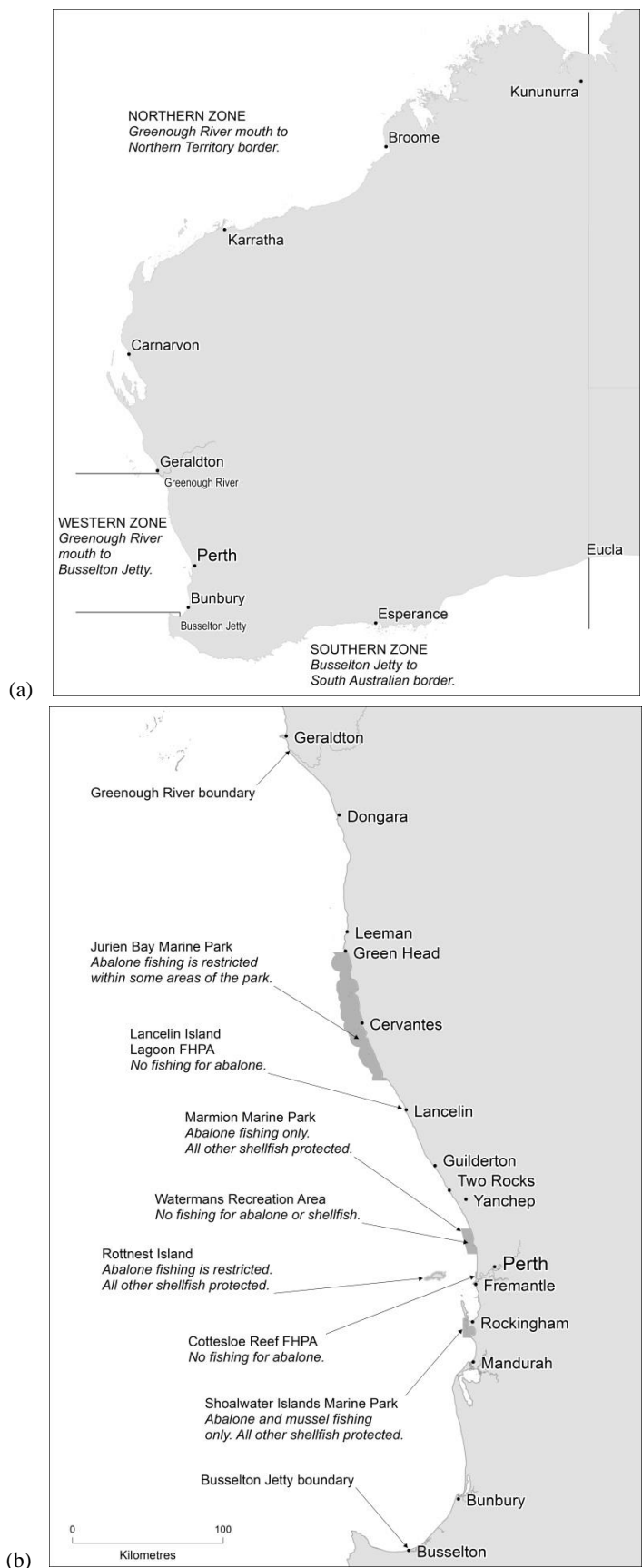
Performance Indicator	Performance Measure ¹	2012 Values	Assessment/Comments
<i>Area 1</i>			
Total catch (TACC)	5,000 kg	0	Exploratory quota – no fishing in 2012.
Effort range (Diver days)	14 – 43	0	See above.
<i>Area 2</i>			
Total catch (TACC)	19,800 kg	18,128	Met – 92% of quota caught.
Standardised CPUE	19 – 29	25	Met
<i>Area 5</i>			
Total catch (TACC)	20,000kg	12,509	Not Met – 63% of quota caught.
Standardised CPUE	15 – 23	21	Met
<i>Area 6</i>			
Total catch (TACC)	12,000 kg	8,497	Not Met – 71% of quota caught.
Standardised CPUE	17 – 25	18	Met
<i>Area 7</i>			
Total catch (TACC)	36,000 kg	27,895	Not Met – 77% of quota caught.
Standardised CPUE	29 – 42	34	Met.
<i>Area 8</i>			
Total catch (TACC)	9,000 kg		Not assessed – fishery closed.
Standardised CPUE	16 – 24		Not assessed – fishery closed.

1. The range in SCPUE represents the Target (upper) and Limit (lower) biological reference points as developed in the following document. Hart A, Fabris F, Caputi N (2009). Performance indicators, biological reference points and decision rules for Western Australian abalone fisheries (*Haliotis* sp.): (1) Standardised catch per unit effort. Fisheries Research Report No. 185. Department of Fisheries, Western Australia. 32p.



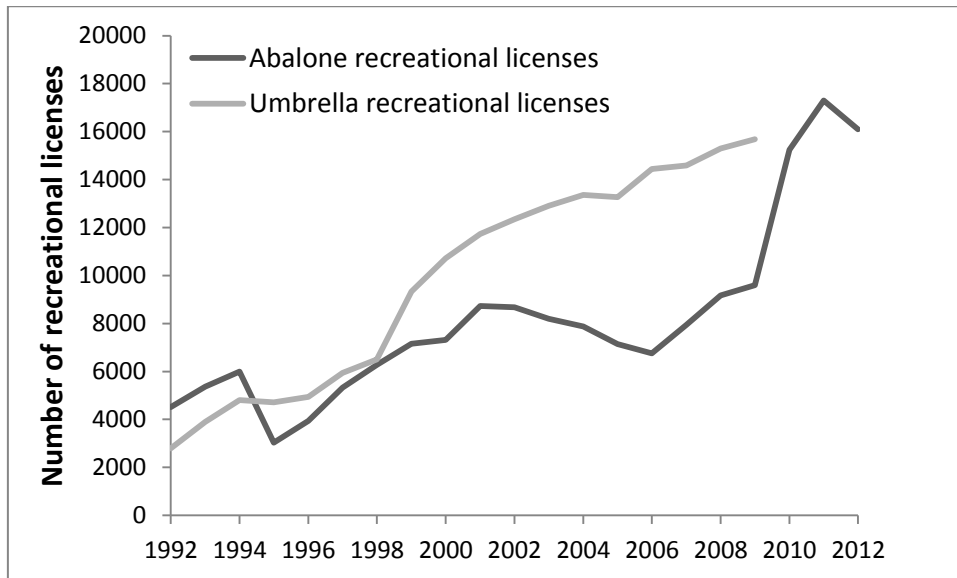
ROE'S ABALONE FIGURE 1

Map showing the management areas used to set quotas for the Roe's abalone commercial fishery in Western Australia.



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.



ROE'S ABALONE FIGURE 3

The number of licences issued in the recreational abalone fishery, by licence type, for the period since 1992. Umbrella licences were discontinued in 2010.

Abrolhos Islands and Mid West, South West Trawl Managed Fisheries and South Coast Trawl Fishery Status Report

E. Sporer, M. Kangas, S. Brown, N. Blay

Main Features			
Status		Current Landings	
Stock level	Inadequate (non-fishing)	AIMWTMF:	Scallops nil (whole weight)
		SWTMF:	Scallops 40 t (whole weight) Prawns 8 t
Fishing level	Acceptable	SCTF:	Scallops 119 t (whole weight)

Fishery Description

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

The South West Trawl Managed Fishery (SWTMF) includes two of the State's smaller scallop fishing grounds – Fremantle and north of Geopraphe Bay. It is a multi-species fishery.

The South Coast Trawl Fishery (SCTF) principally targets scallops (*A.balloti*) and associated byproducts, although in years of low scallop catches licensees may use other trawl gear to target fin-fish species. Scallop landings for the fishery have varied dramatically over the years, depending primarily on the strength of recruitment. While the boundaries of the fishery covers a large section of the south coast, the operations of the fleet are effectively restricted to very small areas of higher scallop abundance.

Each of these fisheries operates using low opening otter trawl systems.

Governing legislation/ fishing authority

Abrolhos Islands and Mid West Trawl Management Plan 1993

Abrolhos Islands and Mid West Trawl Managed Fishery Licence

South West Trawl Management Plan 1989

South West Trawl Managed Fishery Licence

Trawling Prohibition (Whole of State) Notice 1992

Surface Trawl Net Fishery (South Coast) Notice 1992

Trawling for Scallops (South Coast) Notice 1992

Condition 73 and/or 79 on Fishing Boat Licences

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

Consultation process

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

Boundaries

AIMWTMF: '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'.

SWTMF: 'all the waters of the Indian Ocean adjacent to Western Australia between 31°43.38'27" south latitude and 115°08.08' 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 MFL's)
Zone B	South of 32°16' S to west of 115°08' E	(12 MFL's)
Zone C	north-east of Cape Naturaliste	(0 MFL's Closed to trawling)
Zone D	Comet Bay off Mandurah	(3 MFL's)

SCTF: Condition 73 provides for the use of demersal otter trawl nets off the south coast of Western Australia in waters east of 115° E longitude. Condition 79 provides for the use of low opening otter trawl systems for taking scallops within the Recherche Archipelago. The four fishing boat licences have both conditions.

Management arrangements

AIMWTMF

The AIMWTF (including the Port Gregory prawn trawl area) operates under an input control and constant escapement

based management system. There was initially a maximum total net headrope capacity restriction of 336.5m (184 fathoms), specified net mesh size, along with seasonal closures and significant spatial closures protecting all near-shore waters and sensitive reef areas. Bycatch reduction devices (grids) to release large species are fully implemented in the AIMWTMF as a licence condition. The fishery operates to a catch rate threshold level of 250 kg meat weight per 24 hours trawling to cease fishing.

Two restructures (2009 and 2010) have removed 113.4 m (62 fathoms) of headrope, reducing the current permitted overall net headrope capacity to 223.1 m (122 fathoms) with 10 licences. However, the total net headrope used by the 10 boats that remain in the fishery when fishing with two 12.8 m (7 fathom) nets is 256 m (140 fathoms), which is 33 m (18 fathom) in excess of the allowed capacity remaining after the VFAS. An exemption has been approved and there is an amendment sought to remove the current headrope utilisation from the Management Plan and establish standardisation of nets in the AIMWTMF. The same boats fish the AIMWTMF and the Shark Bay Scallop Managed Fishery and use the same size nets (two 12.8 m nets) in the Shark Bay scallop fishery and therefore these sized nets will also be the standard net for the AIMWTMF. This will make fishing more cost effective for licensees.

In 2012 the fishing season did not open for both the AIMWTMF and the Port Gregory prawn trawl area.

Because the AIMWTMF area is fished by the rock lobster and the scallop fishing sectors of the fishing industry, the fishery is spatially separated for the scallop sector into two parts: the traditional parts of the fishery which, are divided into nine fish grounds, and non-traditional areas. The traditional parts of the fishery contain known scallop grounds and these are the grounds historically fished by the scallop fleet. The non-traditional areas, comprise parts of the fishery where scallops are not commonly found and have not been traditionally fished by the scallop fleet. Trawl fishing can be undertaken in this area but there are guidelines for exploratory fishing before any commercial trawl fishing can be undertaken.

The Australian Government's Department of Sustainability Environment Water Populations and Communities (SEWPaC), has assessed the AIMWTMF under the provisions of the Environment Protection and Biodiversity Conservation Act 1999. The SEWPaC Minister granted a further 5-year export approval for the fishery until 15 March 2018.

SWTMF

The SWTMF is a gear based managed fishery that operates under an input control system that limits boat numbers, gear sizes and fishing areas. There is a total of 14 MFLs operating in this fishery, some in more than one zone. The fishing season operates between 1 January and 15 November in Zones A and B. Access to Zone C ceased in 2002. The management plan also includes large closures to protect sensitive coastal habitats (including seagrass beds) and nursery areas such as Cockburn Sound, Warnbro Sound and inshore Geographe Bay.

SCTF

The SCTF is managed primarily by limited entry with only four licences permitted to operate in the fishery. There are also seasonal closures in specified parts of the fishery under

the Trawling for Scallops (South Coast) Notice 1992.

The Department's vessel monitoring system (VMS) monitors the activities of all boats including compliance with the spatial closures.

SEWPaC has assessed the SCTF under the provisions of the Environment Protection and Biodiversity Conservation Act 1999. The SEWPaC Minister granted a 3-year export approval for the fishery until 6 May 2016.

Research summary

Research monitoring of the scallop stocks for all these fisheries is undertaken using mandatory daily logbooks validated by processor returns. Advice on the status of stocks and appropriate season opening and closing dates is provided to industry and management. In the AIMWTMF there is also an annual pre-season survey that provides the information required for assessing the fishery. This pre-season survey is undertaken in the traditional fish grounds and provides scallop abundance information for each fish ground and an overall catch prediction for the fishery.

Retained Species

Commercial landings (season 2012)

AIMWTMF:	Scallops nil whole weight
SWTMF:	Scallops 40 tonnes whole weight Prawns 8 tonnes
SCTF:	Scallops 119 tonnes whole weight

AIMWTMF

No scallop fishing occurred in this fishery during 2012 because the annual scallop survey showed scallop abundance below the limit level to commence fishing.

SWTMF

The recorded landings in the SWTMF for the season comprised 8 t of western king prawns and 40 t whole weight of scallops (West and South Coast Scallop Figure 2). Since 2004 annual king prawn landings have been low, in the range of 3 to 14 t. The scallop landings have declined from the peak in 2010 (217 t), similar to the decline observed to the very high catch of 1990 (221 t). Scallop recruitment and subsequent landings are variable with a historical range between 1 and 221 t whole weight (West and South Coast Scallop Figure 3). Being a multi-species fishery, other products retained include 6 t of mixed whiting spp., 2 t of blue swimmer crabs (*Portunus armatus*) and 1 t of squid. All other landings (mixed fish) were recorded as less than 1 t for each species for a total of (1.6 t).

SCTF

The scallop catch was 119 t (whole weight) which was lower than last year's catch of 176 t. There is generally low effort expended in the fishery and variable recruitment (West and South Coast Scallop Figure 3). Byproduct species landings were negligible with Balmain bugs (*Ibicus peronii*) the most abundant at 1.7 t with less than 1 t of cuttlefish, squid, octopus and mixed fish for a total landed catch of 1 t.

Recreational catch: Nil

Fishing effort/access level

AIMWTMF

In 2012 no commercial otter trawl fishing was undertaken in the AIMWTM including the Port Gregory area.

SWTMF

A total of 176 boat days were fished in the SWTMF a decrease compared to 2011 (279 boat days). This is also low compared to the effort levels (between 1990 and 2003) of generally over 400 boat days. Low effort also reflects the availability of boats to fish in this fishery, inclement weather conditions restricting fishing time and the rising cost of fishing. Also there has been a reduction of boats fishing because of a reduction of commercial License holders in two zones of the fishery who have bought out the other licenses. This allows one licensee to operate one boat whilst owning all three licenses in each zone resulting in a reduction of effort and improving economic efficiency. There is, however still potential for effort to increase markedly because of latent effort in this fishery.

SCTF

For the 2012 season four boats fished for scallops between April and December recording a total of 177 boat days. The effort expended each season in the SCTF is mostly affected by scallop recruitment levels. As a consequence, the level of effort utilised each year closely follows stock abundance and catch levels.

Stock Assessment

Assessment complete:

AIMWTMF: Yes

SWTMF and SCTF: Not assessed

Assessment method:

AIMWTMF: Level 4 - Direct survey, catch rate

Breeding stock levels:

AIMWTMF: Inadequate

SWTMF and SCTF: Not assessed

Projected catch range next season (2013)

AIMWTMF: Scallops nil tonnes

The annual fishing season arrangements in the AIMWTMF are set so that the majority of the mature scallops are able to spawn before fishing occurs. Breeding stocks are therefore protected to ensure that recruitment is dependent only on environmental conditions each year. This fishery is highly variable, being dependent on sporadic recruitment, which appears to be strongly influenced by environmental conditions, e.g. the Leeuwin Current. A pre-season survey is undertaken annually. The 2011 recruitment survey abundance was the lowest observed since 1997 and believed to be mainly due to environmental conditions such as the La Niña conditions and strong Leeuwin Current. This resulted in predicted landings that were less than the target range (95-1830 t whole weight) and therefore, the fishery was not opened for 2012. The very low recruitment would have

resulted in a subsequent low breeding stock in 2012. The 2012 recruitment survey abundance was also very low, probably as a result of environmental conditions as well as the low breeding stock. The predicted landings for 2013 were again below the target range so the fishery did not open.

The main performance measure for the AIMWTM 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 2012 fishing season was not fished due to the low stock available and was all left as the breeding stock.

Bycatch species impact: Low

The AIMWTMF trawl fleet operates over a small portion of the licensed fishing area, focusing on scallop aggregations in several different areas or fish grounds and fishing activity is dependent on how widespread settlement is each season. Scallops settle on relatively bare sand habitats. The overall extent of the fishery is 3808 square nautical miles and of that the permitted trawl area is 2420 square nautical miles, 64% of the extent of the fishery. No fishing was undertaken in 2012.

In the SWTMF trawling for scallops is focused on a few small offshore areas, while the prawn catch is mainly taken from Comet Bay (Zone D).

The large-mesh (100 mm) trawl gear used in the SCTF takes minimal bycatch. The areas trawled by the boats for scallops (primarily in waters near Bremer Bay, the Recherche Archipelago and Israelite Bay) represents a very small percentage of the fishing area within the SCTF waters, therefore bycatch species impact is considered to be minimal.

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 negligible. Aside from migrating humpback whales that usually avoid trawl boats, and occasional great white sharks few other protected, endangered or threatened species, are sighted in this area. For the SWTMF and SCTF whilst some protected, endangered and threatened species frequent these waters they do not occur regularly in the fishing areas. There were no recorded captures of protected species in 2012 for either of these fisheries.

Ecosystem Effects

Food chain effects: Low

The total biomass taken by these fisheries 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 of the licensed area and therefore the total area impacted by trawling is small. Trawling is not extensive and confined to trawl grounds where fishable scallop abundance is significant.

The areas associated with scallops are sandy habitats and trawling activity does not impact these significantly.

Social Effects

The estimated employment of crew for the year 2012 was nil in the AIMWTMF, 6 in the SWTMF and 12 in the SCTF.

Economic Effects

Estimated annual value (to fishers) for year 2011:

AIMWTMF **Level 1 - \$ Nil**

SWTMF: **Level 1 - \$0.3 million**

SCTF: **Level 1 - \$0.6 million**

For the SWTMF and the SCTF the estimated value of the scallop catch is based on wholesale price per kilogram (beach price) obtained from these fisheries, which is \$5.0/kg and \$6.0/kg whole weight respectively. King prawn price was about \$15.00/kg.

Fishery Governance

Target catch range:

AIMWTMF: **95 – 1,830 tonnes whole weight**

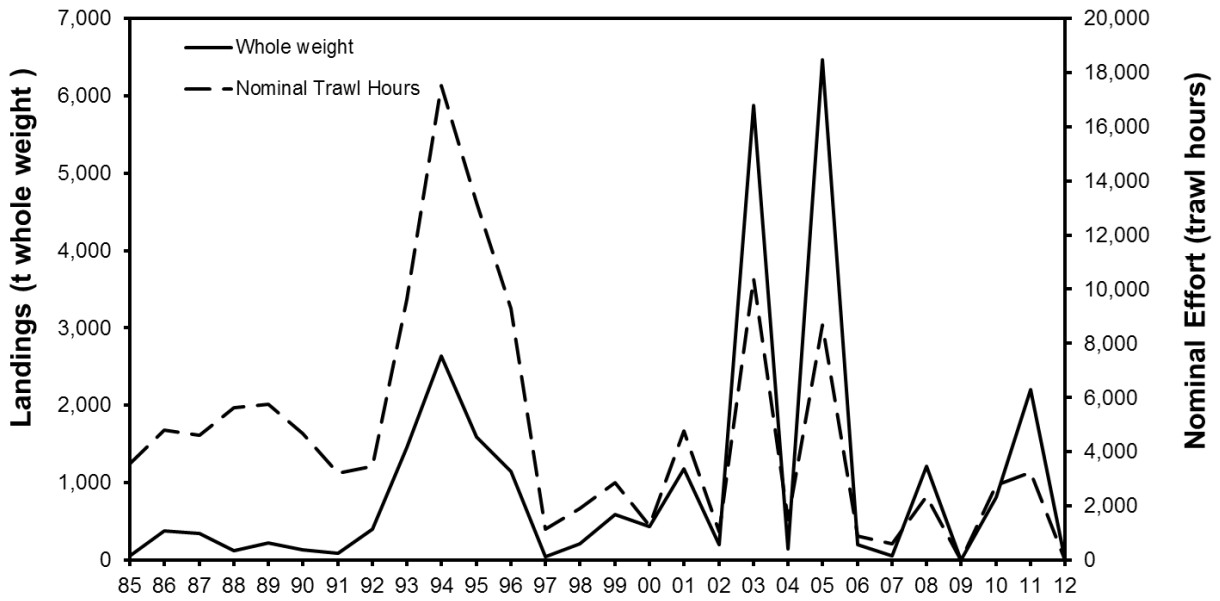
Current fishing level: **N/A**

Except for a small number of years (see External Factors for details) the historic catch range for this fishery is 95 – 1,830 tonnes whole weight. No fishing was undertaken in 2012.

New management initiatives (2013) **nil**

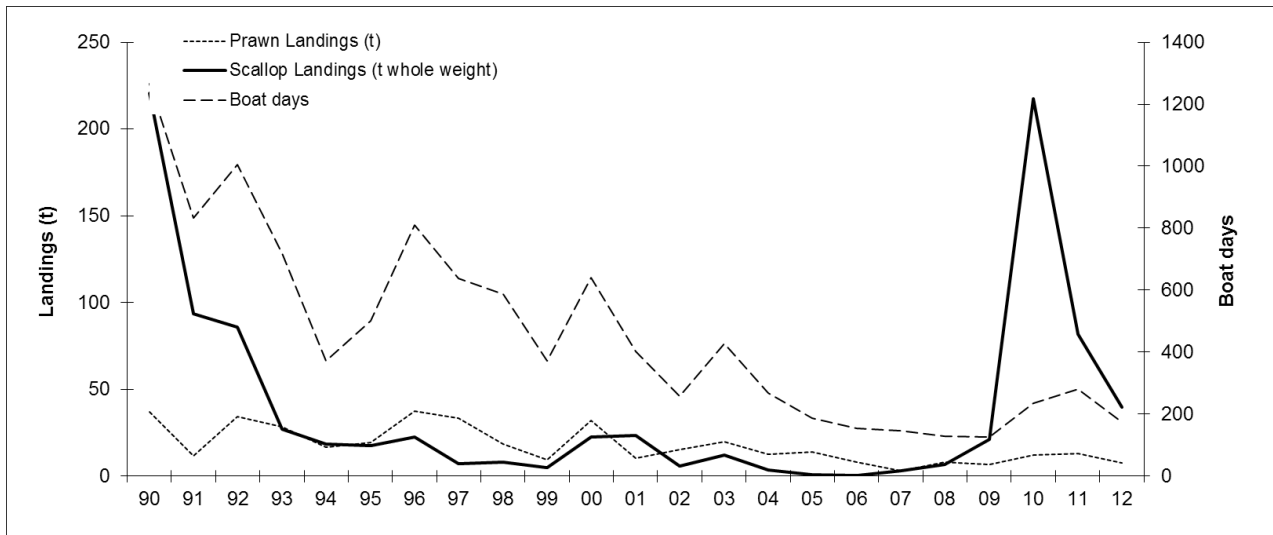
External Factors

High variability in the level of recruitment highlights the dependence of recruitment success upon environmental conditions, such as the Leeuwin Current, rather than spawning stock levels. The relationship between environmental factors and recruitment success is being evaluated for all these regions. The low 2011 recruitment is believed to be mainly due to environmental conditions such as the La Niña conditions and strong Leeuwin Current. The very low recruitment would have resulted in a subsequent low breeding stock in 2012. The low 2012 recruitment was probably influenced by the environmental conditions as well as the low breeding stock. This high variability in recruitment results in a variable level of fishing activity and quantity of catch. Additionally, the high cost of fishing in recent times has affected fishing levels. Meat quality and size (for marketing purposes) are also important in the current economic climate and are factors in determining the amount of effort expended in addition to stock abundance levels.



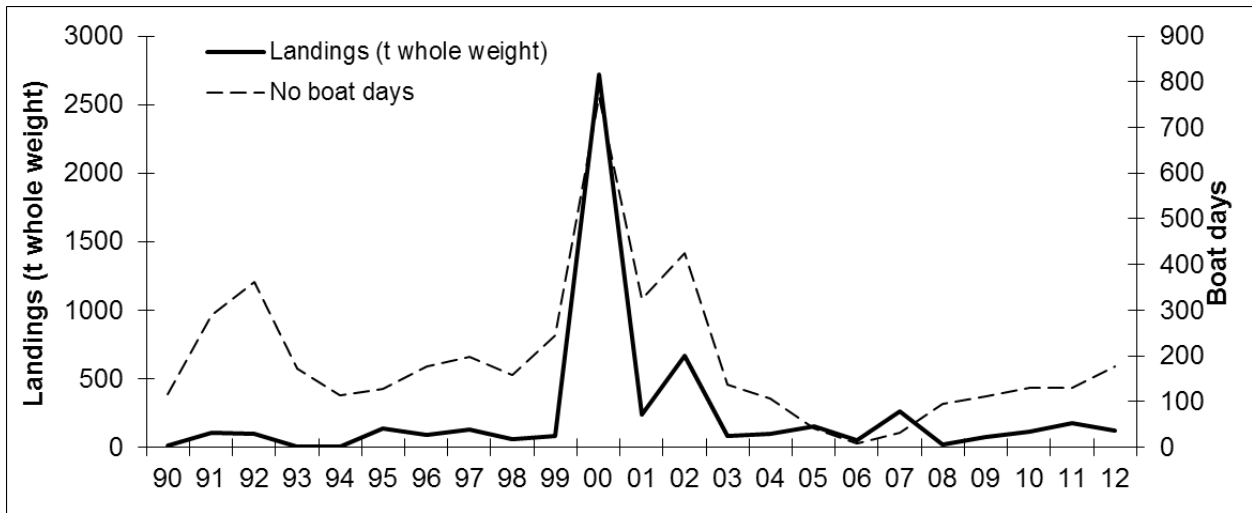
WEST AND SOUTH COAST SCALLOP FIGURE 1

Annual Scallop Landings and Nominal Effort for the Abrolhos Islands and Mid West Trawl Managed Fishery, 1985 – 2011. Note no fishing in 2012.



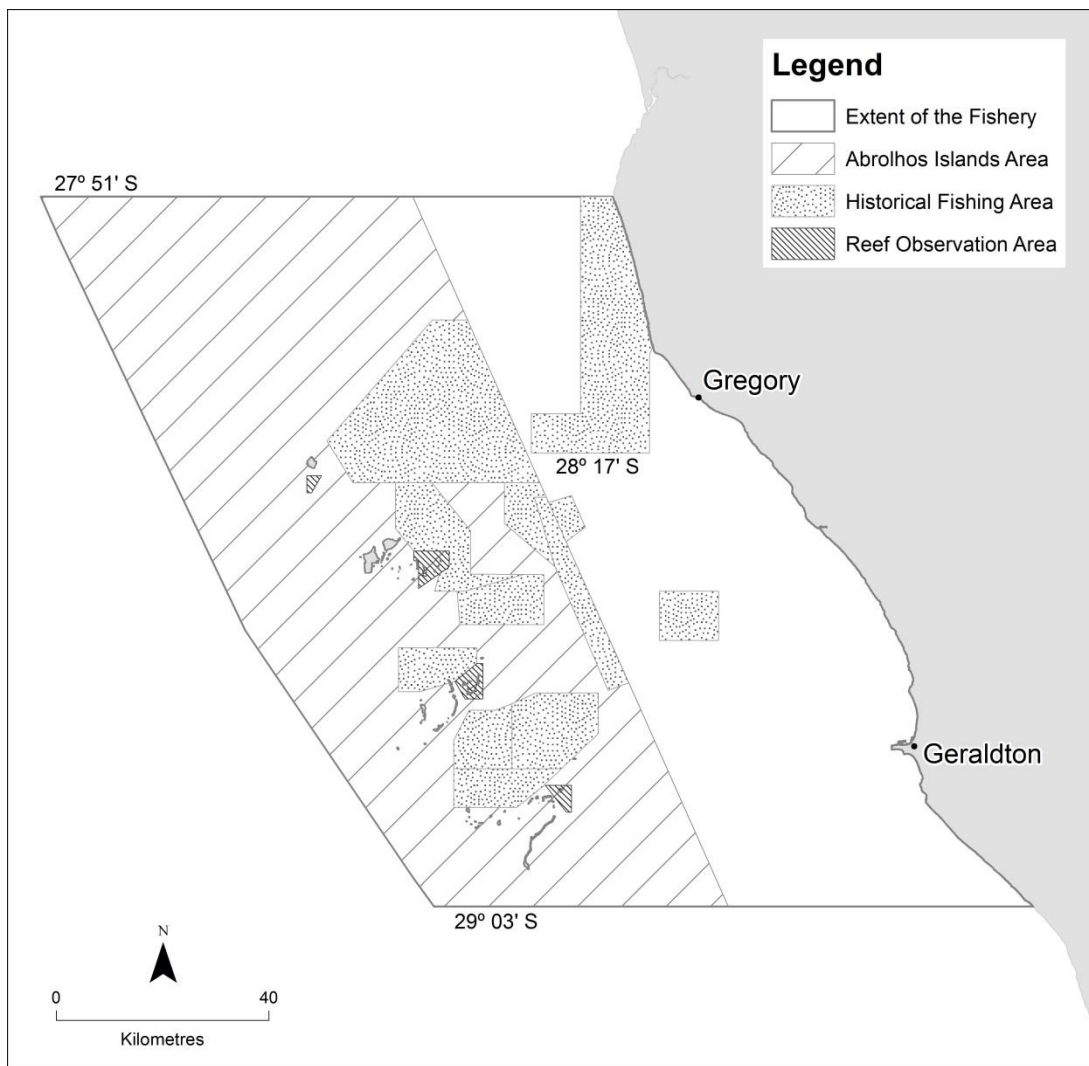
WEST AND SOUTH COAST SCALLOP FIGURE 2

Annual Scallop and Prawn Landings and number of boat days for South West Trawl Fishery, 1990 – 2012.



WEST AND SOUTH COAST SCALLOP FIGURE 3

Annual Scallop Landings and number of boat days for South Coast Fishery, 1990 – 2012.



WEST AND SOUTH COAST SCALLOP FIGURE 4

Boundaries of the Abrolhos Islands and Mid West Trawl Managed Fishery, extent of fishery, Port Gregory area, Kidney patch and reef observation areas. Note there was no fishing in 2012.

West Coast Blue Swimmer Crab Fishery Status Report

D. Johnston, D. Harris and J. Fissioli

Main Features

Status

Stock level	
Cockburn Sound	Acceptable
Peel-Harvey Estuary	Acceptable
Fishing Level	
Cockburn Sound	Acceptable
Peel-Harvey	Acceptable

Current Landings

Total Commercial catch (2011/12)	186 t
Cockburn Sound	46 t
Peel-Harvey Estuary	81 t
Catch by other commercial fisheries	59 t
Total Recreational catch	
West Coast Bioregion (Boat-based) (Feb 11- Mar 12)	87 t
Peel-Harvey Estuary (boat and shore) (Nov 07 - Oct 08)	107-193 t

Fishery Description

The blue swimmer crab (*Portunus armatus*) is found along the entire Western Australian coast, in a wide range of inshore and continental shelf areas, from the intertidal 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).

The commercial blue swimmer crab fisheries within the West Coast Bioregion are the Cockburn Sound Crab Managed Fishery, the Warnbro Sound Crab Managed Fishery, Area I (the Swan and Canning Rivers) and Area II (the Peel-Harvey Estuary) of the West Coast Estuarine Managed Fishery and Area I (Comet Bay) and Area II (Mandurah to Bunbury) of the Mandurah to Bunbury Developing Crab Fishery. Originally, commercial crab fishers in WA used set (gill) nets or drop nets, but most have now converted to purpose-designed crab traps. Blue swimmer crabs are also retained as byproduct by trawlers operating in Comet Bay (Area D of the South West Trawl Managed Fishery), and occasionally by trawlers operating in the waters from Fremantle to Cape Naturaliste (Area B of the South West Trawl Managed Fishery).

Recreational crabbing in the West Coast Bioregion is centred largely on the estuaries and coastal embayments from Geographe Bay north to the Swan River and Cockburn Sound. Blue swimmer crabs represent the most important recreationally fished inshore species in the southwest 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.

There are separate reports for crab fisheries in the Gascoyne and North Coast Bioregions.

Governing legislation/fishing authority

West Coast Estuarine Fishery (Interim) Management Plan 2003

Cockburn Sound (Crab) Management Plan 1995

Warnbro Sound (Crab) Management Plan 1995

South West Trawl Management Plan 1989

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 including WAFIC

Meetings between the Department of Fisheries 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 Developing Crab Fishery covers the waters south of the Shoalwater Islands Marine Park (32°22'40" S) to Point McKenna near Bunbury (33°18' S), and offshore to 115°30' E. The fishery is further divided into two zones. A single northern zone (Area 1) 80-pot exemption authorises crab fishing in a specified area of Comet Bay between 32°22'40" S and 32°30' S. A single southern zone (Area 2) 120-pot exemption authorises crab fishing in the waters between Cape Bouvard and the southern

boundary of the fishery. The area separating the 2 zones (waters between 32°30' S and Cape Bouvard) is closed to commercial crab fishing.

The Geographe Bay fishery was officially closed on 21 January 2005 to reduce conflict between the recreational and commercial fishing sectors and 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. Blue swimmer crabs become sexually mature below 100 mm carapace width. The legal minimum size range varies between 127 – 135 mm carapace width in the fisheries of the West Coast Bioregion – well above the size at sexual maturity (86-97 mm carapace width depending on the fishery).

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 10 crabs per person or 20 crabs per boat. A Recreational Fishing from Boat Licence was introduced in March 2010 that restricts catch to 20 crabs per powered boat when there are two or more people on-board holding Recreational Fishing from Boat Licences and 10 crabs if there is only one person on-board holding a Recreational Fishing from Boat Licence regardless of the number of fishers aboard.

Restrictions also govern gear types that can be used to take blue swimmer crabs, along with localised spatial and temporal closures. Management measures were 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.

In 2006, the Cockburn Sound crab fishery was closed to protect crab stocks that were significantly depleted due to fishing pressures and environmental conditions that resulted in poor recruitment. Commercial fishers were prohibited from taking crabs in all waters 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, 2007/08 and 2008/09 season.

Following a rebuilding of the Cockburn Sound crab stock, the fishery was re-opened on 15 December 2009. A precautionary management approach has been adopted since

re-opening the fishery with several changes being made over the past few years (see Johnston *et al.*, State of Fisheries Reports, 2010, 2011, 2012)¹.

There was further easing of fishing arrangements for the 2011/12 season, with a decrease in minimum size of males and a season extension for the commercial and recreational sectors. The following management controls were implemented:

- a 20% reduction in commercial pot numbers;
- a commercial size limit of 130 mm for male crabs and 135 mm for female crabs;
- a recreational size limit of 127 mm;
- a limited commercial season from 15 December 2011 to 15 June 2012; and
- a limited recreational season from 15 December 2011 to 31 July 2012.

There was slight easing of fishing arrangements for the 2012/13 season, with a decrease in minimum size of females to 130 mm CW (all other season arrangements remained the same).

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. A further licence was removed from the fishery in early 2008.

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 is assessed using fishers' compulsory monthly catch and effort returns, voluntary daily log books from fishers in the Mandurah to Bunbury Developing Crab Fishery, and data from on-board catch monitoring conducted by the Department of Fisheries' research staff in each of the West Coast Bioregion's commercial crab fisheries.

In addition, direct surveys generating recruit, residual and breeding stock indices, along with data on the general crab population, have been conducted in Cockburn Sound for about 10 years and in the Peel-Harvey for five years.

A stock-recruitment-environment model has been developed for Cockburn Sound, which correlates water temperature in

1 Johnston, D. and Harris, D. (2010). West Coast Blue Swimmer Crab Fishery Status Report. In: State of the Fisheries and Aquatic Resources Report 2009/10 eds. W.J. Fletcher and K. Santoro, Department of Fisheries, Western Australia, pp. 54-61.

Johnston, D., Harris, D., Warmbrunn, A. and Coloper, M. (2011). West Coast Blue Swimmer Crab Fishery Status Report. In: State of the Fisheries and Aquatic Resources Report 2010/11 eds. W.J. Fletcher and K. Santoro, Department of Fisheries, Western Australia, pp. 68-75.

Johnston, D., Harris, D., Fissioli, J. and Walshe, K. (2012). West Coast Blue Swimmer Crab Fishery Status Report. In: Status Reports of the Fisheries and Aquatic Resources of Western Australia 2011/12: The State of the Fisheries eds. W.J. Fletcher and K. Santoro, Department of Fisheries, Western Australia, pp. 68-75.

WEST COAST BIOREGION

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 assess the reasons for the stock collapse and monitor the recovery of the fishery. The causes of the collapse and description of the recovery have been described in the scientific paper (Johnston *et al.*, 2011)¹. The stock status of the Cockburn Sound crab fishery, a description of the stock-recruitment-environment relationship for the Cockburn Sound crab stock, and a summary of the crab fisheries in Warnbro Sound and the Swan River have been presented (Johnston *et al.*, 2011)². Reports on the population status of the Peel-Harvey Estuary crab stock, and the 2007/08 recreational crabbing survey in the Peel-Harvey Estuary, are being finalised. A new 3 year project funded through the Recreational Fishing Initiatives Fund will commence in July 2013 to obtain data on recreational catch and effort and crab stocks in the important recreational fisheries of Swan-Canning River, Geographe Bay and Leschenault Estuary.

Retained Species

Commercial landings (season 2011/12):

	Total 186 tonnes
Cockburn Sound	46 tonnes
Peel-Harvey Estuary	81 tonnes
Other west coast commercial fisheries	59 tonnes

The total commercial catch from the West Coast Bioregion in 2010/11 was 186 t, a 16% increase on the 161 t taken in 2010/11. This increase was primarily due to significant increases in crab catch from Warnbro Sound and the Peel-Harvey Estuary, and slight increases in catch from the Mandurah to Bunbury trap fishery. This catch accounted for 53% of the state commercial blue swimmer crab catch of 352 t for 2011/12 (West Coast Blue Swimmer Crab Figure 1).

The commercial catch from the Cockburn Sound Crab Managed Fishery for 2011/12 was 46 t, a 13% decrease from the 53 t caught during the 2010/11 season (West Coast Blue Swimmer Crab Figure 2).

The commercial catch from the Peel-Harvey Estuary (Area II of the West Coast Estuarine Managed Fishery) for 2011/12 was 81 t. This represents a 31% increase on the 62 t in 2010/11 (West Coast Blue Swimmer Crab Figure 4).

The Mandurah to Bunbury Developing Crab Fishery reported an annual catch for 2011/12 of 15 t, representing a 36% increase on the 11 t reported for the 2010/11 financial year

1 Johnston, D., Harris, D., Caputi, N. and Thomson, A. (2011). Decline of a blue swimmer crab (*Portunus pelagicus*) fishery in Western Australia—History, contributing factors and future management strategy. *Fish. Res.* 109(1), 119-130 doi:10.1016/j.fishres.2011.01.027

2 Johnston, D., Harris, D., Caputi, N., de Lestang, S. and Thomson, A. (2011). Status of the Cockburn Sound Crab Fishery. Fisheries Research Report No. 219. Department of Fisheries, Western Australia. 104 pp.

(West Coast Blue Swimmer Crab Figure 5).

Recreational boat-based catch estimate:

West Coast Bioregion (boat-based)

(Feb 11-Mar 12) 87 tonnes

Recreational catch estimate:

Peel-Harvey Estuary (boat and shore)

(Nov 07 - Oct 08) 107-193 tonnes

An integrated survey of boat-based recreational fishing in WA was conducted between 1 March 2011 and 29 February 2012. Most of the recreational blue swimmer crab fishing in Western Australia occurs in the West Coast Bioregion, with 92% of the recreational crab catch reported in a state-wide survey of boat-based recreational fishing in 2011/12 coming from this area (Ryan *et al.*, 2013)³. Catch data were recorded in numbers of animals, and have been converted to weight for this report using a mean state-wide estimate of 229 g/animal (based on 382 crabs weighed during boat ramp surveys). The survey provided a boat-based recreational estimate of retained blue swimmer crabs for the 12-month period for the West Coast Bioregion of 87 t.

This compares with total commercial landings for this bioregion of 174 t over the same period.

The total recreational catch and effort in the Peel-Harvey Estuary which covered fishing from boats, shore, canals, and houseboats was estimated from November 2007 to October 2008 as to be between 107-193 t. This was lower than a similar recreational catch estimate of 251-377 t for this region undertaken in 1998/99.

Within Cockburn Sound, recreational crabbing surveys in 1996/97 and 2001/02, and in the 2002, 2003 and 2004 calendar years, produced relatively consistent recreational catch estimates of 24 t, 25 t, 18 t, 23 t and 18 t respectively for catches made in daylight. The estimated recreational catch for the 2005/06 financial year of only 4 t reflects this was just before the closure for this area was introduced. The portion of Cockburn Sound south of a line drawn between Woodman Point and the northern end of Garden Island was closed to recreational crabbing in 2006 to protect crab stocks that were significantly depleted due to fishing pressures and environmental conditions that resulted in poor recruitment. The whole of Cockburn Sound was re-opened to recreational crabbing for the 2009/10 season from December 15th 2009 to March 31st 2010. A survey quantifying recreational catch and effort in the West Coast Bioregion was conducted over a two-year period between July 2008 and June 2010. The survey provided a recreational catch estimate for the 3½ months of the 2009/10 season of 15.4 t (S.E.±3.3 t) of blue swimmer crabs, for an area covering Cockburn Sound (south of latitude 32°05'S), Shoalwater Bay and the northern half of Warnbro Sound (north of latitude 32°20'S). However, the survey covered only the period during the day between 9am and

3 Ryan, K.L., Wise, B.S., Hall, N.G., Pollock, K.H., Sulin, E.H. and Gaughan, D.J. (2013). An integrated system to survey boat-based recreational fishing in Western Australia 2011/12. Fisheries Research Report No. 249, Department of Fisheries, Western Australia. 162 pp.

5pm. As there is a significant level of early morning recreational crabbing in Cockburn and Warnbro Sounds, an additional survey was conducted between 5.30 am and 9am during the 2009/10 crabbing season. This survey provided an additional recreational catch estimate for this area of 18.8 t (S.E.±5.5 t) of blue swimmer crabs for the 3½ months of the 2009/10 season.

All of Cockburn Sound was again re-opened to recreational crabbing for the 2010/11 season from December 15th 2010 to April 30th 2011.

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 specifically in the Swan-Canning Estuary.

Both the Leschenault Inlet and Geographe Bay are now exclusively for recreational use. Previous surveys have found the annual recreational blue swimmer crab catch from Geographe Bay to be between 7 – 11 t per year.

Fishing effort/access level

After three years of closure due to declining crab stocks, the Cockburn Sound (Crab) Managed Fishery partially re-opened for the 2009/10, 2010/11 and 2011/12 fishing seasons. Commercial fishers in Cockburn Sound reported a total of 76,190 trap lifts for the 2011/12 season, a 38% increase on the 55,294 trap lifts reported during the 2010/11 season (West Coast Blue Swimmer Crab Figure 2) as a result of extending the season by 2.5 months.

Commercial fishers in the Peel-Harvey Estuary reported 48,263 trap lifts during the 2011/12 season – a 17% decrease on the 58,119 trap lifts reported the previous year (West Coast Blue Swimmer Crab Figure 3).

Commercial effort in the Mandurah to Bunbury Developing Crab Fishery increased 61% in 2011/12, with a total of 21,172 trap lifts reported compared to 13,186 trap lifts the previous year (West Coast Blue Swimmer Crab Figure 4), primarily because the Mandurah to Bunbury fisher resumed operations.

Stock Assessment

Assessment complete: Yes

Assessment method and level:

Cockburn Sound Level 4 - Direct survey

Peel-Harvey Level 2 - Catch rate

Other West Coast fisheries Level 2 - Catch rate

Breeding stock levels:

Cockburn Sound Adequate

Peel-Harvey Adequate

Other West Coast fisheries Adequate

Catch rates from crab 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. In addition, direct surveys generating recruit, residual and breeding stock indices, along with data on the general crab population, have been conducted in Cockburn Sound for about 10 years and in the Peel-Harvey for five years.

Cockburn Sound: Historically, natural variations in stock abundance resulted in large fluctuations in the annual commercial blue swimmer crab catch from Cockburn Sound. This fluctuation related largely to variable recruitment dependent on environmental conditions, although the shift by commercial fishers from set nets to crab traps in the mid-1990s initiated a marked increase in effective effort and mean annual crab landings. Following the second highest annual catch on record in 2000 (340 t) the catch began to decline over the next few years to the point where low stock abundance required closure of the fishery in December 2006 for two seasons.

Adequate protection of the breeding stock of blue swimmer crabs in Cockburn Sound had been assumed to occur if the minimum legal size was set well above the size at sexual maturity, which would allow female crabs to spawn at least once before entering the fishery. While this is a common strategy for this species, a combination of biological, environmental and fishery-dependent factors contributed to the collapse and include: 1) vulnerability to environmental fluctuations as this species is at the southern extreme of its temperature tolerance, 2) a life cycle contained within an embayment and is self-recruiting, 3) a change in fishing method from gill nets to traps which increased fishing pressure on pre-spawning females in winter and reduced egg production to one age class, 4) four consecutive years of cooler water temperatures resulting in poor recruitment and 5) continued high fishing pressure during years of low recruitment resulting in low breeding stock.

Fishery-independent trawl and commercial monitoring surveys conducted during 2009 suggested the strength of both recruitment and breeding stock in Cockburn Sound had improved sufficiently to re-open the crab fishery for the 2009/10 fishing season.

The catch in 2011/12 of 46 t was lower than the previous year's catch of 53 t, despite an increase in effort (~80,000 pot lifts in 2011/12 compared to 55,000 potlifts in 2010/11) due to the 2½ month extension of the commercial fishing season to June 15th and a lowering of the minimum size for male crabs from 135 to 130 mm. This relatively low catch was generated by the very high proportion of undersize crabs present in Cockburn Sound resulting in a low proportion of legal sized crabs being present through the season. It appears that the majority of crabs did not moult during the December – January period, with the majority of the cohort remaining at sub-legal sizes for the remainder of the season. Historically, the majority of crabs moult to legal size between December and January, with a high proportion of crabs remaining legal size through the season. This lack of moulting during the 2011/12 season was only observed in Cockburn Sound; the proportion of legal sized crabs in Swan River, Warnbro Sound and Peel Harvey were all at normal or higher levels.

Recruitment index: Based on the juvenile (0+) catches sampled in the research trawls the recruitment of juvenile crabs within Cockburn Sound remained at acceptable levels in 2012. The index has now remained above 1.0 since 2010; substantially above the 0.15 value observed in 2006 (West

WEST COAST BIOREGION

Coast Blue Swimmer Crab Figure 5).

Residual index: The abundance of residual crabs (1+) was again strong in 2012 with the index having now been above 10 for the past three seasons (West Coast Blue Swimmer Crab Figure 5) as a result of the closure and conservative management approach since the resumption of fishing.

Breeding Stock index: The breeding stock (egg production) levels during 2011/12 remains above the proposed threshold breeding stock index of 1.5 (West Coast Blue Swimmer Crab Figure 6) which is based the level of egg production that produced adequate recruitment level during the productive years for the fishery (1989-2003) as determined from the relationship between egg production and recruitment. The levels of juvenile and residual abundance observed in 2012 suggest that the breeding stock in 2012/13 should be maintained at an acceptable level.

Peel Harvey: The mean annual catch rate for 2011/12 in the Peel-Harvey Estuary was 1.68 kg/trap lift, substantially higher than the 2010/11 catch rate of 1.07 kg/trap lift (West Coast Blue Swimmer Crab Figure 3), and representing the highest catch rate since the fishery converted from nets to crab traps in 1996/97.

A recreational survey conducted in the Peel-Harvey Estuary during 2007/08 estimated that the recreational take accounted for approximately 60 % of the total catch therefore the trends in the recreational fishery can affect the stock status. This highlights the importance of having established fishery-independent surveys that will soon be able to complement the commercial logbook and monitoring data.

Mandurah to Bunbury: Mean annual trap catch rates in the Mandurah to Bunbury Developing 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 the region as the commercial operators' knowledge of the spatial and temporal distribution of resident stocks and localized environmental influences increased over time. The mean catch rate for 2011/12 in the Mandurah to Bunbury fishery was 0.71 kg/trap lift – a 12% decrease on the 2010/11 catch rate of 0.81 kg/trap lift (West Coast Blue Swimmer Crab Figure 4).

Monthly monitoring surveys conducted aboard commercial vessels in the Mandurah to Bunbury fishery have indicated a high percentage of female crabs in the catch from this fishery, especially during the peak period of commercial fishing from April to August, and this will need to be closely monitored to avoid overfishing the breeding stock.

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 byproduct 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 crab 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 2011/12, approximately 31 people were employed as skippers and crew on vessels targeting blue swimmer crabs in the West Coast Bioregion.

Blue swimmer crabs also provide a highly popular recreational fishery, particularly in the Swan River, Cockburn Sound, Warnbro Sound, the Peel-Harvey Estuary and the Geographe Bay region, where they dominate the inshore recreational catch.

Economic Effects

Estimated annual value (to fishers) for year

2010/11: Level 2 - \$1-5 million (\$1.65 million)

The commercial blue swimmer crab catch in the West Coast Bioregion for 2011/12 was valued at around \$1.65 million, a 43% increase on the \$1.15 million generated in 2010/11. Most of the catch from the West Coast Bioregion was sold through local markets.

The economic value of the total commercial blue swimmer crab catch for the State of Western Australia for the 2011/12

financial year was estimated to be \$2.53 million – a 58% decrease on the estimated \$6.35 million generated in 2010/11.

Fishery Governance

Current fishing level

Cockburn Sound: Under review
Peel Harvey: 40 - 90 tonnes
Other West Coast fisheries: Under review

The new catch range for Cockburn Sound crabs will need to be developed when the management arrangements are stabilised. The acceptable catch range for Peel Harvey is now determined to be within the last 10 years of catch values. The other west coast crab fisheries are yet to develop a sufficiently stable catch history or set of management arrangements to develop a definitive catch range.

New management initiatives (2012/13)

As an outcome of a review into the management for Cockburn Sound, the following arrangements were implemented in December 2012 for this fishery:

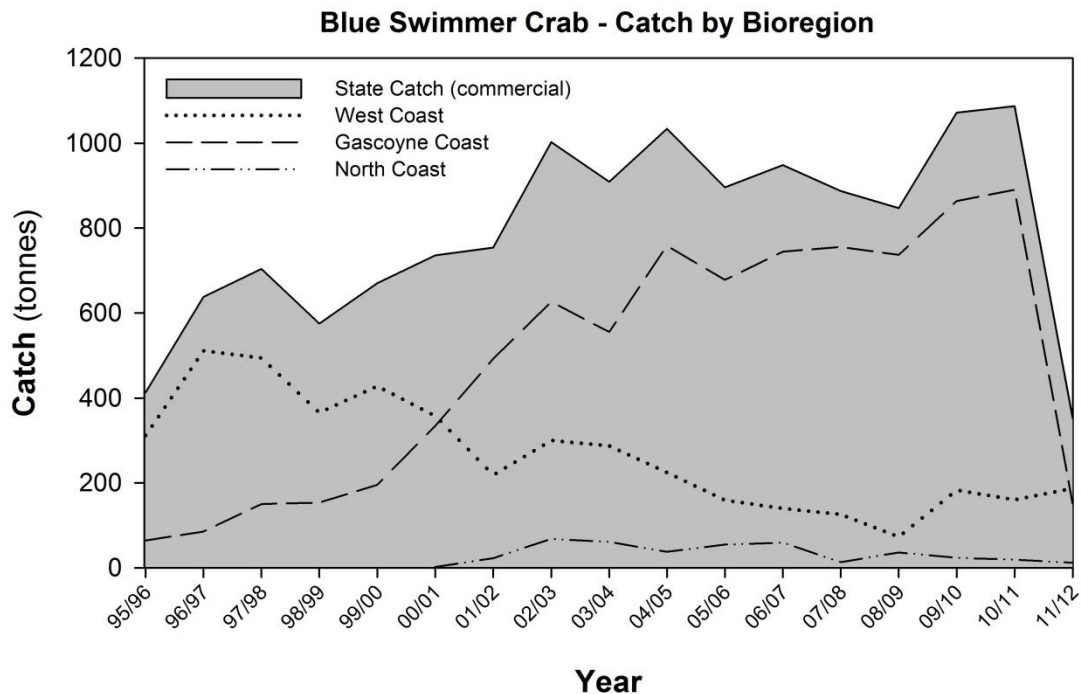
- Maintenance of the commercial fishing season from 15 Dec to 15 June;

- Maintenance of the recreational fishing season from 15 Dec to 30 July;
- A decrease in commercial size limit for female blue swimmer crabs from 135 to 130 mm CW;
- Retention of the commercial size limit for male blue swimmer crabs at 130 mm CW;
- Maintenance of the current 20% pot reduction in the commercial fishery.

The Mandurah to Bunbury Developing Fishery underwent its final review by the Developing Fisheries Assessment Committee (DFAC) in mid-2007 as part of the ‘Developing New Fisheries’ process. The Department of Fisheries is considering the recommendations of the DFAC.

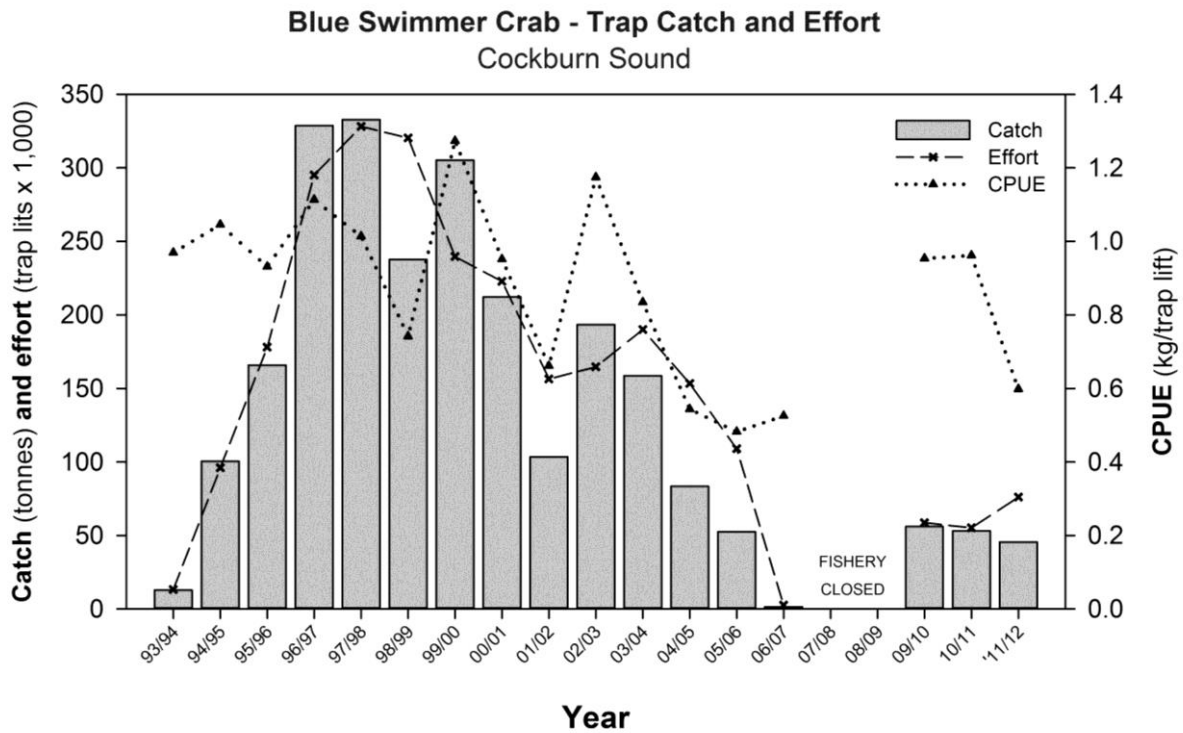
External Factors

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 (e.g. water temperature) both 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.



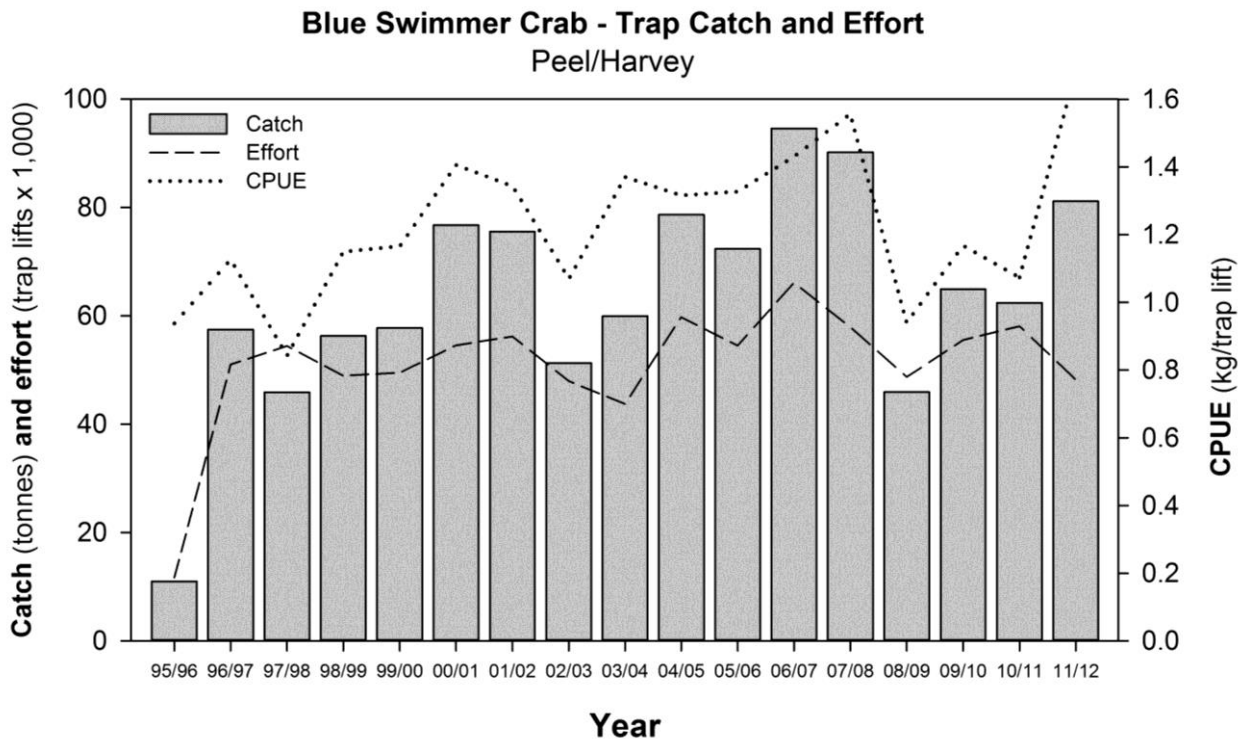
WEST COAST BLUE SWIMMER CRAB FIGURE 1

State and bioregion commercial catch history for the blue swimmer crab in Western Australia since 1995/96.



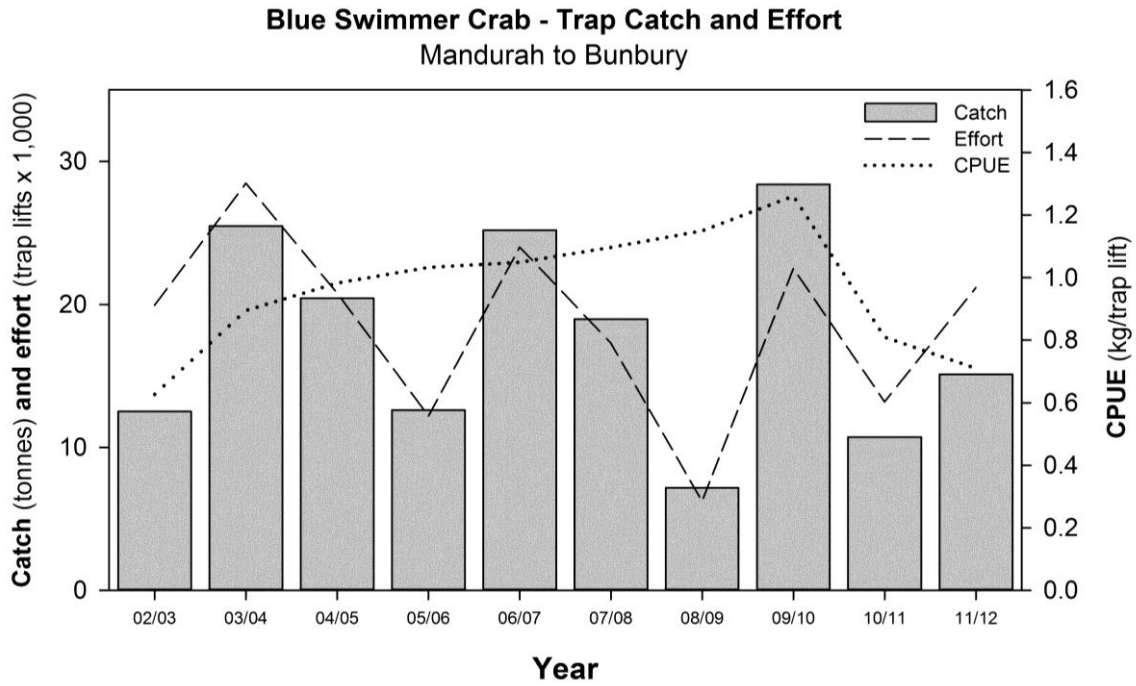
WEST COAST BLUE SWIMMER CRAB FIGURE 2

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 using traps since 1993/94.



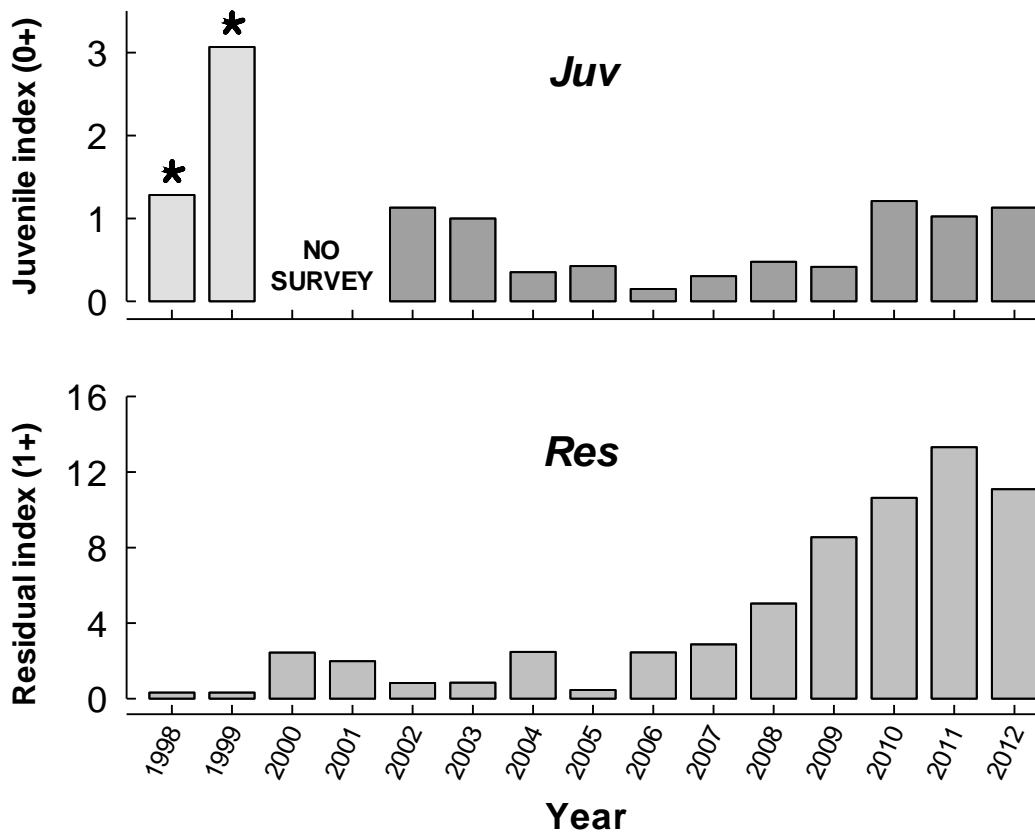
WEST COAST BLUE SWIMMER CRAB FIGURE 3

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) using traps since 1995/96.



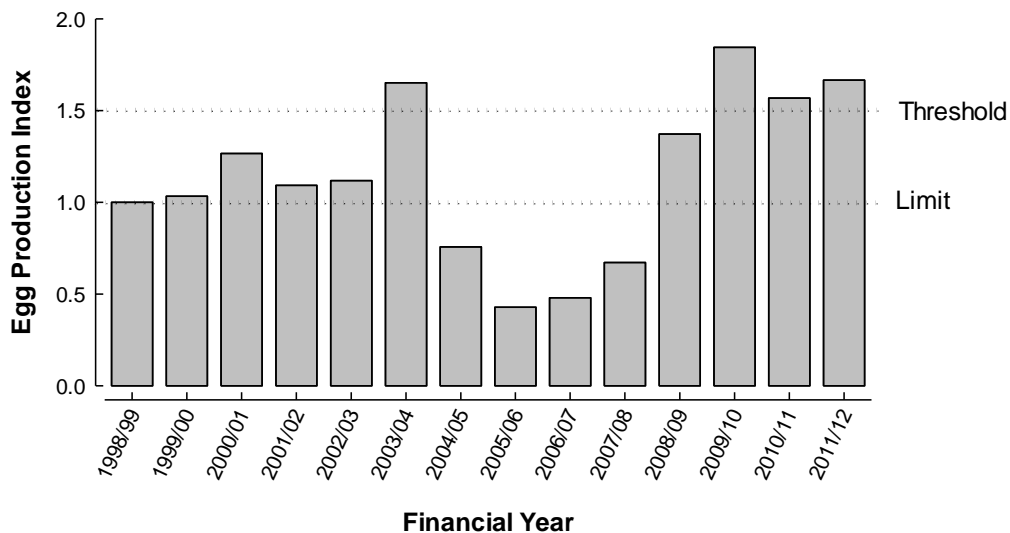
WEST COAST BLUE SWIMMER CRAB FIGURE 4

Blue swimmer crab catch (t), effort (trap lifts x 1,000) and catch per unit effort (kg/trap lift) in the Mandurah to Bunbury Developing Crab Fishery since 2002/03.



WEST COAST BLUE SWIMMER CRAB FIGURE 5

Annual standardized index of juvenile (0+) recruitment and residual (1+) blue swimmer crabs in Cockburn Sound. Juvenile recruitment data was derived from juvenile research trawl conducted in April, May and June of each year, and residual data was derived from catch monitoring surveys aboard commercial crab vessels in August and September of each year. * Daytime trawling (conversion factor (5.84) used for comparison with night trawling).



WEST COAST BLUE SWIMMER CRAB FIGURE 6

Annual standardized egg production index based on numbers and carapace widths of sexually mature female blue swimmer crabs captured during all juvenile trawl surveys between 1996 and 1999, all trawl surveys aboard the Fisheries Research trawlers *RV Flinders* (1999 –2001) and *RV Naturaliste* (2001-2012), and all catch monitoring surveys aboard commercial crab vessels in Cockburn Sound (1999-2012). Proposed threshold (1.5) and limit (1.0) levels are indicated.

West Coast Nearshore and Estuarine Finfish Resources Status Report

K. Smith, A. Howard and J. Brown

Main Features

Status

Stock level:	
Australian herring	Unacceptable
Southern school whiting	Acceptable
Tailor	Acceptable
Southern garfish	Acceptable
King George whiting	Acceptable
Sea mullet	Acceptable
Whitebait	Acceptable
Black bream (Swan-Canning)	Acceptable
Cobbler (Peel-Harvey)	Acceptable

Fishing level:

Australian herring	Unacceptable
Other stocks	Acceptable

Current Landings (2012)

Commercial total	319 t (finfish only)
South West Coast Salmon Fishery	47 t (salmon only)
West Coast Beach Bait & South West Beach Seine Fisheries	83 t (whitebait only)
West Coast Estuarine Fishery	99 t (finfish only)
Recreational total	
Most recent survey 2000/01	940 t (key species only)
Recreational boat-based	
Most recent survey 2011/12	108 t (key species only)

Fishery Description

Commercial - Nearshore

Commercial fishers target a large number of finfish species in nearshore waters of the West Coast Bioregion using a combination of gill nets and beach seine nets.

The Cockburn Sound (Fish Net) Managed Fishery uses haul nets in Cockburn Sound. The main target species are southern garfish (formerly southern sea garfish) (*Hyporhamphus melanochir*) and Australian herring (*Arripis georgianus*).

The South West Coast Salmon Managed Fishery operates on various beaches south of the metropolitan area. This fishery uses seine nets, to take western Australian salmon (*Arripis truttaceus*).

The West Coast Beach Bait Managed Fishery operates on various beaches from Moore River (north of Perth) to Tim's Thicket (south of Mandurah). The South West Beach Seine Fishery operates on various beaches from Tim's Thicket southwards to Port Geographe Bay Marina. These seine net fisheries both target whitebait (*Hyperlophus vittatus*), but blue sprat (*Spratelloides robustus*), sea mullet (*Mugil cephalus*), yellowfin whiting (*Sillago schomburgkii*), southern garfish and yelloweye mullet (*Aldrichetta forsteri*) are also taken in small quantities.

A number of commercial beach net fishers currently operate outside the metropolitan area under an Exemption that allows them to fish in the waters of the West Coast Demersal Scalefish (Interim) Managed Fishery. These fishers mainly use beach seine nets to target sea mullet, mulloway (*Argyrosomus hololepidotus*), Australian herring, yellowfin whiting and southern garfish.

Commercial - Estuarine

West Coast Estuarine (Interim) Managed Fishery (WCEF) operates in the Swan/Canning and Peel/Harvey estuaries. It is a multi-species fishery targeting blue swimmer crabs (*Portunus armatus*) and numerous finfish species. The blue swimmer crab component of the fishery is reported in the West Coast Blue Swimmer Crab Fishery status report. The finfish component is described in this report. The methods used by commercial fishers to target finfish in West Coast Bioregion estuaries are gill nets and seine nets.

A small number of operators have a condition on their Fishing Boat Licence to operate in other West Coast Bioregion estuaries (Hardy Inlet: 1 operator; Vasse/Wonnerup and Toby Inlet: 5 operators). The latter estuary system is only occasionally fished, yielding small quantities of sea mullet. These estuaries are not included in the WCEF interim management plan.

Recreational

Most finfish caught recreationally in West Coast Bioregion estuaries and nearshore waters are taken by shore or boat-based line fishing. The most commonly targeted recreational species include Australian herring, tailor (*Pomatomus saltatrix*), southern school whiting (*Sillago bassensis*), southern garfish, silver trevally (*Pseudocaranx* sp.) and black bream (*Acanthopagrus butcheri*) (estuaries only).

A relatively small amount of recreational net fishing occurs in the West Coast Bioregion, mainly to target sea mullet.

WEST COAST BIOREGION

Governing legislation/fishing authority

Commercial

West Coast Estuarine Fishery (Interim) Management Plan 2003

West Coast Estuarine (Interim) Managed Fishery Permit

Cockburn Sound (Fish Net) Management Plan 1995

Cockburn Sound Fish Net Managed Fishery Licence

Cockburn Sound (Line and Pot) Management Plan 1995

West Coast Demersal Scalefish Fishery (Interim) Management Plan 2007

West Coast Demersal Scalefish (Interim) Managed Fishery Permit

West Coast (Beach Bait Fish Net) Management Plan 1995

West Coast (Beach Bait Fish Net) Managed Fishery Licence

South-West Coast Salmon Fishery Management Plan 1982

South-West Coast Salmon Managed Fishery Licence

Proclaimed Fishing Zone Notice (South-West Coast) 1975

Salmon Block Net Prohibition Notice 1996

Closed waters and Permitted Gear Orders under Section 43 of the Fish Resources Management Act 1994

Condition 19 on a Fishing Boat Licence

Condition 65 and 66 on a Fishing Boat Licence

Condition 68 on a Fishing Boat Licence

Condition 84 on a Fishing Boat Licence

Condition 17 on a Commercial Fishing Licence

Salmon and Snapper Purse Seining Prohibition Notice 1987

Directions to Licensing Officers

Recreational

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

Recreational Net Fishing Licence

Recreational Fishing From Boat Licence

Consultation processes

Commercial

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

Recreational

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

Boundaries

Commercial - Estuarine

WCEF: The management plan encompasses all estuaries in

the West Coast Bioregion between 27° S and 33°11' S. Complex closures exist for both the Swan/Canning and Peel/Harvey commercial fisheries (refer to management plans, related legislation and regulations).

Leschenault Estuary is closed to commercial fishing. The waters of the Vasse/Wonnerup Estuary and Toby's Inlet and all estuaries and canals located in between are open to commercial fishing.

Waters of Hardy Inlet and the Blackwood River are open to commercial fishing 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).

Commercial - Nearshore

Cockburn Sound (Fish Net) Managed Fishery and Cockburn Sound (Line & Pot) Managed Fishery operates within Cockburn Sound.

West Coast Beach Bait Managed Fishery covers WA waters from Moore River (north of Perth) to Tim's Thicket (south of Mandurah).

South West Beach Seine Fishery covers WA waters from Tim's Thicket south to Port Geographe marina.

South-West Coast Salmon Managed Fishery includes all WA waters north of Cape Beaufort except Geographe Bay.

Recreational

Recreational line fishing is permitted in most areas within estuaries and nearshore waters of the West Coast Bioregion. Some spatial closures exist, including closures in marine reserves and around industrial structures.

A small number of areas within estuaries and nearshore waters of the West Coast Bioregion are open to recreational netting. Recreational net fishers must hold a licence.

Recreational net fishing regulations are complex – refer to the 'Recreational Net Fishing Guide' for details.

Management arrangements

Commercial

The West Coast Bioregion nearshore and estuarine commercial fisheries are managed primarily through input controls in the form of limited entry and gear restrictions, as well as seasonal and time closures, area closures and size limits. Finfish fishing methods are gill nets, seine nets and haul nets.

Recreational

Recreational fishers in West Coast Bioregion nearshore and estuarine waters take a diverse array of finfish species. Size and possession limits apply to these species when caught recreationally in WA. A Recreational Fishing from Boat Licence is required to undertake any general fishing activity (including crabbing) conducted with the use of a powered boat anywhere in the State.

As many recreationally targeted species are also targeted by the commercial sector, resource-sharing issues are a major consideration in future management arrangements.

Indicator species

The Department of Fisheries has selected several key species as indicators for monitoring and assessing the status of the

finfish resources in the West Coast Bioregion (DoF 2011¹). Australian herring, tailor, southern garfish, southern school whiting and whitebait are indicators for this Bioregion's nearshore finfish suite and black bream, Perth herring (*Nematalosa vlaminghi*) and cobbler (*Cnidoglanis macrocephalus*) are indicators for the estuarine finfish suite. Although not indicator's, the status of sea mullet and King George whiting (*Sillaginodes punctata*) is also reported here because they are significant components of nearshore fishery landings in this Bioregion.

Research summary

The status of the fish resources in nearshore and estuarine waters of the West Coast Bioregion is assessed by monitoring the status of indicator species (see DoF 2011 for details). Level 2 assessments of indicators are based on trends in commercial catch and effort obtained from compulsory monthly fisher returns, trends in recreational catch and effort obtained from voluntary fisher logbooks (the 'Research Angler Program') and recreational fishing surveys, and trends in juvenile recruitment obtained from fishery-independent surveys. Level 3 assessments of indicators include all of the above information plus information about rates of fishing mortality (F) estimated from the age composition of fishery landings. Fish collected from recreational and commercial fishers are used to determine age structure. Where available, any archived biological samples have been used to estimate historical F levels.

A 4-year State NRM-funded research project designed to provide more rigorous monitoring and assessment of the status of West Coast Bioregion nearshore indicator species (Australian herring, tailor, whiting species and southern garfish) was completed in 2012/13. Stock assessments were completed for all species (see 'Stock Assessments' below). New monitoring strategies developed during this project are now being implemented for each indicator species.

As part of the above project, the species composition of all whiting landings within the West Coast Bioregion was investigated. With the exception of King George whiting, a significant proportion of whiting taken recreationally, and a small proportion taken commercially, were found to be misidentified. The vast majority (~90%) of whiting (excluding King George whiting) taken recreationally were found to be southern school whiting, while the majority of whiting taken commercially were found to be yellowfin whiting.

A pilot tagging study of Australian herring was conducted in the West Coast Bioregion in 2012 to develop another method of estimating of fishing mortality. Approximately 4,500 fish were tagged. Tagging was scheduled to continue in 2013 and 2014 but was ceased due to the low availability of herring in the West Coast Bioregion. Some tagged fish have been recaptured. An eventual recapture rate of about 2-3% is anticipated, which may provide information about movement within the Bioregion to aid interpretation of other data and assist spatial management for Australian herring.

A tagging study of tailor involving volunteer recreational

fishers commenced in 2012 and is ongoing. Recaptures will provide information about tailor movement and stock structure in WA.

A state-wide survey of boat-based recreational fishing was conducted in 2011/12 (Ryan *et al.* 2013²). During this survey, nearshore species including southern school whiting and Australian herring were the most common species caught in the West Coast Bioregion. This survey provided information on catches from boat-based recreational fishers. Catches from shore-based fishers, who take the majority of nearshore species, were not estimated.

Retained Species

Total commercial finfish landings (2012)³:

198 tonnes in nearshore waters

121 tonnes in estuarine waters

Commercial landings by fishery (2012):

South West Coast Salmon: 47 tonnes (salmon)

**WC Beach Bait + SW Beach Seine: 66 tonnes
(whitebait only)**

West Coast Estuarine: 99 tonnes (finfish only)

Catches (West Coast Nearshore and Estuarine Table 1) are taken by commercial estuarine and beach-based fisheries using gill nets, haul nets and beach seines. The minor quantities of the same species taken by other methods (e.g. purse seine, demersal gill nets and long-lines) are not included in Table 1 but the total catch by all methods and fisheries is used for stock assessments.

In 2012, the total commercial catch of finfish by estuarine and beach-based fisheries in the West Coast Bioregion comprised approximately 30 species with the majority consisting of sea mullet (32% by weight), whitebait (21%), western Australian salmon (15%) and Australian herring (9%).

Commercial landings of key finfish species:

Many of the key species listed here have a stock distribution that extends beyond the West Coast Bioregion. Therefore, in addition to the West Coast landings, the catches of each species taken in other Bioregions and/or at a state level are also given here in order to provide information about the total commercial harvest of the stock.

Australian herring: Australian herring comprise a single stock across southern Australian waters. This species is targeted commercially in WA and South Australia (SA). Negligible quantities are also taken commercially in Victoria.

In WA, 80-90% of total annual commercial landings of Australian herring have been taken in the South Coast

1 Department of Fisheries (2011) Resource Assessment Framework for Finfish Resources in Western Australia. Fisheries Occasional Publication. No. 85. 24 pp.

2 Ryan, K.L., Wise, B.S., Hall, N.G., Pollock, K.H., Sulin, E.H. & Gaughan, D.J. (2013). An integrated system to survey boat-based recreational fishing in Western Australia 2011/12. Fisheries Research Report No. 249, Department of Fisheries, Western Australia. 162 pp.

3 Note: Values in overview table were from 2011/12

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Bioregion, with the remaining 10-20% taken in the West Coast Bioregion. Consistent with this pattern, the 2012 South Coast Bioregion catch share was 83% with the majority of commercial landings taken by the ocean beach-based herring trap net fishery (see South Coast Nearshore and Estuarine Finfish Resources Report). In 2012, this fishery reported 67% of the total commercial herring catch in WA and 81% of the total commercial herring catch in the South Coast Bioregion. In 2012, the remainder of the South Coast commercial catch was taken in estuaries (12%) and in nearshore ocean waters (7%). The proportion of commercial landings taken by the trap net fishery has been steadily declining since the late 1990s, when the fishery contributed 95% of the South Coast annual catch.

Within the West Coast Bioregion, 50% of landings in 2012 were taken in the Geographe Bay/Bunbury area, 36% taken in Cockburn Sound and 11% taken in the Peel-Harvey Estuary.

In the South Coast Bioregion, the total annual commercial catch reached an historical peak of 1,427 t in 1991 and then steadily declined to an historical low of 110 t in 2011 with landings in 2012 of 135 t. Recent low catches in the South Coast Bioregion reflects declining catches by the trap net fishery due to a combination of factors – reduced availability of fish from declining stock level and multiple recent years of low recruitment plus lack of targeting in response to low market demand.

In the West Coast Bioregion, the total annual commercial catch of Australian herring reached an historical peak of 211 t in 1988 and attained a similar level of 191 t in 1992. Annual landings have steadily declined to reach an historical low of 28 t in 2012. The downward trend in the West Coast Bioregion mainly reflected declining catches in the Geographe Bay/Bunbury area, where the majority of West Coast landings are taken. These declines were partly due to a substantial decline in fishing effort (i.e. decline in targeting) attributable to the reduced availability of fish.

Nationally, commercial landings of Australian herring peaked at approximately 1800 t per year in the late 1980s and early 1990s and steadily declined thereafter (West Coast Nearshore and Estuarine Figure 1). National landings were approximately 262 t in 2012, the lowest level since the start of reliable catch records in 1950. Commercial landings within WA and in SA each followed this downward trend. In WA, landings peaked at 1,537 t in 1991 and reached an historical low of 147 t in 2011. In 2012, total WA landings were 163 t. In SA, landings peaked at 498 t in 1987/88 and reached an historical low of 99 t in 2011/12 in SA¹. The proportion of total commercial landings taken in South Australia was relatively constant, typically 20-30% per year, from the early 1970s until 2008. However, since 2008 SA annual landings have comprised about 42% of the national catch.

Whiting: The total annual commercial catch of ‘whiting’ in the West Coast Bioregion has been gradually declining due to

an ongoing reduction in commercial effort in estuarine and nearshore waters as a result of various Voluntary Fishery Adjustment Schemes (VFAS) (licence buy-backs) operating since 1990. The vast majority of ‘whiting’ (excluding King George whiting) landed by commercial fishers in this Bioregion are yellowfin whiting with 19 t taken commercially in 2012.

Relatively low quantities of southern school whiting are taken commercially in the West Coast Bioregion (6 t in 2012).

Tailor: In WA, tailor is found in coastal waters from Onslow to Esperance and is likely to constitute a single stock over this range. Incomplete records prior to 1976 suggest the total WA annual commercial catch of tailor probably peaked in 1965 at approximately 90 t. Since 1976, annual landings have fluctuated between 19 and 59 t but with an overall stable trend (West Coast Nearshore and Estuarine Figure 2). In 2012, the total WA commercial catch of tailor was 26 t, the majority of which was taken in the Gascoyne Coast Bioregion (64% by weight), with the remainder from the West Coast Bioregion (34%) and South Coast Bioregion (2%).

In the Gascoyne Coast Bioregion, total landings of tailor were typically 20-30 t per year during the period 1976-1990. Annual landings were markedly higher (>30 t per year) during the period 1990-2000, including an historical peak of 49 t in 1999. Elevated catches in this period probably reflect a higher availability of fish due to strong recruitment. After 2000, annual landings returned to levels similar to those reported prior to 1990. In 2012, the Gascoyne catch was 16 t, all of which was taken in Shark Bay.

In the West Coast Bioregion, total commercial landings of tailor declined from 28 t in 1976 to reach an historical minimum of 2 t in 2008. Subsequent landings have increased slightly, reaching 9 t in 2012. The majority (84%) of West Coast landings in 2012 were taken in the Peel-Harvey Estuary.

Southern garfish: There are possibly five species of garfish landed in southern WA waters with the vast majority believed to be southern garfish (*Hyporhamphus melanochir*) with small quantities of river garfish (*H. regularis*) and robust garfish (*H. robustus*) also landed. In 2012, 52% of total WA commercial landings of southern garfish were taken in the West Coast Bioregion, with the remainder in the South Coast Bioregion.

In the West Coast Bioregion, total annual southern garfish landings peaked at 44 t in 1999. Subsequently, annual landings have been variable with downward trend with a historic minimum of 6 t taken in 2012. The long-term decline in catch was partly due to a reduction in commercial effort but the decline in catch in 2012 probably reflected a decline in the availability of fish.

Since 1995, 82% of total commercial landings of southern garfish in the West Coast Bioregion have been taken in Cockburn Sound. The historical peak in annual landings within Cockburn Sound was 37 t in 1999. Since 1999, annual landings of garfish in Cockburn Sound have gradually declined, following the same trend as total West Coast Bioregion landings (including reaching an historic minimum level in 2012).

¹ Fowler, A.J., McGarvey, R., Steer, M.A. & Feenstra, J.E. (2012). South Australian Marine Scalefish Fishery. Stock Status Report 2011/12. Report to PIRSA Fisheries and Aquaculture South Australian Research and Development Institute (Aquatic Sciences), Adelaide. F2007/000565-7. SARDI Research Report Series No. 681. 44 pp.

King George whiting: King George whiting occurs in coastal waters in the West Coast and South Coast Bioregions with majority of landings occurring in estuaries. There is likely to be high connectivity between Bioregions due to adult migration and larval dispersal, but additional research is required to determine whether King George whiting should be managed as a single stock.

Annual landings of King George whiting are typically highly variable, mainly reflecting variations in juvenile recruitment due to environmental factors. In 2012, 4 t of King George whiting was taken commercially in the West Coast Bioregion, representing 26% of the total annual commercial catch in WA with the remainder taken in the South Coast.

Sea mullet: Sea mullet occurs in coastal waters in all WA Bioregions with high connectivity due to adult migration and larval dispersal. There may also be connectivity between sea mullet along the south coast of WA and in SA.

The total WA annual catch of sea mullet peaked at 694 t in 1988 but has gradually declined mainly due to widespread reductions in commercial fishing effort in nearshore and estuarine waters. In 2012, the WA total catch was 175 t. In 2012, 58% of the total WA catch was taken in the West Coast Bioregion, 24% in the Gascoyne Coast Bioregion, 17% in the South Coast Bioregion and 1% in the North Coast Bioregion.

In the West Coast Bioregion, commercial landings of sea mullet were highest during the 1970 and 1980s, including an historical peak of 429 t in 1988 (West Coast Nearshore and Estuarine Figure 4). Between 1988 and 2004, the total annual catch in the West Coast Bioregion steadily declined. The decline was partly due to an ongoing reduction in commercial effort in estuarine and nearshore waters as a result of VFAS (licence buy-backs) operating since 1990. From 2004 to 2012, total landings were stable at 100-120 t per year, with the exception of 2011 when landings declined to 77 t. In 2012, the catch was 102 t. In 2012, 54% of total commercial landings of sea mullet in West Coast Bioregion were taken in the Peel-Harvey Estuary and the remainder taken from ocean waters near Jurien Bay (latitude 30-31°S).

In the Gascoyne Coast Bioregion, the vast majority (>90% per year) of commercial sea mullet landings are taken by the Shark Bay Beach Seine and Mesh Net Managed Fishery. Refer to the *Inner Shark Bay Scalefish Fishery Status Report* for details of the catch and effort in this fishery.

In the South Coast Bioregion, commercial landings of sea mullet have been stable since 1976 with the annual catch having averaged 36 t (range 11-94 t per year). In 2012, the catch was 30 t (West Coast Nearshore and Estuarine Figure 3). The vast majority (>90%) of annual landings of sea mullet in the South Coast Bioregion have been from estuaries. In 2012, 37% of total commercial landings of sea mullet in the South Coast Bioregion were taken in Oyster Harbour, 23% in Wilson Inlet, 15% in Beaufort Inlet, 7% in Stokes Inlet and 6% in Princess Royal Harbour. Minor sea mullet landings were also reported in 4 other estuaries in 2012.

Whitebait: In WA, whitebait occurs from Kalbarri southwards but is relatively rare along the south coast. All commercial landings of whitebait in WA are taken in the West Coast Bioregion, between Perth and Busselton. Fishing has historically occurred in two areas: Area 1 (Tim's Thicket to Busselton) is fished by the South West Beach Seine Fishery and Area 2 (Perth to Tim's Thicket) is fished by the

West Coast Beach Bait Managed Fishery. Total landings have declined since the 1990s when an historic peak of 302 t occurred in 1996/97 (West Coast Nearshore and Estuarine Figure 4). The decline in total landings mainly reflects declines in Area 2. In 2011/12, the total catch was 83 t, all of which was landed in Area 1.

In Area 2, declines in landings since the 1990s were partly due to effort reductions, particularly between 2002/03 and 2003/04 when the number of vessels operating in this area declined from 8 to 2 per year. Since 2003/04, low (or zero) catch levels in Area 2 are attributed to a low availability of fish.

Since 2004/05, virtually all (98%) whitebait landings have been in Area 1. Annual landings in this area have followed a relatively stable trend (i.e. non-directional over the long term) since the late 1980s. The decline in landings in Area 1 after 2000/01 was due to a decline in effort.

In 2010/11, the total commercial catch of whitebait was 38 t, virtually all of which was landed in Area 1. This was the lowest total whitebait catch since the commencement of the fishery in the early 1970s. It coincided with very unusual oceanographic conditions associated with a 'heatwave' event along the west coast (Pearce *et al.* 2011¹). Substantial variations in whitebait landings appear to occur in response to environmental factors including El Niño-Southern Oscillation (ENSO) and Leeuwin Current fluctuations (Gaughan *et al.*, 1996)².

Perth herring: Perth herring is endemic to the West Coast Bioregion of WA and constitutes a single stock over this range. 'Perth herring' previously reported from the Gascoyne Coast Bioregion are now believed to be a different species. Historically, the majority of landings of this species were caught in the Swan-Canning Estuary. Commercial targeting of Perth herring in this estuary ceased in 2007. The minor quantities taken in subsequent years were predominantly from the Peel-Harvey Estuary. Since 2000, <3 t of Perth herring per year has been reported from the Peel-Harvey Estuary.

Recent landings of Perth herring are very low compared to historical landings. Total West Coast Bioregion landings peaked at 239 t in 1978. From the late 1970s to the early 1990s, Perth herring was captured by various netting fisheries in ocean and estuarine waters (including purse seine, gill and haul net fisheries). The species is now infrequently caught in ocean waters. From 1963 to 1988, annual commercial catches of Perth herring in the Swan-Canning Estuary were consistently >40 t, including a historical peak of 178 t in 1968. Declining landings were partly due to an ongoing reduction in commercial effort in estuarine and nearshore waters as a result of VFAS (licence buy-backs) operating since 1990. However, deteriorating environmental conditions

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

2 Gaughan, D.J., Fletcher, W.J., Tregonning, R.J. and J. Goh. (1996) Aspects of the biology and stock assessment of the whitebait, *Hyperlophus vittatus* in south western Australia. Fisheries Research Report, Fisheries Department of Western Australia 110, 1-115

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in West Coast Bioregion estuaries and historical overfishing are believed to be the main factors contributing to the current low stock level.

Cobbler: In WA, commercial targeting of cobbler is restricted to estuaries. Each estuary hosts a discrete stock of cobbler, which is genetically distinct to other estuarine populations and also distinct to cobbler populations in adjacent ocean waters. Since 2000, 95% of commercial landings of cobbler have been caught in estuaries of the South Coast Bioregion, with the remaining 5% in estuaries of the West Coast Bioregion. Virtually all West Coast landings over this period were in the Peel-Harvey Estuary.

Historically, commercial catches of cobbler in West Coast Bioregion estuaries were much higher. Landings peaked at 298 t in 1961 in the Peel-Harvey Estuary, at 158 t in 1958 in Leschenault Estuary and at 56 t in 1960 in the Swan-Canning Estuary. Landings in the Hardy Inlet have always been relatively low.

In the Peel-Harvey Estuary, annual landings during the 1950s, 1960s and 1970s were frequently >100 t. Landings in the 1970s (1970-79) averaged 127 t per year. However, annual landings fell dramatically from 233 t to 49 t between 1980 and 1982. From 1983 to 1996, annual landings ranged from 3 to 74 t. Since 1996, annual landings have ranged from <1 t to 10 t. In 2012, 5 t of cobbler was reported in this estuary.

In the Swan-Canning Estuary, annual cobbler landings during the 1960s and 1970s were frequently >20 t (average catch 31 t per year for period 1959-1977). However, landings fell dramatically from 76 t to 7 t between 1976 and 1978. From 1978 to 1996, annual landings ranged from 1 to 10 t. After 1997, annual catches in the Swan-Canning Estuary were <800 kg. A prohibition on catching cobbler in the Swan-Canning Estuary was introduced on 6 July 2007 and is in effect until 2017 in order to protect the stock.

In the Leschenault Estuary, a period of relatively high cobbler landings occurred from 1955 to 1965 (average 45 t per year, 1955-65). Landings declined from 17 t in 1978 to 2 t in 1979. From 1979 until the closure of the commercial fishery in 2000/01, annual landings of cobbler ranged from <1 t to 6 t.

Declining landings were partly due to an ongoing reduction in commercial effort in estuaries since 1990. However, deteriorating environmental conditions in West Coast Bioregion estuaries and historical overfishing are believed to be the main factors contributing to the current low stock levels.

Black bream: Black bream is a true estuarine species, spending its entire life cycle in these waters. Each estuary hosts a discrete stock of black bream, which is genetically distinct to other estuarine populations. Most estuaries and coastal lagoons in south-western WA host a black bream population. In 2012, 97% of commercial landings of black bream were in the South Coast Bioregion, with the remaining 3% from the West Coast Bioregion.

In the West Coast Bioregion, commercial landings of black bream have always been relatively low compared to landings of other estuarine target species. Historically, the Swan-Canning Estuary and Hardy Inlet contributed the vast majority of commercial black bream landings. Landings peaked at 8 t in 1996 in the Swan-Canning Estuary and

peaked at 4 t in 1983 in Hardy Inlet. Occasional landings were taken in the Leschenault Estuary (<2 t per year), prior to the closure of that fishery. Annual landings of black bream in the Peel-Harvey Estuary have always been negligible. Commercial targeting of black bream in the Swan-Canning Estuary has been negligible since 2007, resulting in the Hardy Inlet now being the only (albeit minor) commercial black bream fishery in the West Coast Bioregion. Since 2000, total West Coast Bioregion commercial landings of black bream have ranged from <1 to 5 t per year.

Recreational catch estimate (2012): N/A

Nearshore + estuarine catch (most recent estimate 2000/01): 940 tonnes (key species only)

Boat-based nearshore + estuarine catch (most recent estimate 2011/12):

108 tonnes (key species only)

The recreational catch levels of finfish in nearshore and estuarine waters of the West Coast Bioregion were not completely estimated for 2012. A Statewide recreational fishing survey in 2011/12 estimated boat-based catches of finfish in nearshore and estuarine waters. However, shore-based catches were not included in this survey and so total recreational catches are not known.

The most recent complete estimates are from the National Recreational and Indigenous Fishing Survey conducted in 2000/01 (West Coast Nearshore and Estuarine Table 2). In 2000/01, the most abundant species in the retained catch of nearshore and estuarine finfish (combined) were Australian herring (48% by number), whiting (various species, excluding King George) (24%), tailor (9%), southern garfish (3%), King George whiting (2%) and trevally (*Pseudocaranx* spp.). In nearshore waters, the regions contributing the highest catches were southern Perth, Mandurah and Geographe Bay/Bunbury, each of which contributed about 20% of all retained nearshore fish in the Bioregion. During the 2000/01 survey, 61% of fish retained in West Coast nearshore waters were taken by shore-based fishers and 39% by boat-based fishers.

While the dominant nearshore/estuarine species in the current catch are probably similar to those caught in 2000/01, the current catch and effort levels by recreational fishers may have changed substantially since this survey. Although several surveys of boat-based fishing have been conducted since 2000/01, no subsequent surveys of shore-based fishing have been undertaken. Shore-based fishers are believed to take the majority of nearshore and estuarine finfish. The current total recreational catch level in nearshore and estuarine waters cannot be estimated without current information about the shore-based catch.

The Department of Fisheries recently conducted a pilot study of shore-based fishers in the Perth Metropolitan area from April to June 2010 in an attempt to determine the best method to quantify recreational fishing catch and effort from this sector (Smallwood *et al.* 2011¹). During this three-month

1 Smallwood, C. B., Pollock, K. H., Wise, B.S., Hall, N.G. and Gaughan, D.J. 2011. Quantifying recreational fishing catch and effort: a pilot study of shore-based fishers in the Perth Metropolitan area. Fisheries Research Report No. 216.

pilot study, the most frequently retained species were Australian herring, southern garfish and whiting (combined species).

Surveys of boat-based recreational fishing in the West Coast Bioregion were conducted in 1996/97, 2005/06, 2008/09 and 2009/10, and a state-wide survey of boat-based recreational fishing was conducted in 2011/12. During the 2011/12 survey, total of 174 finfish species were taken by boat-based fishers in the West Coast Bioregion with nearshore species dominating the catch. The most common were southern school whiting (20% of the West Coast catch by number), Australian herring (16%), silver trevally (5%), King George whiting (5%), pink snapper (5%), black bream (4%), tailor (3%), West Australian dhufish (*Glaucosoma hebraicum*) (3%) and western king wrasse (*Coris auricularis*) (3%).

Between 1996/7 and 2011/12 there was a decline in the annual catches of Australian herring, southern school whiting and southern garfish by boat-based fishers in the West Coast Bioregion. The annual catch of tailor initially declined but then increased over the same period (West Coast Nearshore and Estuarine Table 3).

Recreational catch share

The recreational catch share of total finfish landings in nearshore and estuarine waters of the West Coast Bioregion cannot be determined for the current year.

Fishing effort/access level

Commercial

Since the early 1990s, the number of licences in nearshore and estuarine commercial fisheries has been substantially reduced via VFAS. The removal of licences has eliminated a significant amount of latent effort (inactive licences) that previously existed in these fisheries.

Fishing effort in nearshore and estuarine fisheries is usually calculated as the number of days fished by each method. Fishing effort is sometimes reported as the number of units of access (vessels, licensees, teams, etc). This measure is sometimes the only type of effort data available throughout the history of the fishery and provides a general indication of effort changes over time.

Licence holders in the West Coast Bioregion estuaries that are open to commercial fishing are endorsed to fish a single estuary system only.

Peel-Harvey Estuary: A substantial proportion of fishing effort in this estuary is directed towards the capture of blue swimmer crabs (50-60% of method days per year since 2000). The vast majority of crabs are taken by crab pots, whereas finfish are taken by gill and haul nets. Since 2000, the effort spent targeting finfish in this estuary (i.e. days spent gill and haul netting) has been stable, fluctuating between 600 and 1200 method days per year. Since 2000, the mean number of active fishing units per month has been about 8. There are currently 11 licences in the fishery.

Swan-Canning Estuary: The mean number of active fishing units per month declined from about 25 in the mid-

1970s to 1 in 2009 and subsequent years. A majority of total commercial effort in 2012 (and other recent years) was targeted towards blue swimmer crabs.

Hardy Inlet: The mean monthly number of fishing units declined from 3 in the 1970s to 1 in 2000 and subsequent years, including 2012. Virtually all commercial effort in recent years was spent targeting a limited number of finfish species.

Cockburn Sound (Fish Net) fishery: Since the early 1990s, there has been a progressive decline in the number of commercial licences operating in Cockburn Sound as a result of VFAS. In the Cockburn Sound (Fish Net) fishery, the number of licences fell from six in the early 1990s to one in 2003 and subsequent years. All effort by this fishery is spent targeting finfish.

Moore River to Kalbarri: The total number of method days fished in this region by shore-based net fishers (gill nets, haul nets and beach seines only) in 2012 was 303. In 2012, 6 licensees reported finfish landings by netting methods in this region.

South West Coast Salmon Fishery: From 1997 to 2005, 15 teams were licenced to capture western Australian salmon in the West Coast Bioregion. This number was reduced via VFAS to 12 teams in 2006 and then to 8 teams in 2010 and subsequent years. Only 3 of the 8 teams reported salmon catches in 2012.

West Coast Beach Bait and South West Beach Seine Fisheries: In 2012, 7 licensees reported landings of whitebait.

Recreational

Current estimates of total recreational effort expended on targeting nearshore or estuarine finfish in the West Coast Bioregion are unavailable.

The 2000/01 National Recreational and Indigenous Fishing Survey, which included all methods and Bioregions, provided the most recent information on total recreational fishing effort in the West Coast Bioregion. About 95% of the nearshore and estuarine 'fishing events' that were targeting finfish during the survey used line fishing (bait or lure). About 75% of line fishing events (nearshore and estuarine combined) were shore-based. In nearshore waters, the estimated line fishing effort (either bait or lure) in 2000/01 comprised 946,841 shore-based and 308,673 boat-based fishing events during the 12-month survey period.

Surveys of boat-based recreational fishing in the West Coast Bioregion were conducted in 1996/97, 2005/06, 2008/09 and 2009/10, and a state-wide survey of boat-based recreational fishing was conducted in 2011/12. These surveys estimated the total effort expended by boat-based recreational fishers in the West Coast Bioregion, including effort expended on all species. However, the proportion of boat-based effort spent specifically targeting nearshore finfish during these surveys is unknown. In 2011/12, 52% of total annual boat-based fishing effort (boat days) in the West Coast Bioregion was estimated to have occurred in nearshore habitats (i.e. bottom depth <20m) and 18% in estuaries.

Recent estimates of effort by shore-based recreational fishers, who are believed to capture the majority of nearshore and estuarine finfish in the West Coast Bioregion, are unavailable. Effort data from a recent pilot study of shore-

based fishing (Smallwood *et al.* 2011¹) is not included here as this study's aim was to examine the relative benefits of different survey techniques and only investigated 3 months of metropolitan recreational fishing.

Stock Assessments

Assessments complete: **Not all**

Assessment level and method:
Level 3 - Fishing mortality

Breeding stock levels:

Australian herring **Inadequate**

Southern school whiting **Adequate**

Assessment level and method:
Level 2 - Catch rates

Breeding stock levels:

Tailor **Adequate**

Southern garfish (Cockburn Sound) **Adequate**

King George whiting **Adequate**

Sea mullet **Adequate**

Whitebait **Adequate**

Black bream (Swan-Canning) **Adequate**

Cobbler (Peel-Harvey) **Adequate**

Perth herring **Not assessed**

Indicator species - nearshore

Australian herring: A level 3 assessment of the stock was completed in 2012 (Smith *et al.* 2013a²). The assessment found evidence of a substantial decline in stock abundance since the late 1990s and a steady increase in fishing mortality (F) over the same period. The estimated current F level is approximately two times higher than natural mortality (M) which is well above the limit reference point for this species. Relatively low annual recruitment was also observed in most years over the past decade. The fishery presently catches predominantly young fish, with >50% of total landings (commercial and recreational) now comprised of young fish that are yet to spawn for the first time. An independent review of this assessment was conducted, and supported the conclusion that the stock level is currently inadequate (DoF 2013³). The assessment recommended a reduction of at least

50% in the total catch of Australian herring.

Low recruitment over the past decade may partly be a consequence of the declining breeding stock level due to overfishing but is also likely to be partly due to environmental factors, including the fluctuations in the strength of the Leeuwin Current. Low recruitment along the southern coast of WA tends to occur in years of weak current. In 2011, extremely unusual oceanographic conditions occurred along the south-western coast of WA, including summer temperatures >3°C above average in some areas (a 'heatwave' event, Pearce *et al.* 2011⁴). These conditions were believed to be unfavourable for spawning by herring. Recruitment was relatively low in 2011. Recruitment improved in 2012 and was the highest level observed in 13 years.

Southern school whiting: A level 3 assessment of the West Coast Bioregion component of the stock was completed in 2012 (Brown *et al.* 2013⁵). The stock level was assessed as adequate. The current rate of fishing mortality (F) was estimated from the age structure of recreational landings in the West Coast Bioregion. The estimated current F level was around the target reference level for this species. In the West Coast Bioregion, the majority (>90%) of the catch is comprised of mature fish.

Tailor: A level 2 assessment of the stock was completed in 2012 (Smith *et al.* 2013b⁶). An independent review of this assessment was conducted, and supported the conclusion that the stock level is currently adequate (Department of Fisheries 2013).

Catch rates from a volunteer fishing program in the Swan-Canning Estuary have provided an indicator of the strength of annual recruitment by juvenile (age 0) tailor to the West Coast Bioregion since 1996. Annual recruitment has been relatively strong since 2006/07 (West Coast Nearshore and Estuarine Figure 5). Increasing recreational catch rates of adult tailor throughout the West Coast Bioregion over the past 3 or 4 years are consistent with higher recruitment. Catch and catch rates of tailor in the main commercial fishery, the Shark Bay Beach Seine and Mesh Net Fishery, are within the historical range and are considered acceptable.

Review of Western Australian Department of Fisheries Report, NRM Project 09003. Status of near-shore finfish stocks in south-western Western Australia: Australian herring and tailor. Fisheries Occasional Publication No. 116. Department of Fisheries Western Australia. Perth.

4 Pearce, A., Lenanton, R., Jackson, G., Moore, J., Feng, M. & Gaughan, D. (2011). The 'marine heat wave' off Western Australia during the summer of 2010/11. Fisheries Research Report No. 222. Department of Fisheries, Western Australia. 40pp.

5 Brown, J., Dowling, C., Hesp, A., Smith, K. & Molony, B. (2013). Status of nearshore finfish stocks in south-western Western Australia. Part 3: Whiting. Final NRM Report - Project No. 09003. Fisheries Research Report No. 248. Department of Fisheries Western Australia. Perth.

6 Smith, K., Brown, J., Lewis, P., Dowling, C., Howard, A., Lenanton, R. & Molony, B. (2013b). Status of nearshore finfish stocks in south-western Western Australia. Part 2: Tailor. Final NRM Report - Project No. 09003. Fisheries Research Report No. 247. Department of Fisheries Western Australia. Perth.

1 Smallwood, C. B., Pollock, K. H., Wise, B.S., Hall, N.G. and Gaughan, D.J. (2011). Quantifying recreational fishing catch and effort: a pilot study of shore-based fishers in the Perth Metropolitan area. Fisheries Research Report No. 216. Final NRM Report - Project No. 09040. Department of Fisheries, Western Australia. 60pp.

2 Smith, K., Brown, J., Lewis, P., Dowling, C., Howard, A., Lenanton, R. & Molony, B. (2013a). Status of nearshore finfish stocks in south-western Western Australia. Part 1: Australian herring. Final NRM Report - Project No. 09003. Fisheries Research Report No. 246. Department of Fisheries, Western Australia.

3 Department of Fisheries (DoF). (2013). Independent

Southern garfish: Southern garfish are distributed across southern Australia from Kalbarri (WA) to Eden (NSW), and Tasmania. Southern garfish populations on the west and south coasts of WA are genetically distinct (Donnellan *et al.* 2002¹) and are managed as separate stocks. Population structuring at finer scales has not been examined in WA, but evidence from elsewhere indicate that garfish populations are comprised of numerous sub-populations which are separated by small (<60 km) distances (Steer *et al.* 2009², 2010³). On this evidence, garfish caught in Cockburn Sound are assumed to belong to a distinct sub-population and treated as a discrete management unit.

Cockburn Sound provides the majority of commercial landings of southern garfish. Recreational landings in this area are also believed to be substantial, although the total recreational catch is unknown due to lack of information about the shore-based component of the catch. Southern garfish are dependent on seagrass and other marine vegetation for reproduction and feeding. Seagrass area in Cockburn Sound has declined by around 80% since the 1950s and continues to be under threat due to ongoing development (e.g. dredging) (Cockburn Sound Management Council 2005⁴). For these reasons, the sustainability of garfish in Cockburn Sound is at higher risk than other populations in WA.

A level 2 assessment of the Cockburn Sound stock was completed in 2012 (Smith *et al.* in prep). Commercial catch rates suggest the abundance of garfish in Cockburn Sound has been declining gradually since 1996 (West Coast Nearshore and Estuarine Figure 6). The majority (~95%) of the current catch (commercial and recreational) is comprised of mature fish. However, the average size of fish in the commercial catch has declined since the late 1990s (the trend in the recreational catch is unknown). A level 3 assessment (fishing mortality) of the stock is planned for 2013.

King George whiting: A level 2 assessment of the stock was completed in 2012 (Brown *et al.* 2013). Juvenile King George whiting occur in inshore marine waters, whereas adults mainly occur in offshore waters. A high proportion of immature fish in current landings reflects the predominantly

inshore distribution of current fishing effort spent targeting this species. The majority (79%) of King George whiting taken recreationally in the West Coast Bioregion (and 94% in the South Coast Bioregion) are immature fish that are yet to spawn. The majority (>95%) of the commercial catch in both Bioregions also consists of immature fish. Presently, limited targeting in offshore waters is allowing the stock level to be maintained at an acceptable level. An increase in targeting of King George whiting in offshore waters would be a risk to the sustainability of the stock.

Sea mullet: Adult sea mullet typically occur in estuaries, except in winter when they migrate to ocean waters to spawn. Juveniles recruit to estuaries, where they remain until maturity. Given this behaviour, trends in catch rates of sea mullet in the Peel-Harvey Estuary and Oyster Harbour, which are both permanently open to the sea, are assumed to be indicative of abundance trends in the West Coast and South Coast Bioregions, respectively. Catch rates of sea mullet in seasonally closed estuaries are not suitable for this purpose because they can vary according to the extent of connectivity to the sea (i.e. sand bar openings) rather than regional abundance.

The annual commercial catch rate of sea mullet in the Peel-Harvey Estuary suggests a stable long-term trend in the availability of sea mullet in the West Coast Bioregion since 1980 (West Coast Nearshore and Estuarine Figure 7). The annual commercial catch rate in Oyster Harbour suggests an increase in the availability of sea mullet in the South Coast Bioregion since 2000. In the Gascoyne Coast Bioregion, catch rates in Shark Bay are assumed to be indicative of local abundance trends. Refer to the *Inner Shark Bay Scalefish Fishery Status Report* for details of the catch rate in this fishery.

Whitebait: Highly variable annual catches and catch rates are characteristic of this fishery. Variations in catch level are correlated with the strength of the Leeuwin Current in the previous year and with rainfall (Gaughan *et al.* 1996⁵). The total commercial catch of 35 t in 2011 was the lowest since the commencement of the commercial whitebait fishery in the early 1970s. Highly unusual oceanographic conditions, resulting in a 'heatwave' event along the west coast of WA (Pearce *et al.* 2011), occurred in 2011 and are likely to be the main reason for the low catch level.

Anecdotal reports and fishery-independent recruitment surveys by the Department in the Perth area are in agreement with local commercial catch and catch rate trends, all suggesting low abundance of whitebait in the Perth area in recent years due to poor juvenile recruitment (West Coast Nearshore and Estuarine Figure 4). An increase in juvenile recruitment was observed in 2011/12, which is expected to result in an increase in adult abundance in the Perth area in the following year. The annual catch and catch rate trends of whitebait in the Bunbury area suggest relatively stable long term abundance of whitebait in this area (West Coast Nearshore and Estuarine Figure 8).

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- 1 Donnellan, S., Haigh, L., Elphinstone, M., McGlennon, D. & Ye, Q. (2002). Genetic discrimination between southern sea garfish (*Hyporhamphus melanochir*) stocks of Western Australia South Australia, Victoria and Tasmania. In: Fisheries Biology and Habitat Ecology of Southern Sea Garfish (*Hyporhamphus melanochir*) in Southern Australia (Jones GK, Ye Q, Ayvazian S & Coutin P, eds), pp. 9-34. FRDC Project 97/133. Canberra: Fisheries Research and Development Corporation.
 - 2 Steer, M., Fowler, A.J. & Gillanders, B.M. (2009). Age-related movement patterns and population structuring in southern garfish, *Hyporhamphus melanochir*, inferred from otolith chemistry. *Fisheries Management and Ecology*. 16:265–278.
 - 3 Steer, M., Halverson, G.P., Fowler, A.J. & Gillanders, B.M. (2010). Stock discrimination of Southern Garfish (*Hyporhamphus melanochir*) by stable isotope ratio analysis of otolith aragonite. *Environmental Biology of Fishes* 89:369–381.
 - 4 Cockburn Sound Management Council. (2005). Environmental Management Plan for Cockburn Sound and its Catchment. Department of Environment, Perth.

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- 5 Gaughan, D., Fletcher, W.J., Tregonning, R.J., and Goh, J. (1996). Aspects of the biology of a stock assessment of the whitebait, *Hyperophus vittatus*, in south western Australia. Fisheries Research Report No. 108. Department of Fisheries, Western Australia. 127pp.

Indicator species - estuarine

Black bream (Swan-Canning only): In the Swan-Canning Estuary, commercial and recreational catch rates suggested an increase in black bream availability between 1990 and 2000, followed by a slight decline from 2000 to 2006 (Smith 2006¹). Voluntary recreational logbook fisher catch rates suggest stable availability of black bream in this estuary from 2004 to 2012 (West Coast Nearshore and Estuarine Figure 9). Black bream in other West Coast estuaries are not assessed.

Cobbler (Peel-Harvey only): Commercial catch rates suggest fluctuating availability of cobbler in the Peel-Harvey Estuary since 1990. The long term trend from 1990 to 2012 was stable (i.e. non-directional) (West Coast Nearshore and Estuarine Figure 10). Cobbler in the Swan-Canning Estuary was assessed via catch rate trends until a fishing ban was imposed in 2007. Anecdotal information suggests ongoing low abundance of the estuarine stock. Cobbler reported from the lower part of the Swan-Canning Estuary are likely to belong to a separate oceanic stock. Cobbler in Leschenault Estuary has not been assessed since the commercial fishery closure in 2000.

Perth herring (Not assessed): Perth herring was assessed via commercial catch rate trends in the Swan-Canning Estuary until cessation of fishing for this species in 2007. Catch rates suggested a major decline in the availability of Perth herring after 1980. A single breeding stock of Perth herring occurs in the West Coast Bioregion. Swan-Canning catch rates are assumed to be representative of regional availability. Limited fishery-independent evidence suggests regional abundance remains relatively low compared to historical levels. However, insufficient information is available to assess current stock status. The development of fishery-independent monitoring methods is required for this species. Low spawning success due to environmental degradation in the upper reaches of West Coast estuaries and low rainfall are believed to be the main causes of low stock abundance.

Non-Retained Species

Bycatch species impact: **Low**

The small-scale commercial finfish fisheries in nearshore and estuarine waters mainly use gill, seine and haul nets that are deployed in a targeted manner. Few non-target species are taken. Mesh size regulations ensure that target species caught by these methods are within an appropriate size range. Minimal discarding occurs because virtually all fish taken can be retained and marketed.

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

injuries than deep water species.

Protected species interaction: **Negligible**

Interactions with protected species by the fishing gear used in these commercial fisheries is negligible. Estuarine birds have been known to interact with fishing nets, but none have been reported in recent years and the risk to their populations is negligible. Commercial fishers are required to report all interactions with protected species.

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

Ecosystem Effects

Food chain effects: **Low**

Current levels of commercial effort are relatively low. Excessive removal by commercial and recreational fisheries of certain species, such as whitebait, Australian herring or salmon, from the food chain could potentially impact on prey and predator species including larger fish, cetaceans and seabirds.

The current low abundance of whitebait in the Perth area is believed to be due to environmental factors and unrelated to fishing. Whitebait in Warnbro Sound is an important source of food for the local colony of little penguins (*Eudyptula minor*). Low abundance of whitebait is believed to have partly contributed to poor breeding success by these penguins in recent years (Cannell *et al.* 2012²).

Habitat effects: **Low**

The operation of gill nets and haul nets over predominantly sand and mud bottoms is unlikely to have any impact on these habitats in estuaries and nearshore waters. Similarly, the line fishing methods used by recreational fishers have a negligible impact on the bottom substrates. Anchoring by recreational fishing vessels may have localised impacts on habitats such as seagrass and reefs.

Social Effects

Commercial - nearshore

In 2012, there was only 1 licensee operating in the Cockburn Sound (Fish Net) Managed Fishery employing 2 fishers per month. Landings from this fishery are used to supply restaurant and retail sectors in the Perth metropolitan area.

In 2012, there were 3 licensees (involving up to 8 fishers) operating within the West Coast Salmon Fishery during the western Australian salmon season. There were 4-21 commercial fishers per month employed in various fisheries targeting Australian herring during 2012. Australian herring and western Australian salmon fishers in the West Coast Bioregion supply local bait and human consumption markets.

Commercial - estuarine

1 Smith, K.A. (2006). Review of fishery resources and status of key fishery stocks in the Swan-Canning Estuary Fisheries Research Report 156. Department of Fisheries, Perth.

2 Cannell, B.L., Chambers, L.E., Wooller, R.D. & Bradley, J.S. (2012). Poorer breeding by little penguins near Perth, Western Australia is correlated with above average sea surface temperatures and a stronger Leeuwin Current. Marine and Freshwater Research 63:914-925.

In 2012, there was an average of 11 commercial fishers operating per month in estuaries of the West Coast Bioregion, largely supplying fresh fish to meet demand for locally-caught product.

Recreational

The nearshore and estuarine waters of the West Coast Bioregion are key areas for recreational fishing and other leisure activities such as snorkelling. Therefore nearshore and estuarine environments have a high social value in the region.

Economic Effects

Estimated annual value (to fishers) for 2012:

Level 2: \$1 to 5 million (finfish only)

Fishery Governance

Commercial

Current Fishing (or Effort) Level:

West Coast Estuarine Fishery **Acceptable**

Cockburn Sound (Fish Net) Fishery **Acceptable**

South West Salmon Fishery **Acceptable**

West Coast Australian herring fisheries
Under review

Whitebait (West Coast Beach Bait + South West Beach Seine Fisheries) **Acceptable**

Target commercial catch range:

West Coast Estuaries (Peel/Harvey only)
75 – 220 tonnes (finfish only)

Cockburn Sound (Fish Net) Fishery
30 – 112 tonnes (finfish only)

Salmon (South West + South Coast Fisheries)
1200 – 2800 tonnes

West Coast Australian herring fisheries
70 – 185 tonnes

Whitebait fisheries **60 – 275 tonnes**

With the completion of the State NRM funded research into the assessment and status of nearshore finfish species in the West Coast, and the planned MSC pre-assessment for all West Coast and South Coast Bioregion fisheries scheduled in 2014, management arrangements, governance, and catch ranges will be reviewed. However, the 2012 catches are reported (below) against their current governance arrangements.

In the Peel-Harvey Estuary, the commercial catch of finfish in 2012 was 99 t, which was within the target range.

In the Cockburn Sound Fish Net Fishery the total catch of finfish in 2012 (19 t) was below the target range. The Cockburn Sound finfish catch has been below the target range for 5 of the past 7 years. Effort declined in this fishery during the 2000s and only a single operator has fished since

2009.

The total catch of western Australian salmon (West Coast and South Coast landings combined) in 2012 (122 t¹) was well below the target range and was the lowest recorded since the commencement of these fisheries in the 1940s. The catch has now been below the target range for 6 consecutive years.

The West Coast herring catch by all fisheries in 2012 (28 t) was below the target range. The West Coast herring catch has been below the target range for 8 of the past 9 years (similar to the trend in the South Coast herring catch, which has been below the target range for 10 consecutive years). Recent research outcomes regarding stock status are being used as a basis for reviewing management arrangements to ensure ongoing sustainability for this iconic species.

In 2012, the commercial catch of whitebait (66 t) was within the target range.

Recreational

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

Target catch range: **Not developed**

New management initiatives

New state-wide recreational fishing rules (bag limits, size limits and total possession limits) were introduced in February 2013. This single set of state-wide rules replaced the various Bioregion-specific rules that previously applied to recreational fishers in WA.

The Department will be considering the results of recently completed research on the status of key nearshore species stocks and examining their implications for current management arrangements.

West Coast fisheries are scheduled to undergo MSC pre-assessment in 2014.

External Factors

Climate change is expected to have impacts on nearshore and estuarine ecosystems. Changes in environmental variables such as ocean temperature, currents, winds, nutrient supply, rainfall, ocean chemistry and extreme weather conditions are expected to have major impacts on marine ecosystems (Hobday *et al.* 2008²). These impacts are expected to create both difficulties and opportunities for fisheries.

Many nearshore species are known to have their abundance levels affected by annual variation in coastal currents (particularly the Leeuwin and Capes Currents). These currents appear to influence the recruitment patterns of larvae of species such as whitebait, tailor, Australian herring and western Australian salmon and thus their subsequent

¹ Australian salmon catch reported in Annual Report is lower than that reported here, due to the submission of additional 2012 catch and effort data by commercial fishers after publication of the Annual Report. The latest data are included here.

² Hobday, A.J., Poloczanska, E.S. & Matear, R.J. (eds). (2008). Implications of Climate Change for Australian Fisheries and Aquaculture: a preliminary assessment. Report to the Department of Climate Change, Canberra, Australia. August 2008.

WEST COAST BIOREGION

recruitment into each fishery (Lenanton *et al.* 2009¹).

In 2011, a very strong Leeuwin Current resulted in unusually warm ocean temperatures in coastal waters of the southern West Coast Bioregion and the western South Coast Bioregion. This 'heatwave' event caused widespread fish kills in the West Coast Bioregion. During and after this event there were reports of atypical distributions of various species (e.g. tropical species occurring in temperate waters) and unusual fish behaviour. The event altered the distribution and behaviour (eg. spawning activity, migration) of many nearshore finfish species, which is likely to have affected the catch levels of these species in 2011 and may continue to affect them in subsequent years.

The abundance of nearshore and estuarine species is likely to be affected by the quantity and quality of habitats that are available for spawning, feeding and/or nursery areas. Habitat loss is ongoing due to coastal development in the West Coast Bioregion and this is likely to result in further reductions in the abundance of nearshore and estuarine species. For example, loss of seagrass in Cockburn Sound is likely to have reduced garfish abundance. 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 2005²). Juveniles of King George whiting are also strongly associated with seagrass and so may be impacted by habitat loss in Cockburn Sound.

West Coast Bioregion 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. Anecdotal reports suggest that habitat and climatic changes have altered the composition and abundance of fish communities in West Coast Bioregion 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). Stock declines in West Coast Bioregion estuaries are most pronounced among 'estuarine-dependent' species, i.e. those that rely on estuarine habitats for spawning, feeding and/or nursery areas (e.g. cobbler, Perth herring, black bream). Whilst not strictly estuarine-dependent, sea mullet and yelloweye mullet exhibit a strong preference for estuarine habitats when available. The status of these species may also be affected by the availability and quality of estuarine habitats. A variety of barriers to fish passage occur in estuaries (e.g. weirs, dredge plumes) which can disrupt the life cycle of migratory species (e.g. mullet, Perth herring).

Fluctuating market demand is a significant factor affecting the annual commercial catch level of many species.

1 Lenanton, R.C., Caputi, N., Kangas, M. & Craine, M. (2009). The ongoing influence of the Leeuwin Current on economically important fish and invertebrates off temperate Western Australia – has it changed? *Journal of the Royal Society of Western Australia* 92: 111–127.

2 Cockburn Sound Management Council. (2005). Environmental Management Plan for Cockburn Sound and its Catchment. Department of Environment, Perth.

WEST COAST NEARSHORE AND ESTUARINE TABLE 1

Total annual catches of finfish (except sharks and rays) from the estuarine and beach-based nearshore commercial fisheries in the West Coast Bioregion, 2008 to 2012.

Species	Scientific name	Catch (tonnes)				
		2008	2009	2010	2011	2012
Western Australian salmon	<i>Arripis truttaceus</i>	333.4	494.6	69.0	6.3	47.1
Sea mullet	<i>Mugil cephalus</i>	96.2	103.0	102.1	77.7	102.9
Whitebait	<i>Hyperlophus vittatus</i>	57.9	139.6	100.6	34.8	65.7
Australian herring	<i>Arripis georgianus</i>	34.7	34.6	30.6	36.3	28.3
Yelloweye mullet	<i>Aldrichetta forsteri</i>	26.2	26.1	24.7	16.2	17.5
Whiting species	<i>Sillago</i> spp.	21.7	23.9	22.5	24.6	19.0
Southern garfish	<i>Hyporhamphus melanochir</i>	11.0	15.7	15.8	19.2	5.8
Cobbler	<i>Cnodoglanis macrocephalus</i>	6.9	9.2	5.4	7.4	5.2
Tailor	<i>Pomatomus saltatrix</i>	1.5	7.1	4.8	7.2	8.8
King George whiting	<i>Sillaginodes punctata</i>	5.1	2.0	5.9	5.1	3.7
Blue sprat	<i>Spratelloides robustus</i>	13.7	7.1	0.1	0.3	0.3
Hardyheads/Silversides	Atherinidae			4.1	4.7	3.5
Trevally	Carangidae	0.9	2.1	3.5	2.4	2.3
Black bream	<i>Acanthopagrus butcheri</i>	1.0	1.1	2.6	0.7	1.4
Yellowtail scad	<i>Trachurus novazelandiae</i>	2.5	1.2	0.9	1.2	0.9
Scaly mackerel	<i>Sardinella lemura</i>			0.9		3.0
Perth herring	<i>Nematalosa vlamingi</i>	0.7	1.6	0.1	0.4	1.0
Trumpeters/Grunters	Teraponidae	0.2	0.0	0.5	1.0	1.6
Other finfish	Teleostei	1.1	0.2	0.2	0.3	0.1
TOTAL		614.7	869.0	394.3	245.6	318.2

WEST COAST NEARSHORE AND ESTUARINE TABLE 2

Estimated total catches of key species by recreational fisheries in nearshore and estuarine waters in the West Coast Bioregion in 2000/01 (Henry and Lyle 2003¹).

Species	Scientific name	2000/01 Catch (tonnes)
Australian herring	<i>Arripis georgianus</i>	438
Tailor	<i>Pomatomus saltatrix</i>	187
Whiting	<i>Sillago</i> spp.	154
King George whiting	<i>Sillaginodes punctata</i>	60
Trevally	<i>Pseudocaranx</i> spp.	42
Southern garfish	<i>Hyporhamphus melanochir</i>	35
Black bream	<i>Acanthopagrus butcheri</i>	24
TOTAL		940

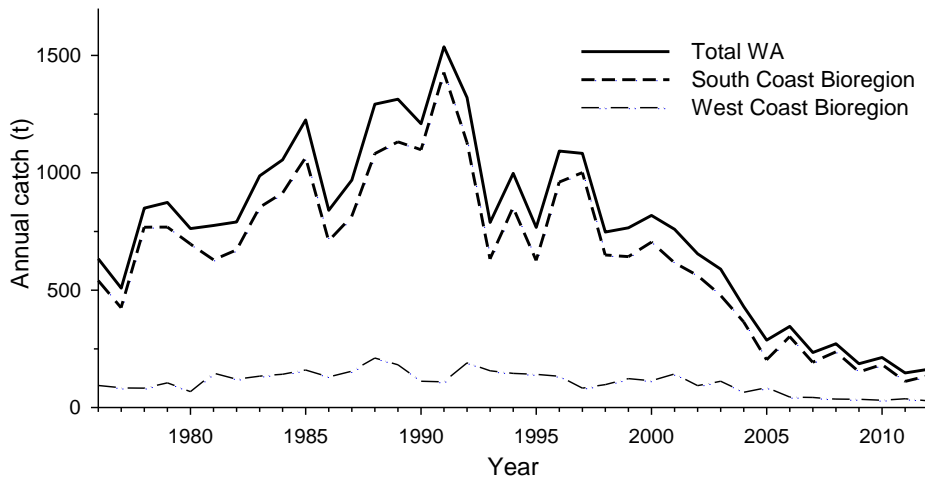
WEST COAST NEARSHORE AND ESTUARINE TABLE 3

Annual catches of key nearshore finfish species in the West Coast Bioregion by boat-based recreational fishers, estimated by various surveys conducted by the Department of Fisheries.

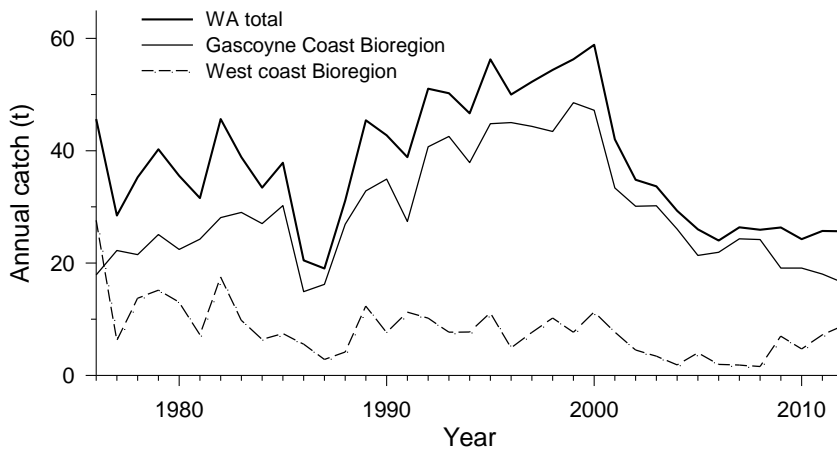
Species		Catch (tonnes)				
		1996/97	2005/06	2008/09	2009/10	2011/12
Australian herring	<i>Arripis georgianus</i>	40	35	33	35	23
Whiting species*	<i>Sillago</i> spp.	50	40	41	38	27
Tailor	<i>Pomatomus saltatrix</i>	11	3	3	2	12
King George whiting	<i>Sillaginodes punctata</i>	31	17	9	7	15
Silver trevally	<i>Pseudocaranx dextex</i>	42	32	28	26	26
Black bream	<i>Acanthopagrus butcheri</i>	n/a	n/a	n/a	n/a	3
Southern garfish	<i>Hyporamphus melanochir</i>	6	2	4	3	2

*estimated to be ~90% southern school whiting

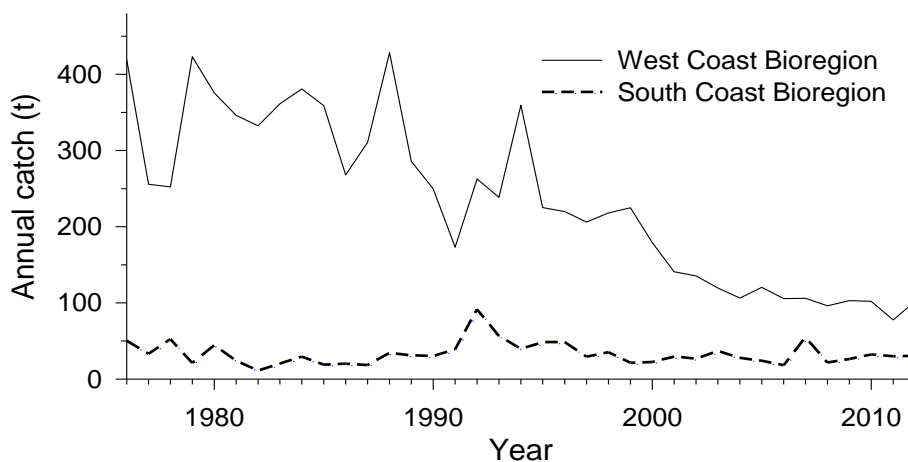
1 Henry, G.W. & Lyle, J.M. (2003). The National Recreational and Indigenous Fishing Survey. FRDC Project No. 99/158. NSW Fisheries Final Report Series No. 48.



WEST COAST NEARSHORE AND ESTUARINE FIGURE 1
Annual commercial catches of Australian herring, by Bioregion, 1976 –2012.

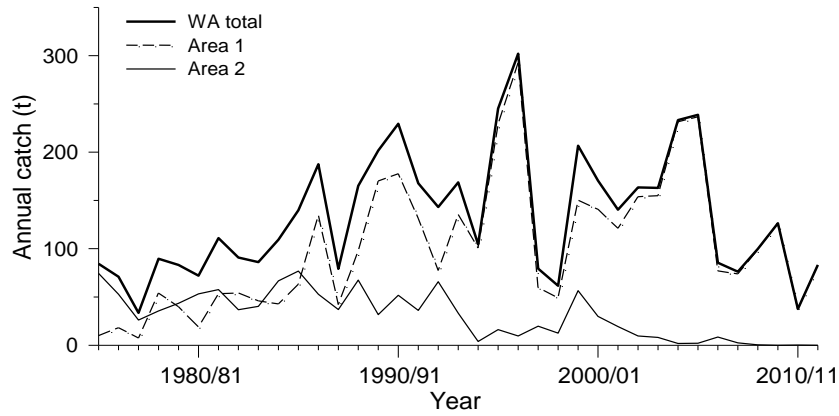


WEST COAST NEARSHORE AND ESTUARINE FIGURE 2
Annual commercial catches of tailor, by Bioregion, 1976 –2012. Minor catches in South Coast Bioregion are not shown, but are included in WA total.



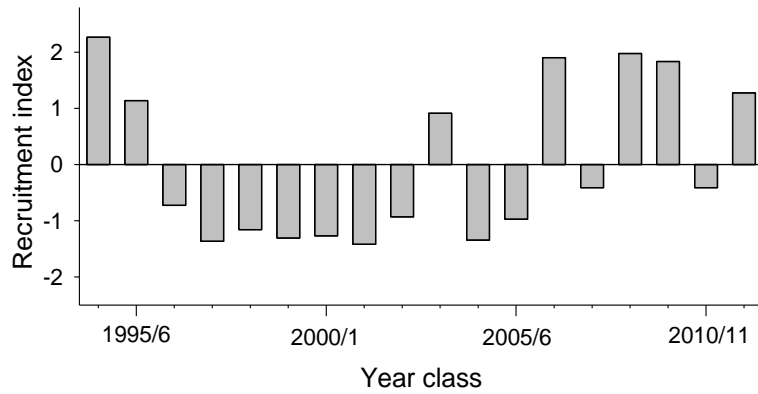
WEST COAST NEARSHORE AND ESTUARINE FIGURE 3
Annual commercial catches of sea mullet, by Bioregion, 1976 –2012. Minor catches in North Coast Bioregion are not shown, but are included in WA total.

WEST COAST BIOREGION



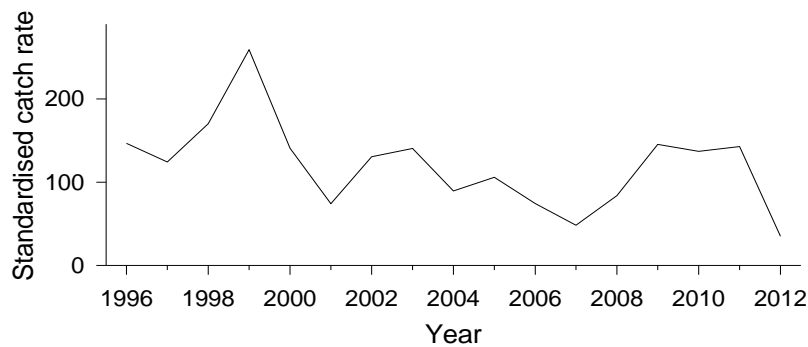
WEST COAST NEARSHORE AND ESTUARINE FIGURE 4

Annual commercial catches of whitebait in West Coast Bioregion, by fishing area, 1975/76 –2011/12. Area 1 = Bunbury; Area 2 = Perth/Mandurah.



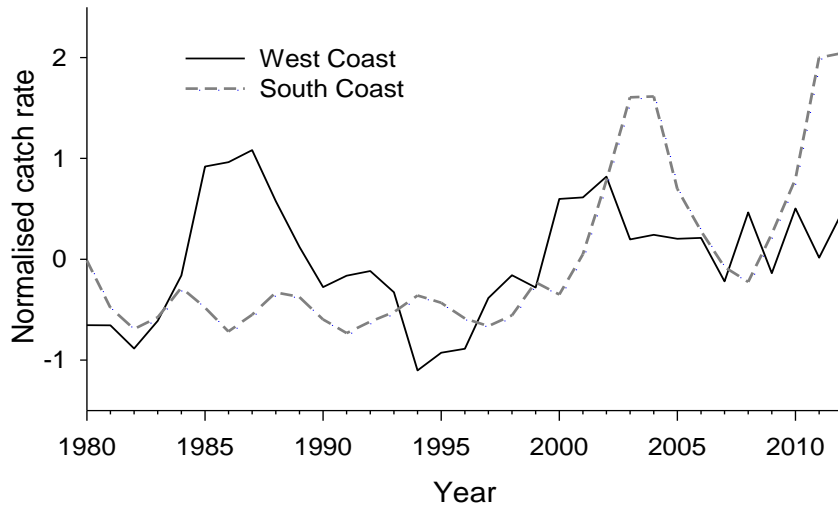
WEST COAST NEARSHORE AND ESTUARINE FIGURE 5

Annual recruitment index for tailor in the West Coast Bioregion, 1996 – 2012, derived from volunteer fisher catch rates of age 0+ juveniles in the Swan-Canning Estuary. Data represent annual deviations from the long-term average. e.g. bars above the line Indicate better than average number of recruits



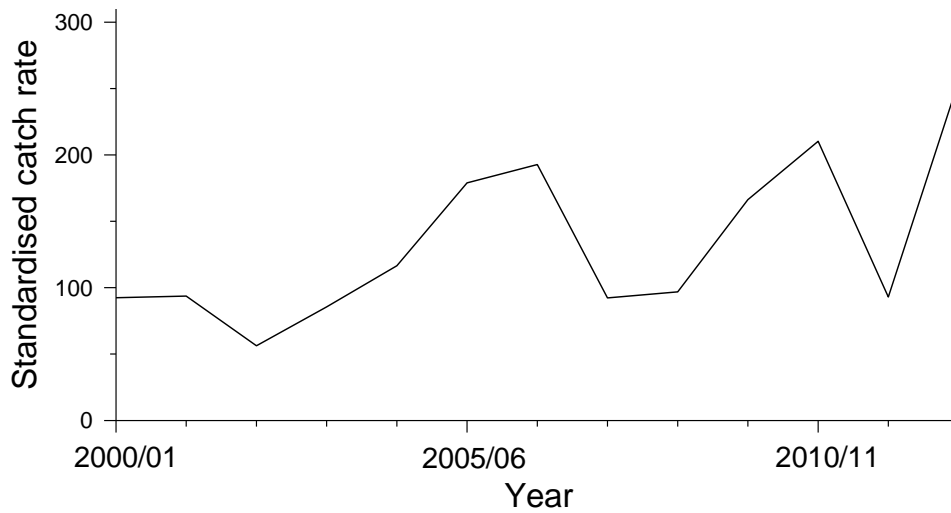
WEST COAST NEARSHORE AND ESTUARINE FIGURE 6

Annual commercial catch rate of southern garfish in Cockburn Sound, 1996 – 2012.



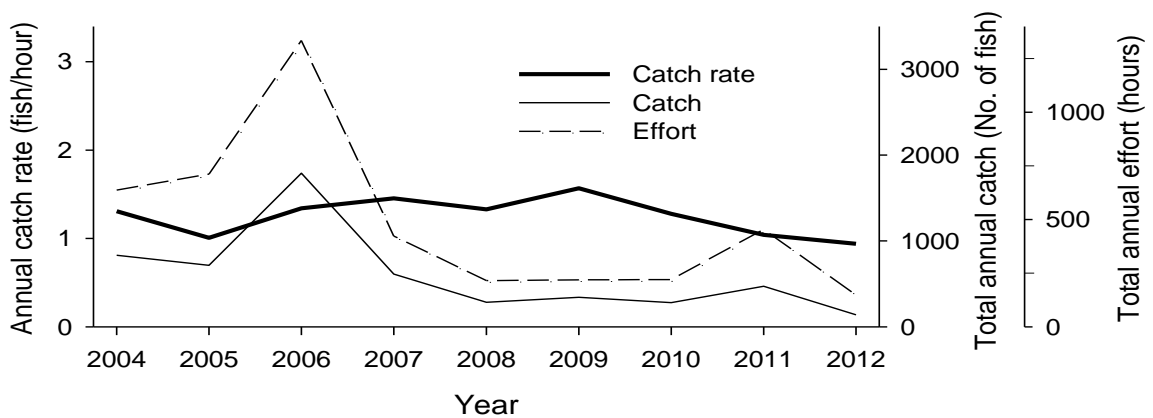
WEST COAST NEARSHORE AND ESTUARINE FIGURE 7

Annual commercial catch rates of sea mullet in West Coast and South Coast Bioregions, 1996 – 2012.



WEST COAST NEARSHORE AND ESTUARINE FIGURE 8

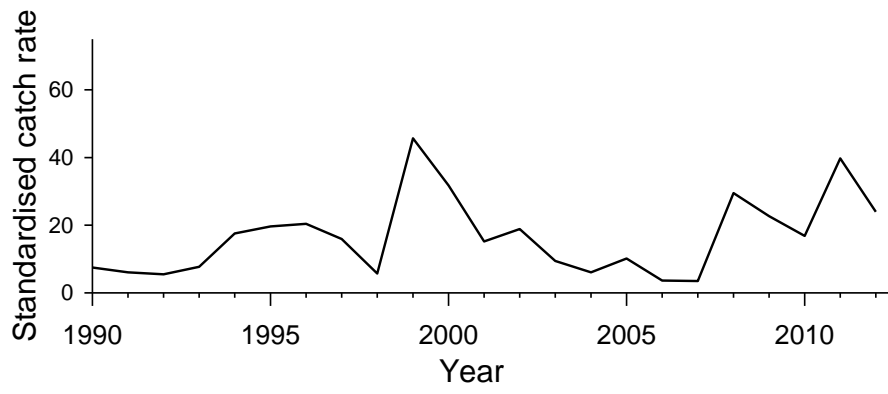
Annual commercial catch rate (kg/method day) of whitebait in Area 1 (Bunbury) 2000 – 2012.



WEST COAST NEARSHORE AND ESTUARINE FIGURE 9

Total annual catch, effort and catch rate of black bream by voluntary recreational logbook fishers in the Swan-Canning Estuary, 2004 – 2012.

WEST COAST BIOREGION



WEST COAST NEARSHORE AND ESTUARINE FIGURE 10

Annual commercial catch rate of cobbler in the Peel-Harvey Estuary, 1990 – 2012.

West Coast Purse Seine Fishery Report: Statistics Only

B. Molony, E. Lai, M. Holtz and R. Jones

Fishery Description

The West Coast Purse Seine Fishery mainly captures pilchards (*Sardinops sagax*) and the tropical sardine (or scaly mackerel) *Sardinella lemuru* (referred to as sardinella) by purse seine in the West Coast Bioregion. Smaller catches of Perth herring (*Nematalosa vlaminghi*), yellowtail scad (*Trachurus novaezelandiae*), Australian anchovy (*Engraulis australis*), maray (*Etrumeus teres*) and other species are also reported.

Boundaries

There are three defined fisheries. The Perth metropolitan fishery operates between 31° S and 33° S latitude (West Coast Purse Seine Figure 1). The Southern Development Zone covers waters between 33° S and Cape Leeuwin. The Northern Development Zone covers waters between 22° S and 31° S.

Management arrangements

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

Access to the Perth Metropolitan fishery is limited to 12 licences that must fish in accordance with the *West Coast Purse Seine Management Plan 1989*. Both pilchards and sardinella are the main target species in the Metropolitan fishery. There are three fishing boat licences with a specific condition that permits the taking of fish using a purse seine net that is hauled by the use of a power block within specific waters of the Southern Development Zone. Two of those fishing boat licences may also retain pilchards. A further three fishing boat licences permit the taking fish using a purse seine net that is hauled by the use of a power block in the Northern Development Zone and sardinella is the main target species.

Currently, a notional 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. For the 2010/11 licensing period (1 April 2010 – 31 March 2011) a notional TAC of 2,328 t for pilchards, with separate TAC of 672 t for the other small pelagic species (including sardinella) is in place. The notional TAC for pilchards has been in place since 2006/07, and is based on approximately 10% of the west coast pilchard stock. The Northern Development Zone has a separate notional TAC. Reaching or exceeding the notional TACs will trigger a management response.

Landings and Effort

Commercial Landings: **19 tonnes**

Effort levels again increased in 2012 to 269 fishing days undertaken by six vessels. Total catches of pilchards and sardinella exceeded 219 t in 2012 (2010 ~ 10 t; 2011 ~ 175 t). The 2012 catch was the highest reported since 2006 but remains well below catches recorded in the mid to late 1990s

and early 2000s (West Coast Purse Seine Figure 2).

Catches were dominated by sardinella (scaly mackerel, 178.2 t) with approximately 41 t of pilchards landed.

Approximately 1.3 t of other species were landed, mainly comprising yellowtail scad and trumpeters.

Fishery Governance

Target commercial catch range: 0 – 3,000 tonnes

Current Fishing (or Effort) Level: Acceptable

Total effort and catch have been relatively low in recent years due to factors other than stock size (e.g. demand, economics). In addition, fishers have reported that the presence of schools is not as predictable as in previous years. Warmer oceanic conditions may influence the behaviour and distribution of schooling pelagic species, making them less available in traditional fishing grounds.

No surveys to estimate pilchard spawning biomass are scheduled for West Coast stocks. The most recent pilchard spawning biomass estimate (2004) indicated that pilchard stocks on the west coast had recovered to pre-virus levels of approximately 20,000 – 30,000 tonnes. A recent national assessment (Ward *et al.* 2012¹) concluded that the stock was being fished at sustainable levels with current exploitation rates being very low. Less information is available for the sardinella stock but it too has been fished in recent years at low levels.

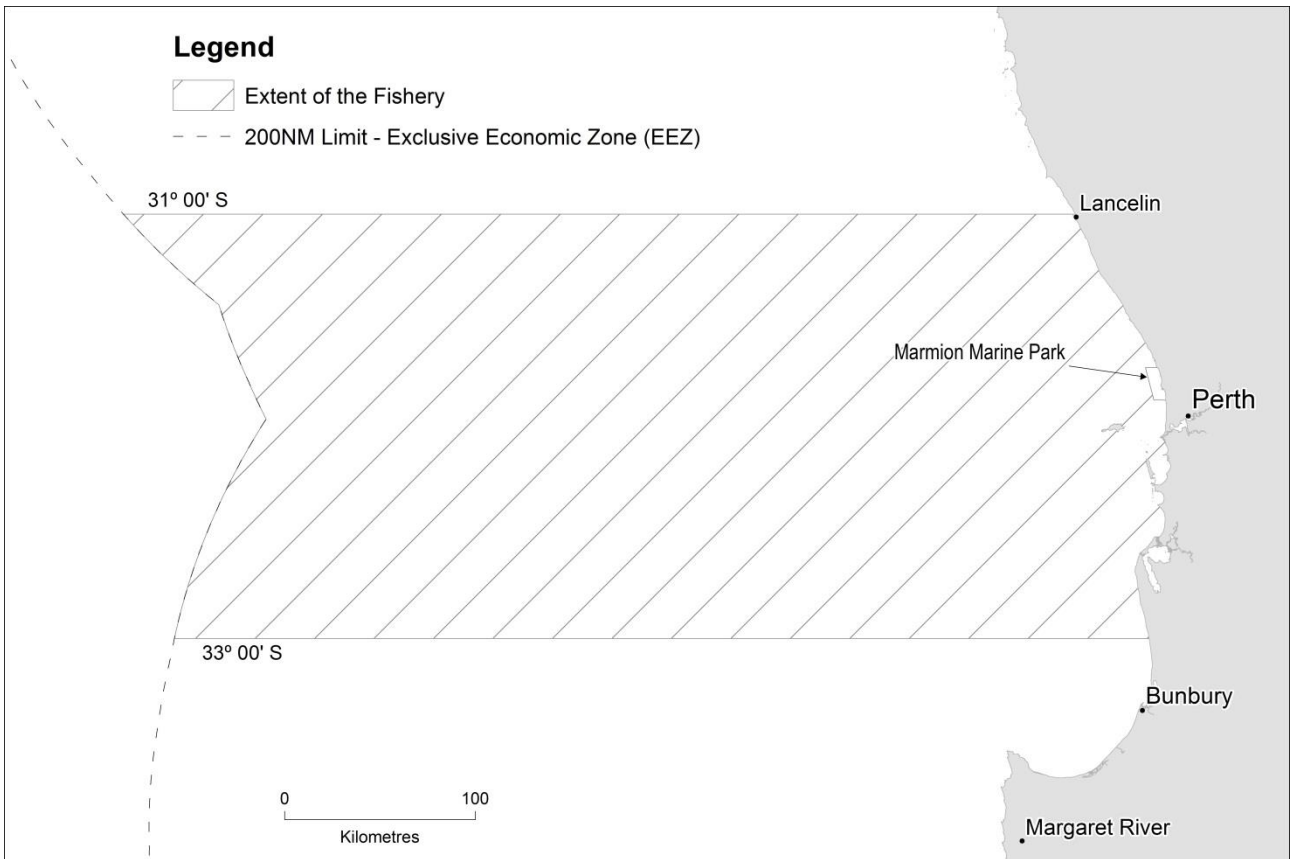
New management initiatives (2012/13)

The implementation of a formal quota system with tradeable, individually transferable quota (ITQ) units and a TAC has been a consideration for this fishery for more than ten years. However the implementation of quota for this fishery is considered to be on hold indefinitely, given that catch of pilchards and the effort expended in this fishery has not returned to normal levels since the second pilchard mass mortality event in 1999.

Depending on priorities, the Department may in the future develop a new management plan for this fishery which will incorporate the Southern and Northern Development zones along with the Perth metropolitan fishery into a single West Coast Purse Seine Fishery.

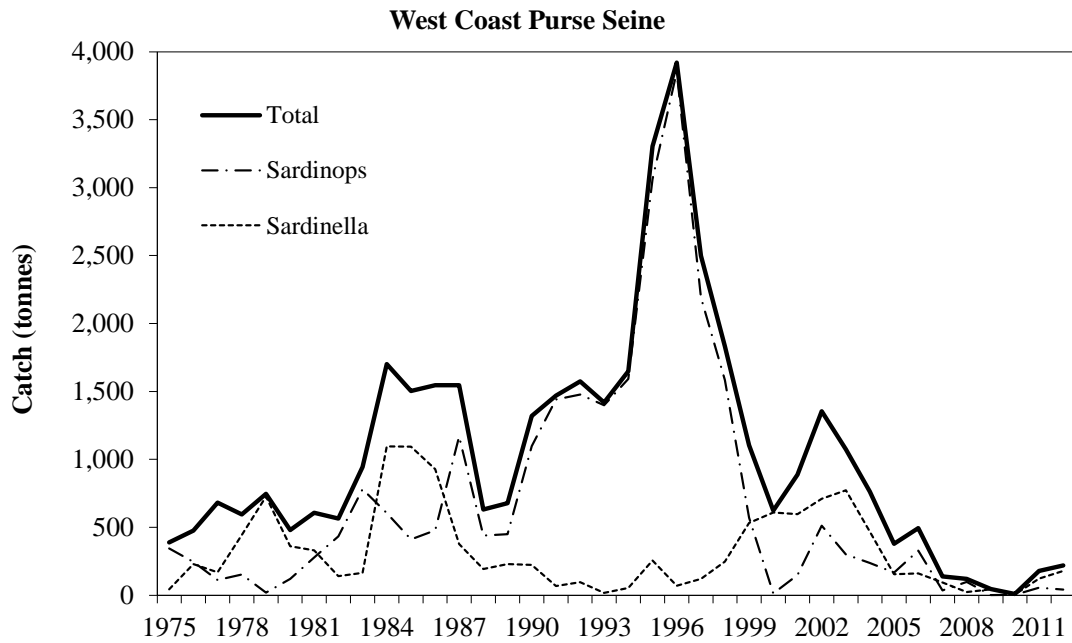
This fishery is scheduled to undergo MSC pre-assessment in 2014.

1 Ward, T., Molony, B., Stewart, J., Andrews, J. and Moore, A. (2012). Australian sardine *Sardinops sagax*, in M. Flood, I. Stobutzki, J. Andrews, G. Begg, W. Fletcher, C. Gardiner, J. Kemp, A. Moore, A. O'Brien, R. Quinn, J. Roach, K. Rowling, K. Sainsbury, T. Saunders, T. Ward & M. Winning (eds), Status of key Australian fish stocks reports 2012, Fisheries Research and Development Corporation, Canberra, pp 272-279.



WEST COAST PURSE SEINE FIGURE 1

Map of the extent of the West Coast Purse Seine Managed Fishery.



WEST COAST PURSE SEINE FIGURE 2

Annual catches of pilchards (*Sardinops*) and sardinella in the West Coast Purse Seine Fishery, 1975 –2012.

West Coast Demersal Scalefish Resource Status Report

D. Fairclough, E. Lai, M. Holtz, T. Nicholas and R. Jones

Main Features

Status		Current Landings		
Stock level	Recovering	Commercial sector		
Fishing Level		All scalefish:		
Commercial:	Not Acceptable (Pink snapper only)	WCDSIMF (2012)		389 t
Recreational:		Demersal suite:		
	Not Acceptable (Pink snapper and baldchin only)	WCDSIMF (2012)		361 t
		Other (DGDLF, WCRLF, CSLPF, SWTMF; 2012 or 2011/12)		46 t
		Total demersal suite		407 t
			WCDSIMF	Other
		Indicator species	(2012)	(2012 or 2011/12)
		West Australian Dhufish	64 t	9 t
		Pink snapper	170 t	10 t
		Baldchin Groper	16 t	1 t
		Recreational sector (2011/12)		
		Top 15 species:		159 t
		Indicator species:		
		West Australian Dhufish		74 t
		Pink snapper		33 t
		Baldchin Groper		29 t
		Charter sector (2011/12)		
		Top 15 species		41 t
		Indicator species:		
		West Australian Dhufish		13 t
		Pink snapper		10 t
		Baldchin Groper		9 t

Fishery Description

The West Coast Demersal Scalefish Resource comprises inshore and offshore suites of demersal scalefish species that are exploited by different commercial fisheries and recreational and charter fishers that operate in the West Coast Bioregion (WCB). The West Coast Inshore Demersal suite occurs in waters 20-250 m deep with approximately 100 species of this suite caught by these fisheries. The most important species are the West Australian Dhufish (*Glaucosoma hebraicum*) and Pink snapper (*Pagrus auratus*) with other species captured including Redthroat Emperor (*Lethrinus miniatus*), Bight Redfish (*Centroberyx gerrardi*) and Baldchin Groper (*Choerodon rubescens*). The West Coast Offshore Demersal suite, which occurs in waters > 250 m deep, includes Eightbar Grouper *Hyporthodus octofasciatus*, Hapuku *Polyprion oxygeneios*, Blue-eye

Trevalla *Hyperoglyphe antarctica* and Ruby Snapper *Etelis carbunculus*.

Commercial

The West Coast Demersal Scalefish (Interim) Managed Fishery (WCDSIMF) is a handline and drop line fishery and it is the main commercial fishery that targets demersal species in the WCB. The West Coast Demersal Gillnet and Demersal Longline (Interim) Managed Fishery (WCDGDLF) and Zone 1 of the Joint Authority Southern Demersal Gillnet and Demersal Longline Managed Fishery (JASDGDLF), referred to collectively as the temperate Demersal Gillnet and Demersal Longline Fisheries (DGDLF), target sharks and rays but also retain demersal scalefish. Other commercial fisheries that may take a small amount of demersal species in the WCB include, when exempted, the Cockburn Sound Line

WEST COAST BIOREGION

and Pot Managed Fishery (CSLPPF) and the South-West Trawl Managed Fishery (SWTMF). The Commonwealth Western Deepwater Trawl Fishery and the Great Australian Bight Trawl Sector of the Southern and Eastern Scalefish and Shark Fishery, that operate in waters of the WCB deeper than 200 metres, also catch demersal species.

Fishing and Aquatic Tour Industry (Charter)

Demersal scalefish are targeted by the fishing activities of the charter boat industry in the WCB. Line fishing is the main method used by operators licensed to fish in that sector. A small number of fishing tour operators also cater for recreational diving charters.

Recreational

Recreational fishers that target demersal species in the WCB are almost exclusively boat-based. Line fishing is the main method used by recreational fishers, although spear fishing also occurs, but mainly in shallow waters, i.e. < 20 m deep.

Note - The WCDSIMF and the charter and recreational sectors in the WCB are collectively referred to as the West Coast Demersal Scalefish Fishery (WCDSF).

Governing legislation/fishing authority

Commercial

West Coast Demersal Scalefish (Interim) Management Plan 2007

West Coast Demersal Interim Managed Fishery Permit

West Coast Demersal Gillnet and Demersal Longline Interim Management Plan 1997

West Coast Demersal Gillnet and Demersal Longline Interim Managed Fishery Permit

Joint Authority Southern Demersal Gillnet and Demersal Longline Management Plan 1992

Joint Authority Southern Demersal Gillnet and Demersal Longline Managed Fishery Licence

Cockburn Sound (Line and Pot) Management Plan 1995

Cockburn Sound (Line and Pot) Managed Fishery Licence

South West Trawl Management Plan 1989

South West Trawl Managed Fishery Licence

Recreational

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

Consultation process

Commercial

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

Recreational

Consultation processes are now facilitated by Recfishwest under a Service Level Agreement although the Department

undertakes direct consultation with the community on specific issues.

Boundaries

Commercial fishery

The WCDSIMF encompasses the waters of the Indian Ocean just south of Shark Bay (at 26°30'S) to just east of Augusta (at 115°30'E) and extends seaward to the 200 nm boundary of the Australian Fishing Zone (AFZ). The commercial fishery is divided into five management areas comprising four inshore areas and one offshore area. The inshore areas, i.e. Kalbarri, Mid-West, Metropolitan and South-West, extend outwards to the 250 m depth contour, while the Offshore Area extends the entire length of the fishery from the 250 m depth contour to the boundary of the AFZ (West Coast Demersal Scalefish Figure 1). The Metropolitan Inshore Area was closed to commercial operators in the WCDSIMF and WCDGDLF in November 2007 (West Coast Demersal Scalefish Figure 1).

The boundaries of each of the other fisheries that catch demersal species in the WCB are given in their separate sections of this Status Reports of the Fisheries and Aquatic Resources of Western Australia.

Fishing and Aquatic Tour Industry (Charter) and Recreational fishery

The boundaries applicable to the charter and recreational sectors in the WCB encompass the waters of the Indian Ocean just south of Shark Bay (at 27°S) to just east of Augusta (at 115°30'E) and extend seaward to the 200 nm boundary of the AFZ (West Coast Demersal Scalefish Figure 1).

Management arrangements

Commercial

The WCDSIMF was established in January 2008, following the introduction of the *West Coast Demersal Scalefish (Interim) Management Plan 2007*. Permit holders are permitted to retain all scalefish (other than a number of species that are under specific State or Commonwealth management) and are not permitted to take sharks and rays.

Access to the Fishery is restricted to 59 Interim Managed Fishery Permit holders. Gear and other restrictions apply (in the form of maximum numbers of lines and hooks and arrangements regulating the carriage of lines and fish) and boats are monitored under the Vessel Monitoring System (VMS).

Each of the five management areas is allocated a maximum number of hours of fishing time that may be fished on an annual basis, with the Metropolitan Area currently allocated zero hours. Units are allocated to permits and provide entitlement in "hours" of fishing time. The use of VMS allows fishing effort to be monitored and entitlement use acquitted accordingly. The total capacity of the Fishery restricts fishing effort at a level to ensure that catches of all scalefish and also of the suite of demersal species do not exceed catch objectives (see below). The capacity can be adjusted as required.

The current harvest strategy objective for the WCDSIMF is to maintain catches of all scalefish and the suites of demersal species below 50 % of those recorded in the WCB during

2005/06 to reduce fishing mortality to a level that will enable recovery of all of these stocks. The status of the three indicator species (Pink snapper, Western Australian Dhufish and Baldchin Groper) is used to indicate the status of the entire West Coast Inshore Demersal Suite of scalefish species.

The catch in each management area should also not exceed 50 % of the 2005/06 catch in that area. The average annual catch for each indicator species in the WCDSIMF and in each of the areas where they are an indicator should also remain below 50 % of their 2005/06 level.

The other commercial fisheries that take demersal scalefish in the WCB (DGDLF, WCRLF, CSLPF and SWTMF) are subject to limited entry and input and/or output controls and the same management objective of maintaining catches of the suite of demersal species below 50 % of those recorded by those fisheries during 2005/06. These other fisheries land only a small proportion (~10%) of the overall catches of demersal scalefish in the WCB.

The detailed management arrangements for each of the other fisheries that catch demersal species in the WCB are given in their separate sections of this *Status Reports of the Fisheries and Aquatic Resources of Western Australia*.

From 2008 until Aug 2011, fishers in the WCRLF were permitted by exemption to retain demersal scalefish caught in rock lobster pots for personal consumption only (i.e. not permitted to be sold). The Exemption expired in Aug 2011 and has not been renewed.

Fishing and Aquatic Tour Industry (Charter)

There are two types of fishing tour licence categories.

Fishing Tour Operators Licence: The focus is on fishing activities, where fish can be taken home at the end of the tour.

Restricted Fishing Tour Operators Licence: The focus is on eco-tourism activities, such as snorkelling or scuba diving, with fishing only allowed for the purpose of a meal eaten during the course of the tour. No fish can be taken home at the end of the tour and any fishing for a meal must be done with a handline. Fishing rods are not permitted on this tour category.

Within each category, there is the provision for a boat-based operation (boat size larger than 7.5 m), a combination land/aircraft/boat (boat size less than 7.5 m) based operation and a land-based operation. Except where extraordinary circumstances can be demonstrated by the applicant, new Fishing Tour Operators Licences are no longer granted. Applications for Restricted Fishing Tour Operators Licences are still considered. Currently, the consideration of any Tour Operator's Licence Application is carried out in accordance with Regulation 128J of the Fish Resources Management Regulations 1995 and Ministerial Policy Guideline No. 12 'Assessment of Applications for the Granting, Renewal or Transfer of Fishing Tour Operators Licences and Aquatic Eco-Tourism Operators Licences'.

All fishing is subject to recreational fishing regulations (see below), however passengers onboard a fishing tour are not required to hold an individual Recreational Fishing from Boat Licence.

Recreational

The recreational fishery for demersal scalefish in the WCB is

managed using input (e.g. size limits, seasonal closures and spatial closures) and output controls (e.g. daily bag limits, boat limits and possession limits).

A suite of new management arrangements was introduced during 2009/10 aimed at reducing the recreational take of demersal scalefish in the WCB by at least 50 % from 2005/06 levels. These arrangements included changes to bag, boat and size limits for demersal scalefish species, a requirement to carry a release weight (to assist in minimising the effects of barotrauma) and the implementation of a closure prohibiting fishing for "high risk" demersal scalefish for two months between 15 October and 15 December.

Since 2 March 2010, all persons fishing from a powered boat anywhere in the State have been required to hold a Recreational Fishing from Boat Licence or fish in the company of a licence holder. The Recreational Fishing from Boat Licence will provide a state-wide database of recreational boat fishers for survey purposes.

Research summary

Research on demersal species in the WCB focuses on monitoring the catch levels and stock status of indicator species. Level 3 stock assessments based on a weight of evidence approach, which now incorporate estimation of fishing mortality rates and spawning potential ratios, are conducted at periodic intervals for each of the indicator species within the West Coast Inshore Demersal Suite. Along with the existing indicator species for that suite, West Australian Dhufish, Pink snapper and Baldchin Groper, two new indicator species (Redthroat emperor and Bight redfish) are also being used. Annual Level 1 assessments of catch are also used to monitor these species and the indicator species for the West Coast Demersal Offshore Suite¹ (Hapuku, Blue-eye Trevalla, Bass Groper). To enable the Level 3 assessments, fish frames of the indicator species are collected from recreational and commercial fishers across the different areas of the WCB (West Coast Demersal Scalefish Figure 1). Otoliths obtained from these frames are used to determine age compositions for species in relevant management areas, from which estimates of fishing mortality and subsequently spawning potential ratios are calculated and stock status determined. A stock assessment for West Australian Dhufish, Pink snapper and Baldchin Groper will be reported in 2013.

Catch and effort data both for the WCDSIMF and charter fisheries are obtained annually from fishers' daily/trip logbooks, which provide fine-scale data from 10 nm × 10 nm and 5 nm × 5 nm blocks, respectively. Estimates of the catch of demersal species in this Bioregion by other commercial fisheries (DGDLF, WCRLF, CSLPF, SWTMF) are determined annually from compulsory logbook data. Full details are reported in the relevant fisheries reports.

An integrated survey of boat-based recreational fishing in WA was conducted during 2011/12.

WA Marine Science Institute-funded research on the stock structure of West Australian Dhufish, Pink snapper and Baldchin Groper in the WCB is now complete. This was a

¹ See Fisheries Occasional Publication No. 85 http://www.fish.wa.gov.au/Documents/occasional_publications/fop085.pdf.

collaborative project between the Department of Fisheries, Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Murdoch University. Scientific papers have been published on the stock structures of West Australian Dhufish, Pink snapper and Baldchin Groper, based on both genetic and otolith microchemistry techniques plus an examination of oceanographic influences on larval dispersal of West Australian dhufish.

Acoustic telemetry is being used to investigate site-fidelity of adult Pink snapper to Cockburn Sound spawning aggregations. Data on the movements of tagged Pink snapper will be collected by remotely deployed receivers until the end of 2013. These data will be used to assess the risks associated with targeting Pink snapper that are either migrating to and from, or aggregating in, Cockburn Sound.

Annual surveys of the numbers of Pink snapper eggs in Cockburn Sound have been conducted consecutively since 2008. These data may in the future be capable of producing estimates of spawning stock biomass using a daily egg production model, similar to that used to monitor Pink snapper stocks in Shark Bay. However, a study of rapid genetic methods to validate the visual identification of Pink snapper eggs (given other visually similar eggs are present in this region) needs to be completed before spawning stock biomass can be robustly estimated.

A State Natural Resource Management-funded project, focused on small juvenile West Australian Dhufish (< 150 mm in length), has identified the habitat types that juvenile dhufish occupy. A final report will be published in 2013.

A collaborative FRDC-funded project (FRDC 2010-004) between Curtin University and the Department of Fisheries was completed in 2013. This project used passive-acoustic techniques and biological examination of fish samples to demonstrate that West Australian dhufish can produce sound, while this is not the case for Pink snapper. Further studies would be required to identify whether sound production in W.A. dhufish is associated with its reproductive behaviour, stress or both.

A collaborative FRDC-funded project (FRDC 2011-016) between CSIRO and the Department of Fisheries was completed in 2012 to survey the occurrence of West Australian dhufish eggs and larvae in the South-west and Metropolitan Areas of the WCB. The study used plankton collection and analysis of samples using rapid DNA screening. The project successfully conducted real-time modelling of ocean currents to guide the plankton sampling. Phytoplankton and nutrient concentration were also examined to correlate with egg/larval abundance. A final report can be downloaded from <http://frdc.com.au/research/final-reports/Pages/2011-016-DLD.aspx>.

Further studies are being conducted to determine the comparability of data for catch and effort of boat-based recreational fishers derived from the integrated survey of boat-based recreational fishing in WA 2011/12 with previous boat ramp surveys (i.e. creel surveys).

Retained Species

Commercial production

All scalefish

WCDSIMF (2012) 389 tonnes

Demersal suite

WCDSIMF (2012) 361 tonnes

DGDLF, WCRLF, CSLPF, SWTMF

(2012 or 2011/12) 46 tonnes

Total 407 tonnes

Indicator species

WCDSIMF (2012)

West Australian Dhufish 64 tonnes

Pink snapper 170 tonnes

Baldchin Groper 16 tonnes

DGDLF, WCRLF, CSLPF, SWTMF

(2012 or 2011/12)

West Australian Dhufish 9 tonnes

Pink snapper 10 tonnes

Baldchin Groper 1 tonnes

Total

West Australian Dhufish 73 tonnes

Pink snapper 180 tonnes

Baldchin Groper 17 tonnes

Landings

Catches are reported from the most recent complete season of logbook data for each commercial fishery that catches demersal species in the WCB. This includes 2012 for the WCDSIMF, CSLPF and SWTMF and 2011/12 for the DGDLF and WCRLF.

Catches of all scalefish by the WCDSIMF decreased by 22 t from 411 t in 2011 to 389 t in 2012, as a result of a decrease in catch of demersal species from 382 t to 361 t. In 2012, catches comprised 352 t of inshore demersal species and 9 t of offshore demersal species.

The respective catches of demersal species in the Kalbarri, Mid-west and South-west areas in 2012 of 133 t, 176 t and 43 t decreased from those in 2011 of 144 t, 50 t and 180 t. The 9 t of demersal species landed in the offshore area in 2012 is a slight increase from 7 t in 2011.

The WCDSIMF catch in 2012 comprised 78 scalefish species or species groups. Fifty four species are from the inshore and offshore demersal suites and 24 from the pelagic and nearshore suites. Six species/species groups comprised 86 % of the total catch of the WCDSIMF, i.e. Pink snapper (170 t), West Australian Dhufish (64 t), Redthroat Emperor (46 t), Redfish species (*Centroberyx* spp., 24 t), Baldchin Groper

(16 t), and Samson Fish (15 t). Catches of offshore demersal species were low, i.e. Eightbar Grouper, 4 t; Hapuku, 3 t and Bass Groper, Blue-eye Trevalla and Ruby Snapper, each ≤ 1 t.

Catches of demersal scalefish by the DGDLF in the WCB decreased from 53 t in 2010/11 to 45 t in 2011/12. Less than 1 t was taken by the WCRLF, CSLPF and SWTMF combined.

West Australian Dhufish: The total catch of West Australian dhufish by the WCDSIMF in 2012 of 64 t changed little from the 67 t in 2011. The catch in the Kalbarri Area decreased from 5 t in 2011 to 4 t in 2012 and in the South-west Area from 19 t to 16 t. The catch of 44 t in 2012 in the Mid-west remained the same as in 2011 (West Coast Demersal Scalefish Figure 2). Catches of dhufish by the DGDLF decreased from 13 t in 2010/11 to 9 t in 2011/12 and by the WCRLF, SWTMF and CSLPF combined were negligible.

Pink snapper: The total catch of 170 t of Pink snapper by the WCDSIMF in 2012 declined from 182 t in 2011. In the Kalbarri area, the catch of 78 t of Pink snapper in 2012 decreased from 88 t in 2011 and in the Mid-west area it decreased from 91 t to 87 t. The catch of Pink snapper in the South-west Area increased to 4 t in 2012 from 3 t in 2011 (West Coast Demersal Scalefish Figure 3). Pink snapper catches of the DGDLF in the WCB increased from 7 t to 10 t between 2010/11 and 2011/12, and were < 1 t in the WCRLF, SWTMF and CSLPF combined, similar to previous years.

Baldchin Groper: The total catch of 16 t of Baldchin groper by the WCDSIMF in 2012 was similar to 2011 (West Coast Demersal Scalefish Figure 4). This was taken almost entirely in the Kalbarri and Mid-west Areas, with about 10 t of that being from the Abrolhos Zone A of the WCRLF. Only 1 t of Baldchin groper was caught by the DGDLF in 2011/12, similar to 2010/11. Reported Baldchin groper catches by the WCRLF, SWTMF and CSLPF combined were negligible (< 1 t).

Charter fishing (2011/12)

Top 15 demersal scalefish species	41 tonnes
Indicator species	
West Australian Dhufish	13 tonnes
Pink snapper	10 tonnes
Baldchin Groper	9 tonnes

The total catch of 41 t of the top 15 demersal species/species groups by charter fishers in 2011/12 (based on 98 % of logbook returns at the time of this report) was the same as in 2010/11 (based on 97 % of logbooks returned; see West Coast Demersal Scalefish Figure 5). The catches of each of the indicator species in 2011/12 were also similar to 2010/11, i.e. West Australian dhufish: 13 vs 12 t, Pink snapper: 10 t in both years, Baldchin groper: 9 t in both years. The West Coast Offshore Demersal Suite comprised 1 t of charter catches in 2011/12 compared with < 1 t in 2010/11.

Recreational fishing (boat-based, non-charter) (2011/12)

Top 15 demersal scalefish species	159 tonnes
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Indicator species

West Australian Dhufish	74 tonnes
Pink snapper	33 tonnes
Baldchin Groper	29 tonnes

Approximately 159 t of the top 15 demersal species/species groups were estimated to have been caught by boat-based fishers in the WCB during 2011/12 (West Coast Demersal Scalefish Figure 5). Estimated catches of indicator species in 2011/12 were as follows: West Australian Dhufish 74 t, Pink snapper 33 t, Baldchin groper 29 t. These data are not directly comparable with estimates of catch from previous surveys, which were based on different survey methods.

Fishing effort/access level

Commercial

In 2012, 51 boats fished in the WCDSIMF. Seventeen vessels fished in the Kalbarri Area, 43 in the Mid-west, 9 in the South-west and 12 in the Offshore Area. Some vessels have entitlements to fish in more than one inshore area, while all can access the Offshore Area.

The total number of days fished in 2012 (1,568) was almost the same as in 2011 (1,572) as was the amount of fishing entitlement (hours) consumed. The number of hours fished (hours searching + hours fishing) increased from 17,700 h in 2011, to 18,800 h in 2012. Entitlement consumed in the Kalbarri area increased by only 4 % and decreased in the Mid-west by 5 %. However, in the South-west and Offshore areas, 11 % and almost 50 % more entitlement was consumed in 2012 than 2011.

Effort recorded by other fisheries that catch demersal species in the WCB is given in their separate sections of this *Status Reports of the Fisheries and Aquatic Resources of Western Australia*. Note that the exemption to retain demersal scalefish caught in lobster pots by the WCRLF expired part way through their 2011/12 fishing season.

Recreational

Fishing effort by the recreational sector during the 2011/12 *i>Survey* of boat-based fishing in the West Coast Bioregion, was estimated as 179,000 boat days. These data are not directly comparable with estimates of effort from previous surveys, which were based on different survey methods.

Fishing and Aquatic Tour Industry (Charter)

Fifty four charter licenses were reported to have undertaken fishing operations in 2011/12, which is the same as in 2010/11. The number of fisher days decreased slightly from 22,000 to 21,500.

Stock Assessment

Assessment complete **Yes (2013)**

Assessment level and method:

- Level 3 - Fishing mortality and spawning potential ratio (Periodic)**
- Level 1 - Catch by sector (Annual)**

Breeding stock levels

West Australian Dhufish:	Recovering
Pink snapper:	Recovering
Baldchin Groper:	Recovering

Inshore Demersal: A level three assessment of the status of stocks of the inshore demersal indicator species (West Australian Dhufish, Pink snapper and Baldchin Groper) in the West Coast Bioregion (WCB) and its different management areas was conducted in 2013, based on fisheries-dependent age structure data collected from 2008/09-2010/11 for the first two species and 2007/08-2010/11 for the latter species. The methods for estimating fishing mortality rates (F) have previously been independently reviewed (O'Neill, 2009)¹. The review recommended using additional estimation methods that use fewer assumptions and as an alternative (Fisher, 2012)². The 2013 assessment also included assessments of spawning potential ratios (SPR) for the first time. Both the F and SPR estimates were compared with internationally accepted biological reference points in a weight of evidence approach to determine the change in status of stocks over time.

The assessment demonstrated that both F and SPR for West Australian dhufish and F for Pink snapper in the West Coast Bioregion have improved. Thus, F has decreased and SPR has increased, since the previous assessment period of 2005/06-2007/08. This indicates evidence of recovery in their breeding stocks. However, at that time, stocks had not recovered to an appropriate level, i.e. the threshold (Fairclough *et al.* (in press)), where F is equivalent to the rate of natural mortality and SPR is equal to 30% of reproductive potential. The recovery trend was consistent among management areas for both species. However, there has been less recovery for Pink snapper stocks in the northern management areas (Kalbarri and Mid-west) compared to those in the southern management areas (Metropolitan and South-west). This indicates better status of stocks in the southern half of the WCB.

The F and SPR for Baldchin groper were beyond the limit reference point and thus at unacceptable levels. Neither the SPR or F levels had changed since the previous available assessment period of 2000/01-2001/02.

The limited levels of recovery for each of the indicator species at the time of this assessment was expected because changes to management were only introduced between late 2007 and early 2010, which overlaps with the sampling period for age data used in this assessment. The precise rate at which the stocks for each indicator species will recover will also be influenced by their biological characteristics. Recovery to threshold management levels is estimated to take at least 10 years (i.e. 2020s).

Offshore Demersal: A Level 1 assessment using catch is

1 O'Neill, M. (2009). *Scientific review of the West Coast Demersal Scalefish Fishery, Western Australia*. Fisheries Occasional Publication, 66. Department of Fisheries, Western Australia, 24 pp.

2 Fisher, E.A. (2012). *Tools for assessing data-limited fisheries and communicating stock status information*. Ph.D. thesis, Murdoch University, Perth, Western Australia. 238 pp. <http://researchrepository.murdoch.edu.au/14881/>

conducted annually for the offshore demersal suite, including Eightbar Grouper, Bass Groper, Hapuku, Blue-eye Trevalla and Ruby Snapper. These species are particularly vulnerable to overfishing, as their biological characteristics include being long-lived with associated low rates of natural mortality and productivity (Wakefield and Newman, 2008³; Wakefield *et al.*, 2010⁴; Wakefield *et al.*, 2013a⁵, b⁶). In addition, some aggregate to spawn and most suffer barotrauma when caught due to the depths in which they are fished (> 250 m). Given the current low level of catches, risks to the biological sustainability of the stocks of these species in the WCB are considered to be acceptable.

Using the assessments of indicator species, revised management actions have reduced the ecological risks to the suites of inshore and offshore demersal species in the WCB to acceptable levels (see Fletcher *et al.*, 2010⁷). The inshore suite still has high risks associated with meeting social and economic objectives for the community. This combination of factors means that this suite of species still has a high priority for the Department with the inshore demersal suite requiring continued close monitoring and assessment. The offshore demersal suite is currently considered to have a medium level priority.

Non-Retained Species

Bycatch species impact

Medium

Line fishing for demersal species using baited hooks is highly selective⁸ for demersal fishes. Other demersal species that are caught but not normally retained during demersal fishing

3 Wakefield, C.B., & Newman, S.J. (2008) Age estimation and reproductive status of an exceptionally large blue-eye trevalla (*Hyperoglyphe antarctica*, Centrolophidae) captured off the south coast of Western Australia. *Cybiurn*, 32, 321-324.

4 Wakefield, C.B., Newman, S.J. & Molony, B.W. (2010) Age-based demography and reproduction of hapuku, *Polyprion oxygeneios* (Polyprionidae), from the south coast of Western Australia: implications for management. *ICES Journal of Marine Science*, 67, 1164-1174.

Wakefield, C.B., Newman, S.J. & Boddington, D.K. (2013b). Exceptional longevity, slow growth and late maturation infer high inherent vulnerability to exploitation for bass groper *Polyprion americanus* (Teleostei: Polyprionidae). *Aquatic Biology*, 18, 161-174.

5 Wakefield, *et al.* (2013a). Contrasting life history characteristics of the eightbar grouper *Hyporthodus octofasciatus* (Pisces: Epinephelidae) over a large latitudinal range reveals spawning omission at higher latitudes. *ICES J Mar Sci*, 70, 485-497

6 Wakefield, C.B., Newman, S.J. & Boddington, D.K. (2013b). Exceptional longevity, slow growth and late maturation infer high inherent vulnerability to exploitation for bass groper *Polyprion americanus* (Teleostei: Polyprionidae). *Aquatic Biology*, 18, 161-174.

7 W.J. Fletcher, J. Shaw, S.J. Metcalf & D.J. Gaughan (2010) An Ecosystem Based Fisheries Management framework: the efficient, regional-level planning tool for management agencies. *Marine Policy* 34 (2010) 1226-1238

8 Bycatch interactions of the gillnet and longline sector are presented in the relevant report.

activities (including inedible species, e.g. Silver Toadfish, and small species, such as wrasses) are often susceptible to the effects of barotrauma and may not survive. Note, that while they are not bycatch species, post-release survival of target species, such as West Australian Dhufish and Pink snapper decreases when caught in waters > about 30 m deep¹, and this is likely to be similar for many species caught but not retained in this fishery.

Protected species interaction **Negligible**

As line fishing is highly selective for demersal fishes, interactions with protected species by commercial, charter and recreational fishers in the WCDSF are minimal. Commercial WCDSIMF and charter fishers are required to record protected species interactions in their logbooks. During 2012, no interactions were reported by the WCDSIMF. Two grey nurse sharks were caught and released alive by the Charter Fishery in the WCB during 2011/12.

Ecosystem Effects

Food chain effects **Low**

An FRDC study² examined the last 30 years of catch data by commercial wetline, gillnet and longline fisheries in the WCB and found that the species composition in catches had changed over time. This may be a function of changes in targeting or differences in reporting methods but there was no evidence of a decline in the trophic level or mean size in catches representing a low risk to the ecosystem.

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 and hence negligible risk to benthic habitats.

Social Effects

Commercial

The total number of crew members (excluding the skipper) employed per trip on permitted vessels that fished in the WCDSIMF in 2012 ranged from zero to five, with the majority employing two. Approximately 150 people are therefore directly employed by this fishery.

Fishing and Aquatic Tour Industry (Charter)

In 2010/11, 111 charter operators were licensed to operate in the WCB via a Fishing Tour Operators Licence, compared with 125 in 2009/10. Twenty one held a Restricted Fishing Tour Operators Licence. The number of people employed in the charter industry has not been estimated.

¹ see Fisheries Research Report No. 191

http://www.fish.wa.gov.au/Documents/research_reports/fr191.pdf

² Hall, N.G. and Wise, B.S. (2011). Development of an ecosystem approach to the monitoring and management of Western Australian fisheries. FRDC Report – Project 2005/063. Fisheries Research Report No. 215. Department of Fisheries, Western Australia. 112 pp.

Recreational Fishing

Over 123,000 Recreational Fishing from Boat Licenses have been issued in Western Australia as at 2nd March 2012.

Economic Effects

Estimated annual value (to fishers) for 2011:

Level 2 - \$1-5 million

The estimated economic value of the WCDSIMF in 2012 was in the range of \$1-5 million, as in 2011.

Fishery Governance

Commercial

Current Fishing (or effort) level

Not acceptable (Pink snapper)

Catch (or effort) limit range:

All scalefish

WCDSIMF 449-469 tonnes

Demersal suite

WCDSIMF 361 tonnes

All fisheries combined (WCDSIMF, DGDLF,

WCRLF, CSLPF, SWTMF) < 407 tonnes

The primary management objectives for the WCDSIMF are to reduce total catch of all scalefish, of the demersal suites, including each of the indicator species, i.e. West Australian Dhufish, Pink snapper and Baldchin Groper, by at least 50 % of those caught by wetline fishers in the WCB during 2005/06. In addition, catches of the demersal suites in the WCB by other fisheries, i.e. DGDLF, WCRLF, CSLPF, AIMWTMF and the SWTMF, should remain at or below 50 % of those in 2005/06.

In 2012, catches of all scalefish (389 t) and of the suite of demersal species (361 t) by the WCDSIMF remained below 50 % of those of 2005/06, i.e. 449-469 and 408 t, respectively. The total catch of demersal species in a full year of fishing (either 2011/12 or 2012) by the WCDSIMF, DGDLF, WCRLF, CSLPF and the SWTMF was 407 t which is below the 450 t benchmark. WCDSIMF catches of West Australian Dhufish (64 t) and Baldchin Groper (16 t) also remained below 50 % of the 2005/06 level (i.e. 72 and 17 t, respectively). However, the catch of Pink snapper in 2012 (170 t), which was taken almost exclusively in the Mid-west and Kalbarri Areas, was above the relevant benchmark (120 t) for the fishery.

As the entitlements available to permit holders in 2012 were not fully acquitted, there is potential for further increases in effort and catch in subsequent years if catch rates remain similar or increase. Catches of Pink snapper and the other indicator species will need to be monitored closely in coming years to determine whether this trend continues and further management intervention becomes necessary.

Charter/recreational Current Fishing level

Demersal suite Acceptable

Catch (or effort) limit range:**250 tonnes (adjusted IFAAC value)**

Catches of the suite of demersal species (represented by the top 15 species/species groups) and of the indicator species by the charter and recreational sector in the WCB should remain below 50 % of 2005/06 catches (adjusted to 250 t by the Integrated Fisheries Allocation Advisory Committee, IFAAC, 2013).

The latest available catch data for recreational fishers in 2011/12 was estimated via a phone diary survey of boat-based fishers. This is not directly comparable to the previous estimates of recreational catch of demersal species from 2005/06, which was determined from a boat ramp survey of boat-based fishers and is an under-estimate of the total recreational boat-based catch. Therefore, an increased adjusted estimate of catch in 2005/06 of the top 15 demersal species and of the indicator species was estimated by the IFAAC. These values (plus those from charter fishers) for 2005/06 will now be used for comparison.

The estimated catch of the top 15 species/species groups by the charter/recreational sector in 2011/12 was 200 t, which was below the adjusted 250 t IFAAC value. The total catch of West Australian Dhufish (87 t) was less than 50 % of 2005/06 catches of 126 t. The catches of 43 t of Pink snapper and 38 t of Baldchin groper were greater than 50% of 2005/06 catches of 37 t and 33 t, respectively.

New management initiatives**Commercial**

A new management plan for the WCDSIMF is to be progressed during 2013-14, which will include a review of the fishery's management arrangements and the management objectives for the demersal scalefish resource in the WCB and will incorporate the outcomes of the stock assessment of key indicator species completed in 2013. This review will also include an evaluation of the management arrangements of the other relevant commercial fisheries (DGDLF, WCRLF, CSLPF and SWTMF) as they relate to those fisheries' take of demersal species in the WCB and the development of a formal harvest strategy and catch control guidelines designed to accommodate any recognised variations in recruitment levels.

Formal catch management guidelines are being developed to determine how the various target catch adjustments by the different commercial sectors that take demersal species will be most efficiently achieved.

Recreational/Charter

The Department of Fisheries undertook its first Statewide Recreational Boat Fishing Survey in 2011/12 and has commenced the second survey in mid-2013. The Department is now able to estimate the quantity of fish retained and released by the boat based sector for each WA marine Bioregion. This information will assist the Department in managing the State's fisheries and aquatic ecosystem resources.

A review of the effectiveness of the recreational fishing arrangements implemented in the WCB to achieve the 50 % reduction in catch from 05/06 levels will be made during 2013, following the results of the Statewide Recreational Boat Fishing Survey and the outcomes of the stock

assessment of indicator species.

On 1 February 2013 a simplified statewide set of recreational fishing rules were implemented. The major changes being a reduction from 13 to 4 categories of finfish species and, where possible, single bag limits for each species across the State.

Integrated Fisheries Management

Integrated Fisheries Management (IFM) is one of the policies aimed at making sure that Western Australia's fisheries continue to be managed in a sustainable and equitable manner into the future. The IFM process has been completed for the demersal scalefish resource in the WCB. Two Fisheries Management Papers relevant to the implementation of IFM for the demersal scalefish resource in the WCB were released in July 2010¹. The Minister for Fisheries has now made a determination in relation to the sectoral allocations for the West Coast Demersal Scalefish Resource. The overall allocation of shares in the total suite of species being 64% to the commercial fishing sector and 36% to the recreational sector. In addition catch proportion guidelines (rather than specific fixed proportional shares) for WCB indicator species were also determined. These were as follows:

West Australian Dhufish – recreational sector 60%, commercial sector 40%

Pink Snapper – recreational sector 20%, commercial sector 80%

Baldchin groper – recreational sector 65%, commercial sector 35%

External Factors

Recruitment success of both West Australian Dhufish and Pink snapper varies from year to year and is influenced by environmental factors. Thus, the stocks of those species and catches in the fishery are dominated by a limited number of strong recruitment years. This is likely to be similar for other long-lived demersal species in the WCB.

Cockburn Sound is the only known spawning aggregation location for Pink snapper in the WCB. Juveniles also use the area as a nursery for approximately one and a half years following settlement, before leaving Cockburn Sound. Ongoing industrial development in the area may have detrimental effects on the environmental conditions that are important for both spawning and juvenile survival and thus influence future recruitment success from Cockburn Sound to the WCB; thus these developments may increase the risks to sustainability of Pink snapper in the WCB.

The Commonwealth Western Deepwater Trawl Fishery and Great Australian Bight Trawl Sector of the Southern and Eastern Scalefish and Shark Fishery fish in waters of the WCB from the 200 m isobath to the boundary of the AFZ. These fisheries target species such as Deepwater Flathead *Platycephalus conatus* and Bight Redfish *Centroberyx gerrardi*. The geographical overlap of these fisheries with the WCDSF indicates that they are likely to be fishing the same stocks. Currently, catches by these Commonwealth fisheries

1 See Fisheries Management Papers 237 and 247 <http://www.fish.wa.gov.au/About-Us/Publications/Pages/Fisheries-Management-Papers.aspx>.

are very small in the WCB. A current project is focussed on the status and connectivity of Bight Redfish in the SCB and WCB and will include Commonwealth fishery catches in the assessment of stock status and risks to sustainability.

The Commonwealth's South-West Marine Bioregional Plan incorporates areas closed to fishing. These will restrict access to fishing in parts of the WCB to all sectors, i.e. commercial, recreational and charter. The management plans for this will come into effect on 1 July 2014. A compensation package will be offered to fishers for losses associated with closure to fishing in different areas. A public consultation period

WEST COAST DEMERSAL SCALEFISH FIGURE 1

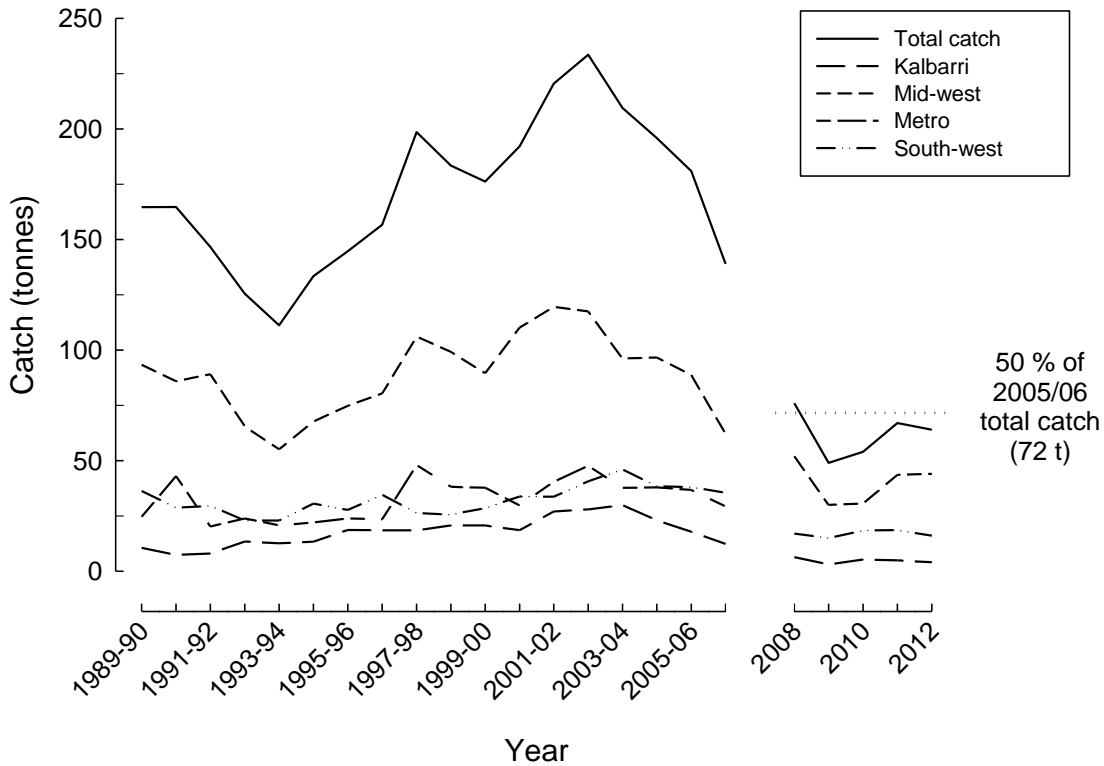
Map of the boundaries of the West Coast Demersal Scalefish Fishery extending from 26°30' S to 115°30' E. The northern boundary shown applies to the West Coast Demersal Scalefish (Interim) Managed Fishery (WCDSIMF) and is the proposed future boundary for the charter and recreational fishery. The Kalbarri, Mid-west, Metropolitan and South-west areas apply only to the WCDSIMF and extend from the coast to the 250 m depth contour, while the offshore area encompasses the waters from the 250 m depth contour outwards to the boundary of the 200 nm Australian Fishing Zone boundary (AFZ) and from 26°30' S to 115°30' E. Note the Metropolitan Area is currently closed to fishing by the WCDSIMF.

requesting comment on the guidelines for the operation of the package closed on July 1 2013. It is proposed that effort removal will be complete by the 2016/17 financial year.

Climate change may lead to a range of impacts (e.g. increased water temperatures, acidification) which may influence aspects of the biology of demersal species, such as spawning success and thus recruitment patterns. Extreme events, such as the marine heatwave recently reported¹, may have severe negative effects, including increased mortalities.

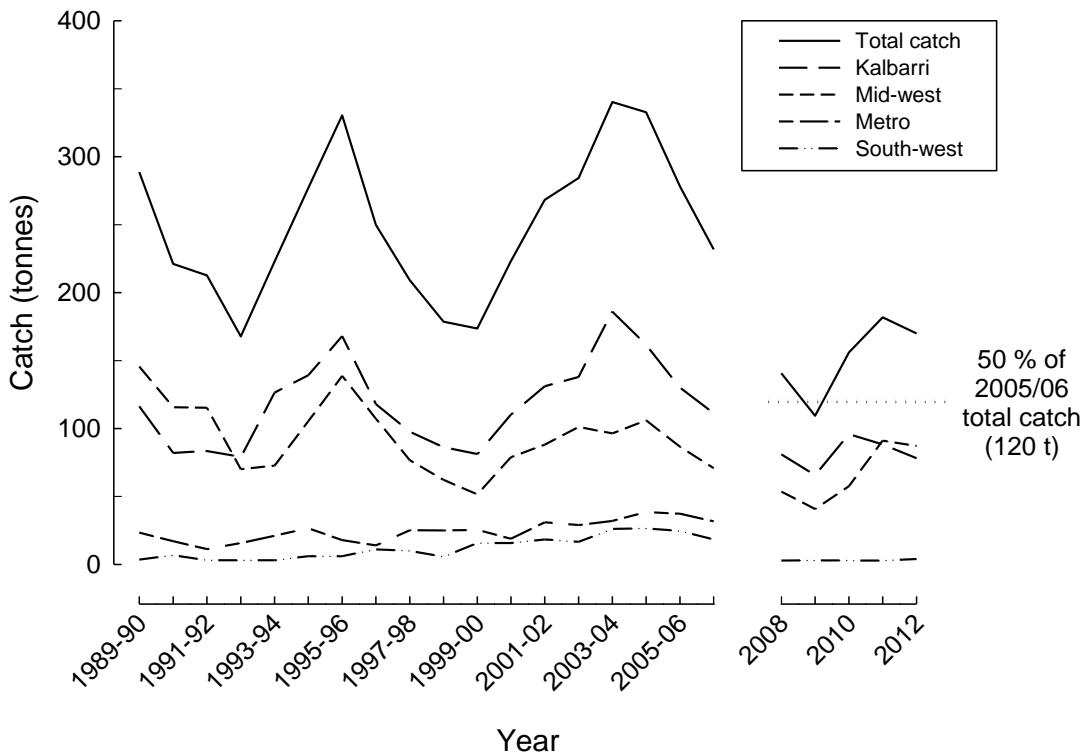
¹ See http://www.fish.wa.gov.au/Documents/research_reports/frr222.pdf.

WEST COAST BIOREGION



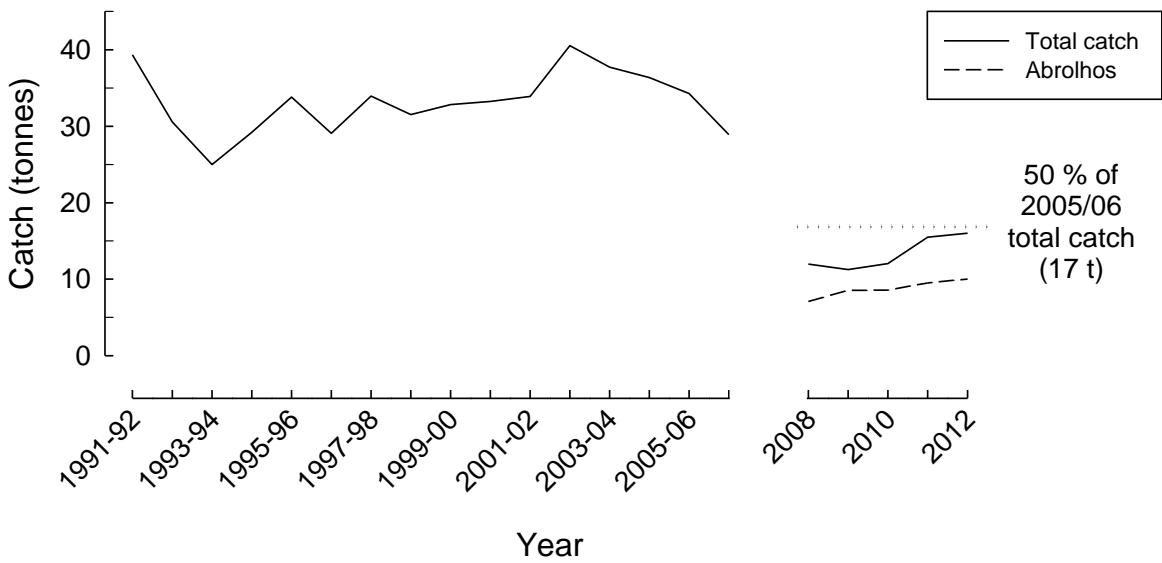
WEST COAST DEMERSAL SCALEFISH FIGURE 2

Total catch and catch by area of West Australian dhufish *Glaucosoma hebraicum* by commercial wetline fishers in the West Coast Bioregion between 1989/90 and 2006/07 and in the West Coast Demersal Scalefish (Interim) Managed Fishery between 2008 and 2012.



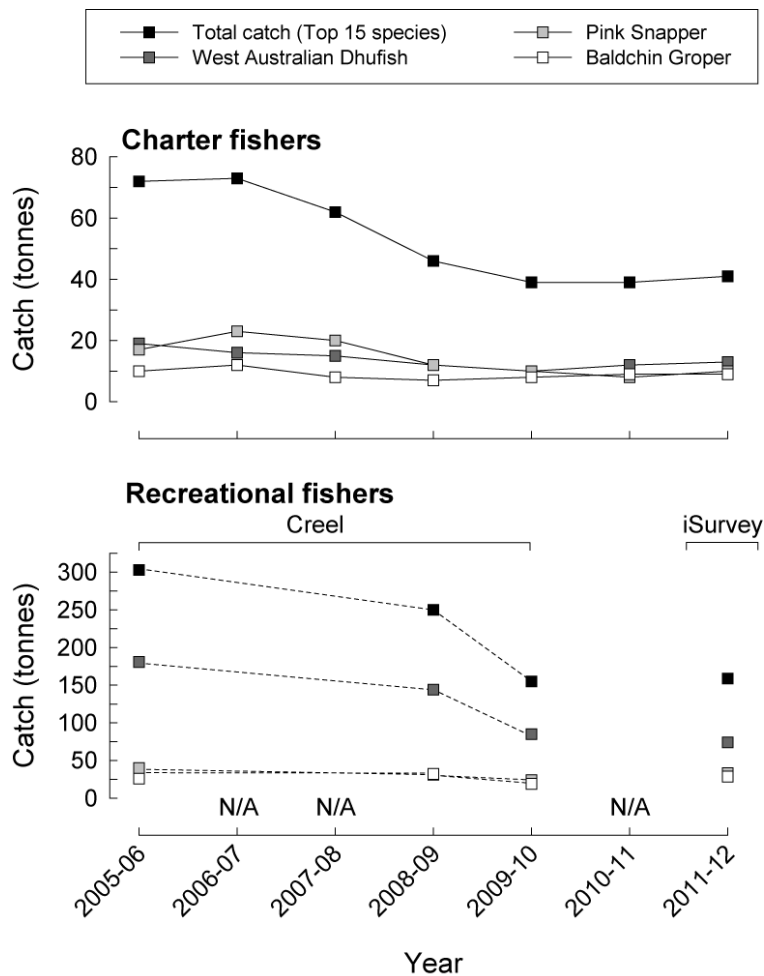
WEST COAST DEMERSAL SCALEFISH FIGURE 3

Total catch and catch by area of Pink snapper *Pagrus auratus* by commercial wetline fishers in the West Coast Bioregion between 1989/90 and 2006/07 and in the West Coast Demersal Scalefish (Interim) Managed Fishery between 2008 and 2012.



WEST COAST DEMERSAL SCALEFISH FIGURE 4

Total catch of Baldchin Groper *Choerodon rubescens* by commercial wetline fishers in the West Coast Bioregion (WCB) between 1991/92 and 2006/07 and by the West Coast Demersal Scalefish (Interim) Managed Fishery in the WCB and the Abrolhos Zone A of the Western Rock Lobster fishery between 2008 and 2012.



WEST COAST DEMERSAL SCALEFISH FIGURE 5

Catch of the top fifteen demersal species and of West Australian Dhufish, Pink snapper and Baldchin Groper by charter and recreational fishers in the West Coast Bioregion between 2005/06 and 2011/12. N/A, catch estimates not available.

Octopus Fishery Status Report

A. Hart, D. Murphy, S. Leporati, L. Joll

Main Features

Status		Current Landings	
Stock level	Adequate	Commercial – Statewide	208 t
Fishing level	Acceptable	Recreational – Statewide (2011/12 estimate)	17 t

Fishery Description

The octopus fishery in Western Australia primarily targets *Octopus cf. tetricus*, with occasional bycatch of *O. ornatus* and *O. cyanea* in the northern parts of the fishery, and *O. maorum* in the southern and deeper sectors.

Fishing activities targeting octopus in Western Australia can be divided in four main categories. The West Coast Rock Lobster Managed Fishery (WCRLF) harvests octopus as a byproduct, and historically accounted for the majority of total octopus landings, although the Developing Octopus Fishery (DOF) is now the major octopus fishery. The Cockburn Sound (Line and Pot) Managed Fishery (CSLPF), uses unbaited or passive (shelter) octopus pots; the DOF uses both passive shelter pots and active (trigger pots) traps to selectively harvest octopus. Recreational octopus fishing consists of bycatch from recreational lobster pots, and targeted octopus fishing, mostly by SCUBA divers. In addition to these 4 main sectors, numerous trawl and trap fisheries land small amounts of octopus as a byproduct.

Governing legislation/fishing authority

Commercial

Cockburn Sound (Line and Pot) Management Plan 1995

Cockburn Sound (Line and Pot) Managed Fishery Licence

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

West Coast Lobster Management Plan 1993

West Coast Rock Lobster Managed Fishery Licence

Recreational

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

Consultation process

Commercial

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

Recreational

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

specific issues.

Boundaries

Recreational octopus fishing is permitted to operate throughout Western Australian waters, with the exception of areas closed to recreational fishing such as reserves and sanctuaries. Each of the four commercial fishing sectors are limited spatially to the boundaries inherent in their legislative instruments. Octopus caught in the WCRLF are restricted to the boundaries of that fishery (between latitude 21° 44' S and 34° 24' S). Octopus catch in the CSLPF is limited to Cockburn Sound. Octopus caught in the DOF are limited to the boundaries of the developmental fishery, which is an area bounded by the Kalbarri Cliffs (26°30'S) in the north and Esperance in the south. Within the DOF there is also spatial separation of the areas fished by "Exemption holders".

Management arrangements

For the WCRLF, the keeping of octopus as a byproduct is permitted without catch restrictions or size-limits. The catch rate of octopus within the fishery is monitored as a performance indicator to ensure it is maintained within historical levels (see WCRLF status report).

The CSLPF is managed through input controls in the form of limited entry and gear restrictions. The DOF is also managed through limited entry (currently only 5 exemption holders) and limits on octopus pot allocations specific for passive (shelter) and active (trigger) octopus traps. Effort is spatially controlled, with each exemption holder allocated a specific area of coast. Sustainable harvest levels and pot allocations in the DOF are currently being examined through a combination of exploration of new areas, and associated biological and stock assessment research.

For the recreational sector, the current bag limit is 15 octopus, with a boat possession limit of 30 octopus.

A comprehensive Ecologically Sustainable Development assessment of this fishery has also been undertaken to identify any potential sustainability risks requiring direct management. Boxed text in this status report provides the annual assessment of performance for this issue.

Research summary

Current research is focused on the assessment of annual catch and effort statistics from commercial fisheries which are generally reported on a monthly basis. In the DOF, additional

reporting of daily catch and effort statistics by spatial location is also undertaken. The daily logbook provides details of the octopus fishing operations such as the depth, habitat, pot types used and soak times (the period of time pots remain in the water until next pull). Details on catch include catch size categories and the location of the fishing gear is recorded with a GPS position to enable a more precise spatial breakdown of fishing activities and the identification of fishing zones.

The Department has obtained a research grant from the Fisheries Research and Development Corporation (FRDC) for a project titled "Innovative development of the *Octopus tetricus* fishery in Western Australia". Results from this project will inform industry and management on the potential for expansion of the DOF and project completion is scheduled for March 2014.

Retained Species

Commercial landings (season 2012):

208 tonnes (live weight)

Recreational catch estimate (season 2011/12):

2 tonnes (live weight)

Landings

Commercial: In 2012 the total commercial octopus catch was 208 t live weight, a 25% increase over last year's catch of 166 t (Octopus Figure 1).

On a sector-specific level, octopus catch from the WCRLF was relatively stable between 2009 and 2012, averaging 30 tonnes. Catch from the CSLP has also been stable since 2009, averaging around 22 tonnes. Catch from the DOF has increased by 380% between 2009 (33 t) and 2012 (160 t; Octopus Figure 1). The 2012 DOF catch represents the highest on record.

The DOF has steadily risen from 4% of the total catch in 2001 to 76% in 2012 (Octopus Table 1). At the same time, share of catch from the lobster fishery has declined from 86% to 13%, primarily as a result of effort reductions, which have occurred in that fishery.

Recreational: In 2001, the national recreational and indigenous fishing survey¹ estimated a total catch of 25,600 octopus in WA. Using an average weight of 0.7 kg, this amounts to a total catch 17 tonnes. Annual estimates of recreational catch by boat-based fishers at both the state-wide and bioregional levels were recently calculated for 2011/12 (Ryan *et al.*, 2013). The estimated total number of octopus captured during this period for all bioregions was 1,982 (90% in the West Coast Bioregion) which equates to a total weight of 1.4 tonnes.

Fishing effort/access level

Commercial: Fishing effort in the commercial octopus fishery is measured as the amount of days fishing in which octopus was caught. Total octopus effort (days on which octopus were landed) in the WCRLF in 2012 was 5,875 days,

a 17% reduction from 7,063 days in 2011 (Octopus Table 1). Days fished in the CSLP and DOF were 230 and 927 respectively, an increase of 6% and 77% respectively, from 2011 (Octopus Table 1). The 2012 DOF effort represents the highest on record. The fishing efficiency of the days fished in the DOF has also increased with the move to trigger traps.

Stock Assessment

Assessment complete:

Preliminary

Assessment level and method:

Level 2 - Catch rate

Breeding stock levels:

Adequate

Catch per unit effort: The catch per unit effort (CPUE) from the three main sectors (WCRLF, CSLPF, DOF) are the principal indicators of abundance of octopus.

The CPUE for octopus from the WCRLF was 4.6 kg/day, which was similar to the 2011 (Octopus Figure 2). The large increases in WCRLF CPUE from 2009 to 2011 may reflect changes in efficiency during this period when large reduction in fishing effort occurred for this fishery generated by changes in the management of rock lobster (see Western Rock Lobster report). In the case of the DOF it is due to gear efficiency increases.

The CPUE for octopus in the CSLPF and DOF sectors was 91 and 180 kg/day respectively. CPUE decreased slightly for both these sectors over the last year (Octopus Figure 2).

A standardised CPUE (SCPUE) analysis for the CSLPF and DOF was also undertaken, based on daily catch and effort logbook data which provide more precise estimates of effort, and standardised for month, soak time, and depth effects. This methodology is still under development, however preliminary trends have been estimated and are compared with the raw CPUE.

SCPUE for both shelter and trigger pots showed a slight declining trend between 2011 and 2012 (Octopus Figure 3). SCPUE for trigger pots was similar in 2008 and 2009, then there was a sharp increase up to 1.9 kg / pot. This was the first year of major development of the fishery, with catch increasing from 30 to 110 t as the fishery expanded into areas which previously had little effort applied to them and the experience of operators with new gear increased. However it may also have correlated with environmentally favourable conditions for octopus, as 2012 also saw a significant expansion of the fishery with new operators working in new grounds, but SCPUE did not increase. Future year's trends should reveal whether this is the case.

The initial performance measures for the fishery relate to breeding stock maintenance as indicated by catches remaining in the range 50 – 250 t and catch rate remaining above 70 kg/day in the CSLP and DOF sectors. Both the catch and catch rate measure were met.

Target catch ranges and performance indicators will be reviewed as more information becomes available.

¹ Henry, G.W. and Lyle, J.M. (eds). (2003). The national recreational and indigenous fishing survey. FRDC project no. 99/158. NSW Fisheries Final Report Series No. 48.

Non-Retained Species

Bycatch species impact: **Negligible**

Octopus are a bycatch for the WCRLF, the impacts of this fishery on other components is discussed in the specific report for this fishery. The selective method of fishing used for the CSLPF and DOF results in a minimal level of bycatch of other species.

Protected species interaction: **Low**

In 2012 there were three reported whale entanglements (Humpback whale: *Megaptera novaeangliae*) in octopus fishing gear. All whales were successfully disentangled.

Ecosystem Effects

Food chain effects: **Negligible**

This fishery harvests only a small amount of octopus per annum. The effect from this harvesting on the rest of the ecosystem, given that the catch is spread over a wide region, is likely to be insignificant.

Habitat effects: **Negligible**

Rock lobster potting in the WCRLF occurs primarily on sand areas around robust limestone reef habitats covered with coralline and macro-algae, and these habitats are considered resistant to lobster potting due to the hard nature of the bottom substrate (see WCRLF report for full details).

In the CSLPF and DOF, octopus-specific pots are set in similar habitats to those fished in the WCRLF, as well as sandy and seagrass areas, particularly in Cockburn Sound. These are not expected to impact on benthic habitats as the soak times are at long intervals, averaging 11 days in the DOF and 25 days in the CSLP.

Social Effects

Each dedicated octopus fishing vessel employs between 2 and 3 people. In 2012, ~ 200 vessels caught octopus, although the vast majority of these landings were small (< 100 kg), as they were bycatch in the WCRLF. Within the octopus specific fisheries, 8 vessels fished in the CSLP, and 17 vessels in the DOF. There is also a substantial processing and value-added component to the octopus catch with factories in Fremantle and Geraldton.

Economic Effects

Estimated annual value (to fishers) for 2012:

Level 2 - \$1 - 5 million (\$1.48 million)

The estimated annual value for 2012 was \$1.48 million based on the total catch of 208 t. and an average product price of \$7.11 /kg live weight.

Fishery Governance

Target catch range: **50 – 250 tonnes**

This is a preliminary target range due to the developing nature of the fishery. Current fishing level of 208 tonnes is within the target range.

New management initiatives (2013/14)

The DOF moved into a new phase in its management arrangements during 2012. While one operator had pioneered the development and usage of trigger traps, the opportunity to use this gear was provided to other Exemption holders in the fishery during the year. In conjunction with this change the spatial management framework of the fishery was also modified to align it with the northern and southern zones of the West Coast rock lobster fishery. Permitted gear usage levels (both trigger traps and shelter pots) were set at levels designed to ensure sustainability while exploring the scope for an increased level of catch.

The CSLP management plan is currently under review and discussions are being held between Industry and the Department of Fisheries on the octopus fishing gear usage and entitlement levels. It is likely that changes to this plan will be made in 2013/14.

On 13 March 2013, the Department introduced an Exemption to commence a two year trial of the recreational use of octopus trigger traps. Under the conditions of the trial, recreational fishers can use a maximum of six octopus trigger traps when fishing for octopus. Any trigger trap used under the exemption needs to conform to a number of specific conditions. This is in addition to restrictions on where and when the traps can be used as well as bag and boat limits. In 2015 the Department intends to conduct a review of the trigger trap trial as well as the ongoing use of shelter pots in the recreational fishery. The outcomes of these reviews will be used to develop more permanent management arrangements for the recreational take of octopus.

External Factors

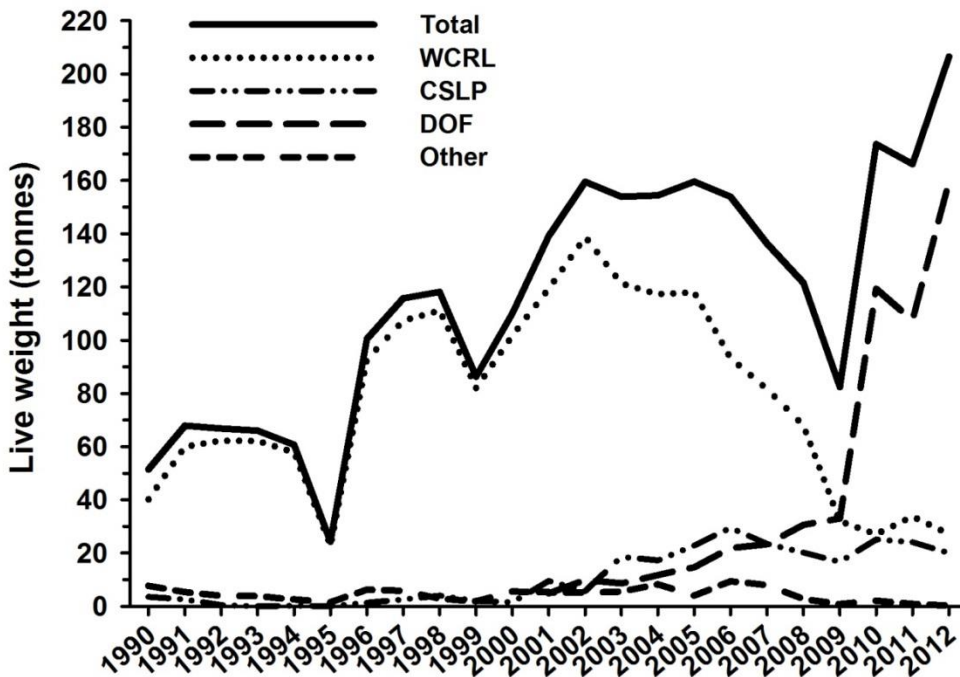
Cephalopods in general, including octopus, are known to be subject to large environmentally-driven fluctuations in abundance. If the fishery expands to reach a catch level approaching maximum sustainable yield, this year-to-year variability in abundance may prove a significant issue for the fishery. In particular, a "marine heatwave" experienced on the West Coast in the summer of 2010/11, where water temperatures reached 3 degrees C above average, may have been the cause of the elevated catch rates during the first year of expansion in the fishery.

The move of the rock lobster fishery from an effort-controlled fishery to a catch quota fishery, coupled with significant effort reductions will ensure the octopus catch in the WCRLF fishery remains a low % of the overall catch.

OCTOPUS TABLE 1

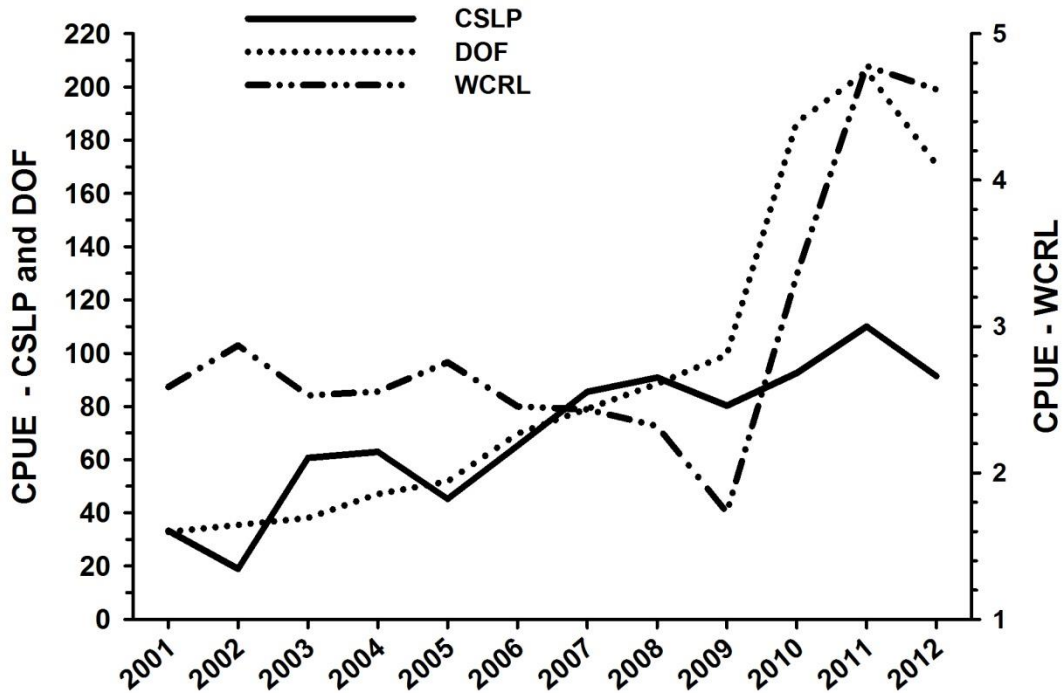
Percentage of octopus catch and total days fished from different sectors of the fishery. – WCRLF (West Coast Rock Lobster Fishery), CSLPF (Cockburn Sound Line and Pot), DOF (Developing Octopus Fishery) and Other, which is bycatch from trawl and miscellaneous pot fisheries.

Year	Percentage of total catch				Effort (total days fished)		
	WCRLF	CSLPF	DOF	Other	WCRLF	CSLPF	DOF
2001	86	6.9	3.5	3.8	46,100	287	149
2002	87	3.6	6.2	3.2	48,300	300	278
2003	79	12.1	5.6	3.6	47,900	306	225
2004	76	11.1	7.6	5.3	45,900	273	249
2005	74	14.3	9.2	2.5	42,800	505	284
2006	62	19.7	11.6	6.3	38,000	451	250
2007	63	18.1	12.9	6.1	33,500	274	211
2008	61	18.0	19.0	2.4	29,400	222	241
2009	39	20.3	40.0	1.0	19,299	256	248
2010	16	14.4	68.7	1.2	8,071	271	639
2011	20	14.5	64.7	0.5	7,063	218	522
2012	13	11	76	0.1	5,875	230	927



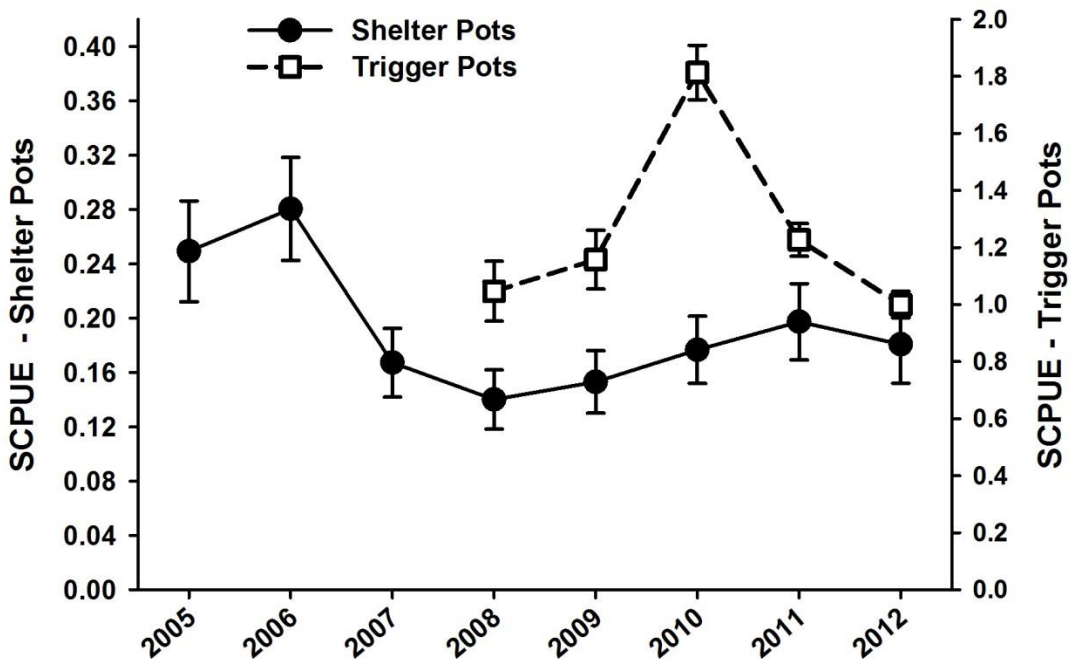
OCTOPUS FIGURE 1

Commercial catch (t) of octopus in Western Australia since 1990. Catch is divided between the main sectors – WCRLF (West Coast Rock Lobster Fishery), CSLPF (Cockburn Sound Line and Pot), DOF (Developing Octopus Fishery) and Other, which is bycatch from trawl and miscellaneous pot fisheries.



OCTOPUS FIGURE 2

Catch per unit effort (CPUE) in kg/day of Octopus in the three main sectors – WCRLF (West Coast Rock Lobster Fishery), CSLPF (Cockburn Sound Line and Pot), DOF (Developing Octopus Fishery).



OCTOPUS FIGURE 3

Standardised catch per unit effort (SCPUE) ($\pm 95\%$ CL) in kg / pot (kg in live weight) of Octopus in all sectors. Trends are for two pot types – passive shelter pots, and active trigger pots.

AQUACULTURE

Regional Research and Development Overview

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

The *Fish Resources Management Act 1994* now includes several new and amended provisions for aquaculture, mainly in relation to the environmental management of the industry and the establishment of offshore zones for aquaculture development.

The Department of Fisheries is now responsible for the environmental management of aquaculture in WA waters under the terms of a Memorandum of Understanding it has executed with the Department of Environment Regulation (DER). Environmental management will be effected principally through a requirement for licensees (with some exceptions) to develop and operate according to a Management and Environmental Monitoring Plan (MEMP). In June 2013, the Department expects to provide relevant licence holders a guidance statement and template to assist in the preparation of their MEMPs.

A focus of the Department of Fisheries in the Abrolhos Islands area is the regulation of the pearling industry which is based on species such as the blacklip oyster *Pinctada margaritifera*. The production of pearls from several other species such as *Pinctada albina* and *Pteria penguin* is also increasing in importance. More recently, attention has focused on the naturally-occurring Akoya oyster (*Pinctada imbricata*). A recent project, initiated by industry partners, demonstrated Akoya pearls can be produced successfully and provided the industry sector with the information it needs to continue to improve production strategies, reduce production costs, improve pearl quality and enhance the market value of the cultured Akoya pearls.

In addition to the production of pearl oysters, in the vicinity of the Abrolhos Islands there is increasing interest in the aquaculture of species that include coral and live rock. The Department of Fisheries has therefore started the development of an aquaculture policy to ensure the proper management and regulation of the aquaculture industry in the

Abrolhos Islands. The policy development process will involve substantial communication and consultation with stakeholders.

Through its Fish Health Unit, the Department of Fisheries has worked closely with the Marine Fishfarmers Association and the Mid-West Development Corporation on a successful project to test the feasibility of farming yellowtail kingfish in sea cages at Geraldton. The project demonstrated the technical feasibility of offshore marine finfish aquaculture in WA coastal waters. Information generated by the project will underpin the future growth of the industry in the Mid-West region.

An FRDC project, developed in collaboration with a commercial octopus fishing and processing company, is continuing with research on ranching wild-caught juvenile octopus and seeking to close the life cycle through larvae rearing. This project has made a number of advances in rearing mechanisms for this species.

To assist in addressing the regulatory and approvals issues concerning aquaculture development in WA coastal waters, the Department of Fisheries has received Government funding of \$1.85 million to establish two aquaculture zones in the Kimberley and Mid-West regions. The aquaculture zones will comprise defined areas of water selected for their suitability for the commercial production of marine finfish. Through this project, the Department of Fisheries will secure strategic environmental approvals for the zones from the Environmental Protection Authority, thereby streamlining the approvals processes for commercial projects within zoned areas and providing an “investment ready” platform for prospective investors. The establishment of the Mid-West zone is in its early stages.

The Department’s review of aquaculture licence conditions is scheduled to start in the 2012/13 fiscal year. The outcome of the review will deliver higher levels of consistency, transparency and certainty in licensing and compliance arrangements across all aquaculture industry sectors.

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, Hillary's, Lancelin, Jurien, Dongara and Geraldton offices, statewide mobile patrol units and officers aboard the large ocean-going patrol vessels *P.V's Houtman and Walcott*. The Department's MarineDiscoveryWest education team delivers targeted education programs throughout the West Coast region. These programs are delivered by Community Education Officers based in Busselton and Fremantle, with the assistance (where available) of Fisheries Volunteers based in some regional centres within the bioregion. Staff from the MarineDiscoveryWest team and the Naturaliste Marine Discovery Centre also provide education services and activities at Hillarys and in the Regions.

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 size from 5 m to 12 m. They also provide support to seagoing personnel and provide a wide variety of educational and extension services through formal and informal media to commercial fishers, fishing related operations (wholesale/retail/processors), other resource management agencies and community members.

The Department also delivers at-sea marine safety compliance services on behalf of the Department of Transport in the 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. Marine park education and compliance functions are also undertaken in the Ngari Capes Marine Park (South West), and Shoalwater and Marmion Marine Parks (Metropolitan). These functions are primarily related to the integrity of management arrangements for Sanctuary Zones within the Parks.

Activities during 2011/12

During 2011/12, Fisheries and Marine Officers delivered a total of 25,354 hours of compliance and community education services in the field (West Coast Bioregion Compliance Table 1). This represents a 4% increase in field compliance over the previous year. A continuing emphasis was placed on employing risk- and intelligence-based approaches to compliance planning and prioritisation.

The West Coast Rock Lobster Managed Fishery is the largest commercial fishery in the state and within the bio region and therefore much of the compliance focus is in this fishery. In addition to the rock lobster fishery, FMO's focused activity on ensuring high levels of compliance in other commercial fisheries such as the abalone, demersal scalefish (Wetline), crab, shark and estuarine fisheries.

The West Coast Rock Lobster Fishery entered its second season under a Quota Management System. Due to the transitioning of the fishery to a full year regime the season commenced on 15 November 2011 and extended into 2013

ending on 14 January 2013. The fishery will now commence on 15 January each year.

A focus for the second quota year for the rock lobster fishery was the introduction of Integrated Voice Response (IVR) reporting of catch returns. An extensive education program was conducted to support this new system, including a number of preseason education sessions and a high level of field education over the first few months.

Other new regulatory changes included a prohibition on bait bands, and introduction of the requirement of Sea Lion Exclusion devices (SLED's) in pots at the Abrolhos. Attention was given to education, and monitoring compliance, with these new requirements.

The focus of compliance activity for the West Coast Rock Lobster Managed Fishery reflected the outcomes of the Compliance Risk Assessment process. Routine compliance operations targeted black market operations, catch disposal records, quota weight declarations, container security, and over potting. There were a number of cases of fishers exceeding quota that required investigation.

One contentious matter that arose during the season was the quantum of water loss in a consignment between the time of weighing by the Master and the weighing by the Receiver. Field staff undertook investigations to provide quantitative data on this matter to assist policy formulation and subsequent Management Plan changes for the following season.

Overall, compliance in the West Coast Bioregion by commercial fishers was good, however there were increases in the number of prosecutions from 41 to 56, infringements from 16 to 21 and infringement warnings from 36 to 53 compared to 2010-11.

Recreational fishing compliance and education is a very large part of the compliance and education activity and primarily revolves around the prize species of demersal scalefish, rock lobster, abalone and marron and also blue manna crabs and minor finfish species. Demersal scalefish closures and fishing within the bio region is supported by statewide recreational mobile patrol units.

Field contacts with the recreational fishing community increased from 71,257 to 82,685. Overall compliance was good however there were increases in prosecutions from 267 to 306, infringements from 903 to 1004 and infringement warnings from 1,405 to 1,471.

The Department continues to work collaboratively with the Department of Environment and Conservation (DEC) in delivering compliance services to marine parks throughout the bioregion. This collaborative approach has worked very effectively, particularly during the metropolitan abalone season (which occurs predominantly within the Marmion Marine Park), and in the Jurien Marine Park, where DEC officers undertake joint patrols with FMOs thereby increasing the effectiveness of compliance service delivery. The level of non-compliance encountered in these parks is low.

Throughout the year FMOs undertook joint patrols with other agencies including the Department of Transport, Australian Customs Service and WA Police Service. The Department also continued to provide at sea resources to assist the

Department of Environment and Conservation in the disentanglement of whales in the West Coast Bio Region. This assistance led to the successful disentanglement of a number of humpback whales entangled in both rock lobster and octopus fishing gear.

In the bioregion, the Department has had a growing role in shark response as part of the whole of government approach to the shark hazard program. During the year, FMO's provided support to incident responses and other program activities.

Initiatives in 2012/13

The third year of the Quota Management System commencing on 15 January 2013 in the West Coast Rock Lobster fishery will see the introduction of electronic catch reporting – FishEye – at some point in the season. The

significant move from a paper to an electronic system will involve a high level of industry liaison and education. A key management priority will be to ensure integrity with catch balances.

The increased focus on recreational fishing compliance will continue, particularly with the ongoing operation of the recreational mobile patrols operating within the Bio Region. Compliance and management personnel will continue to refine compliance planning to deliver greater efficiencies and outcomes through the use of risk assessments and intelligence processes.

The Department's role in the management of the Ngari Capes Marine Park will also be expanded and staff will be working closely with the Department of Conservation and Environment and the community, in planning both compliance and educational activities.

WEST COAST COMPLIANCE TABLE 1

Summary of compliance and educative contacts and detected offences within the West Coast Bioregion during the 2011/12 financial year.

PATROL HOURS DELIVERED TO THE BIOREGION	25,354 Officer Hours
CONTACT WITH THE COMMERCIAL FISHING COMMUNITY¹	
Field Contacts by Fisheries & Marine Officers	2044
Infringement warnings	53
Infringement notices	21
Prosecutions	56
Fishwatch reports ²	20
VMS (Vessel Days) ³	19,011
CONTACT WITH THE RECREATIONAL FISHING COMMUNITY	
Field Contacts by Fisheries & Marine Officers	82,685
Infringement warnings	1,471
Infringement notices	1004
Prosecutions	306
Fishwatch reports	409
OTHER FISHING-RELATED CONTACTS WITH THE COMMUNITY	
Field Contacts by Fisheries & Marine Officers	6,666
Fishwatch reports	208

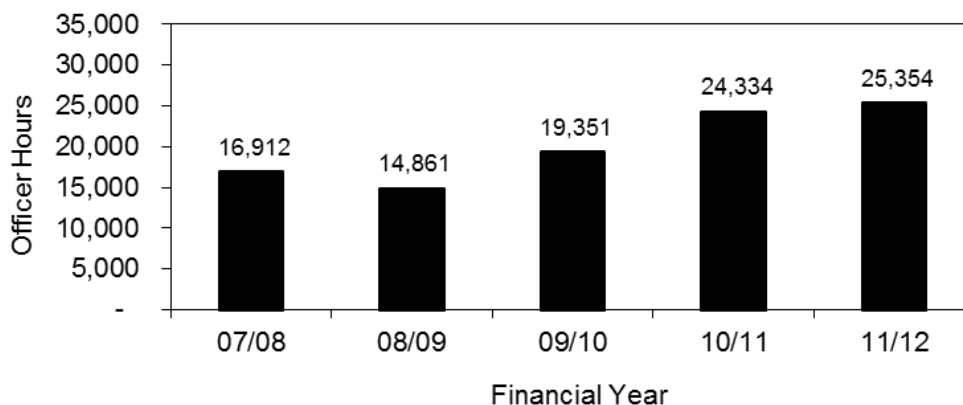
1 Contacts are classified according to the specific fishery, which is usually clearly delineated as being either commercial or recreational.

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 PV Houtman. Contacts made by PV Walcott are included in North Coast Compliance Table 1.

2 Fishwatch reports are allocated to the District Offices relevant to the Bioregion. It is not possible to distinguish between calls relating to Inland Bioregions.

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

West Coast Bioregion Compliance Patrol Hours



WEST COAST COMPLIANCE FIGURE 1¹

“On Patrol” Officer Hours showing the level of compliance patrol activity delivered to the West Coast Bioregion over the previous 5 years. The 11/12 total gives the patrol hours in the bioregion that resulted in the contacts detailed in Table 1. (The totals exclude time spent on other compliance related tasks e.g. travel time between patrol areas, preparation and planning time etc.)

¹ These figures do not include 1,460 “on-patrol” hours delivered in 2011/12 by PV Houtman.

The total on-patrol hours for each of the Department’s 3 large patrol vessels are reported in the compliance summary of the most relevant bioregion: PV Walcott in North Coast, PV Houtman and PV Hamelin in West Coast.