

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 most of the West Coast Bioregion inside 200 m depth could be classified as one of the marine protected area IUCN categories (Ecosystem Management Table 1; as per Dudley, 2008)¹.

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

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 is also undertaking a Marine Bioregional Planning process for Commonwealth waters between Kangaroo Island, South Australia and Shark Bay.

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)¹ 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)² 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

Listed 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 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

¹ 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.

² 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

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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 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 a series of new initiatives during 2013 – 2014. 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 2013/2014. A large-scale, nationally approved survey of HMAS Stirling was also

completed in late 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 listed species interactions, and (b) determine byproduct and target species catches.

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.

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 State Waters and all continental shelf waters, out to 200 m depth, which meet the IUCN criteria for classification as marine protected areas.

IUCN category or equivalent	State Waters only (10,088 km ²)				All Waters (481,488 km ² (including State waters))			
	Fisheries km ² %		Existing MPA km ² %		Fisheries km ² %		Existing MPA km ² %	
I	0	0	0	0	0	0	0	0
II	1	< 1	171	2	1	< 1	171	< 1
III	0	0	0	0	0	0	0	0
IV	4,500	44	1,900	19	33,600	7	1,900	< 1
V	0	0	0	0	0	0	0	0
VI	3,400	34	116	1	445,700	93	116	< 1

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.

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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 an 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.

Listed 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).

Listed species	Species	Risk	Status and Current Activities
Listed 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.
Listed '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.

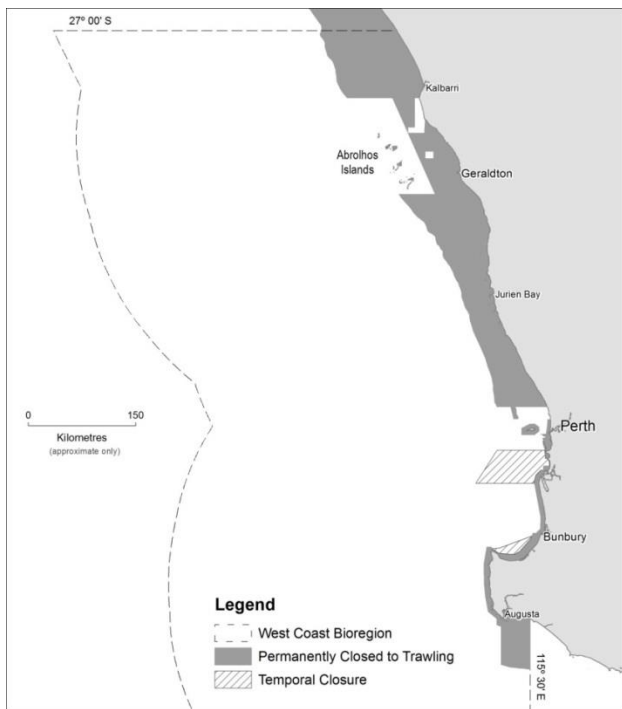
Benthic Habitat	Category	Risk	Status and Current Activities
Estuaries and Embayments	Sand	SIGNIFICANT (non-fishing)	Estuarine and embayment habitats are threatened by various non-fishing factors (poor water quality, direct loss of habitat through coastal infrastructure and physical disturbance, e.g. 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.

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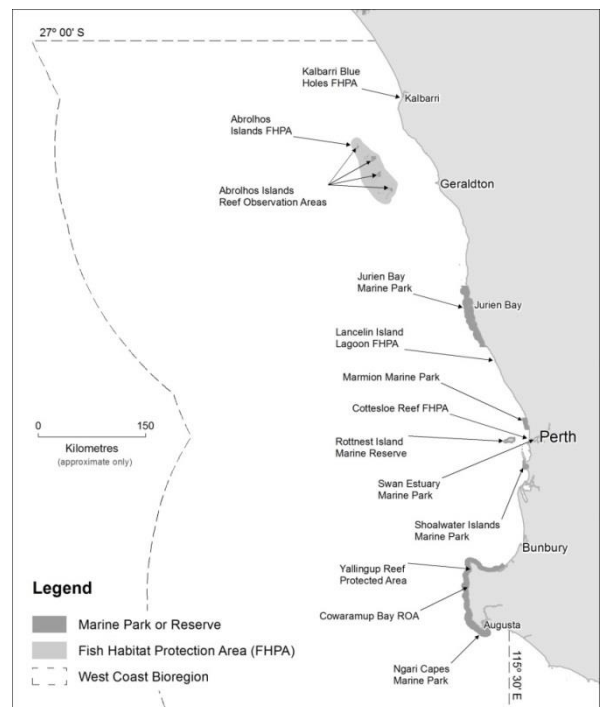
External Drivers: Details on some of the analyses used for these scores are located in the individual fishery reports plus there were whole of region assessments completed in the draft West Coast EBFM report.

External Drivers	Risk	Status and Current Activities
Introduced Pests and Diseases	MODERATE in short term HIGH in medium 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.
Climate	MODERATE in short term HIGH in medium 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.



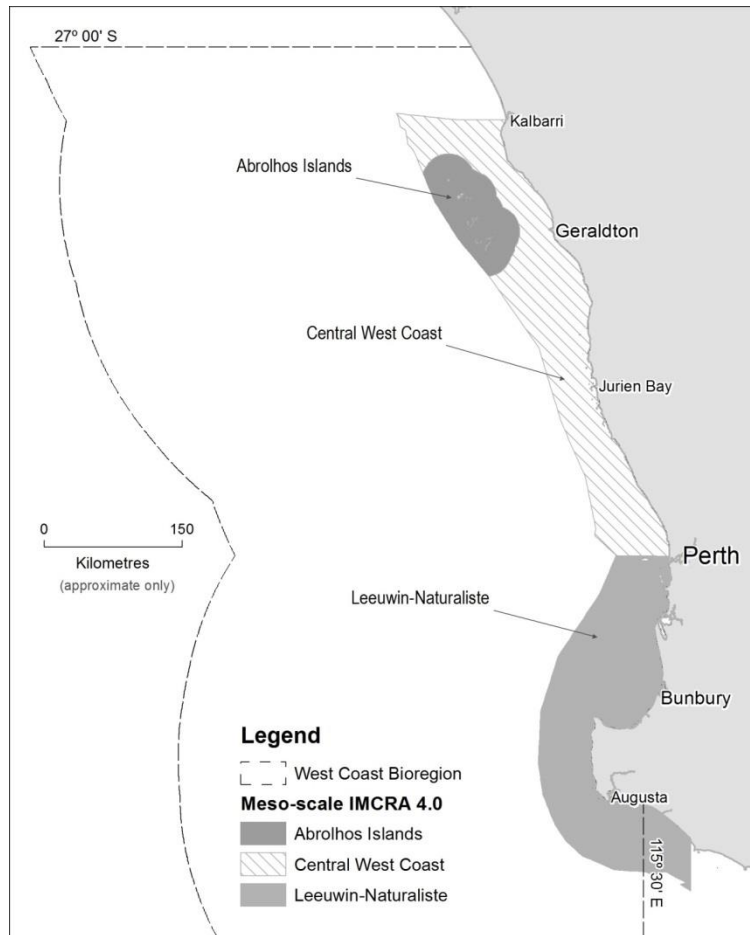
**WEST COAST ECOSYSTEM MANAGEMENT
FIGURE 1**

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**

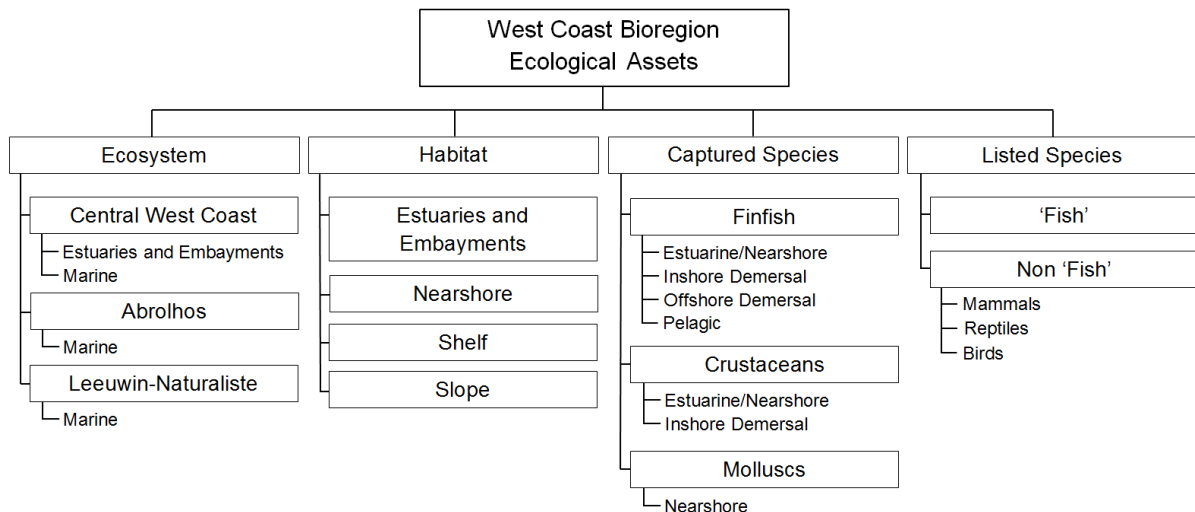
Map showing current and proposed formal marine protected areas in the West Coast Bioregion various areas of which are either consistent with IUCN categories I, II, III, IV or V.



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. There are two key vectors for marine pest translocation: ballast water and hull fouling. The Marine Biosecurity Research and Monitoring group continue to implement a series of biosecurity related projects in the West Coast Bioregion with two aims. The first is to examine the likelihood of inoculation, infection and establishment of compatible marine pests in the West Coast Bioregion from commercial vessel movements (see Bridgwood & McDonald 2014)¹. The second aim is for early detection of the presence of introduced marine pests (IMPs) using a suite of tools.

From a biosecurity perspective the introduction of a marine pest to any region is based on multiple factors that can be grouped into two themes; the likelihood of inoculation and the likelihood of infection and establishment. Inoculation likelihood assumes that the greater the number of vessel visits from a source with IMPs the greater the risk of IMPs being brought into the recipient port i.e. a positive linear relationship. Based on commercial vessel data from 2011, there were 3135 commercial visits to the West Coast Bioregion and the greatest inoculation risk was from international vessel movements. The infection and establishment likelihood takes into account the sources of IMPs (based on a vessels last port of call (LPOC)), the frequency of visits from those sources and the compatibility between the IMPs salinity and temperature tolerances and West Coast Bioregion's marine environment. There was an 88% compatibility rating of potential inbound IMPs with the environment of the West Coast Bioregion from 40 international last ports (Introduced Pests Figure 1). When the cumulative effect of the number of vessel visits from a LPOC and number of IMPs present at that LPOC is considered, the greatest infection and establishment risk to the West Coast Bioregion was from Singapore, followed closely by China and Indonesia (Introduces Pests Figure 2).

Early detection of IMPs is vital if any attempt at eradication or other management strategies is to be successful. Thus the Marine Biosecurity Research and Monitoring group regularly undertake marine pest monitoring at Fremantle Port and HMAS Stirling (Garden Island). In recognition of the risks IMPs pose to WA ports the Marine Biosecurity Research and Monitoring group have developed complementary monitoring to occur every alternate year to national monitoring. Whereas the national monitoring adheres to the Australian Marine Pest Monitoring Guidelines and is endorsed by the Commonwealth, the complementary monitoring is a smaller more focussed version designed to target select high risk sites in each port. The complementary monitoring of Fremantle Port was completed in early 2014. The next round of national monitoring for Fremantle Port is scheduled for early 2015. National monitoring at HMAS Stirling was completed in late 2013, with the complementary survey scheduled for late 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 have recently completed four 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. - this project has been published as a Research Report and development of publications is underway;
- Determination of the efficacy of wrapping a recreational vessel hull to eliminate/kill biofouling on the wet areas of the hull- this project has been submitted for publication in a peer reviewed journal ;
- 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* - this project has been submitted for publication in a peer reviewed journal.

The group is currently quantifying the risk associated with recreational vessels for the introduction and translocation of marine pests along our coast by analysing the biofouling associated with recreation vessels in marinas across the state.

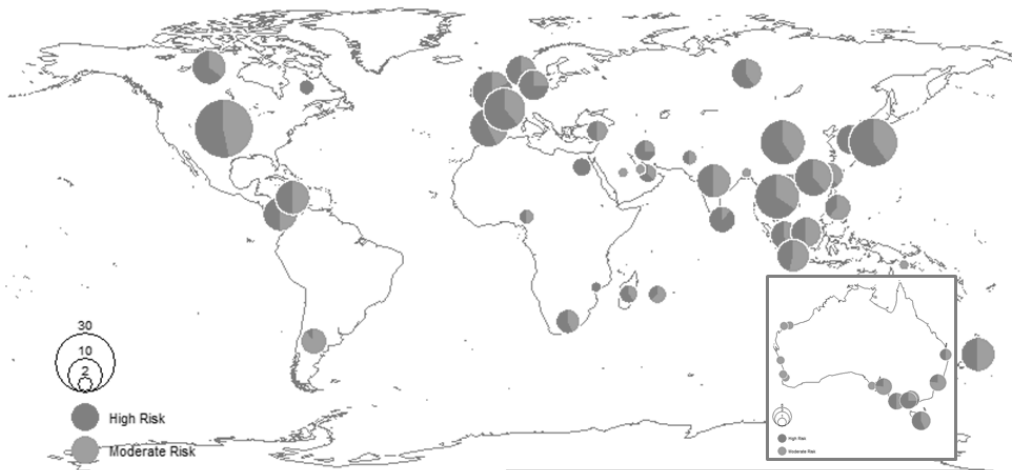
While conducted in this bioregion, the research outputs are designed to be applicable to biosecurity management across the state.

¹ Bridgwood, S. and McDonald, J. A likelihood analysis of the introduction of marine pests to Western Australian ports via commercial vessels. Fisheries Research Report No. 259. Department of Fisheries, Western Australia. 212pp.

INTRODUCED PESTS TABLE 1

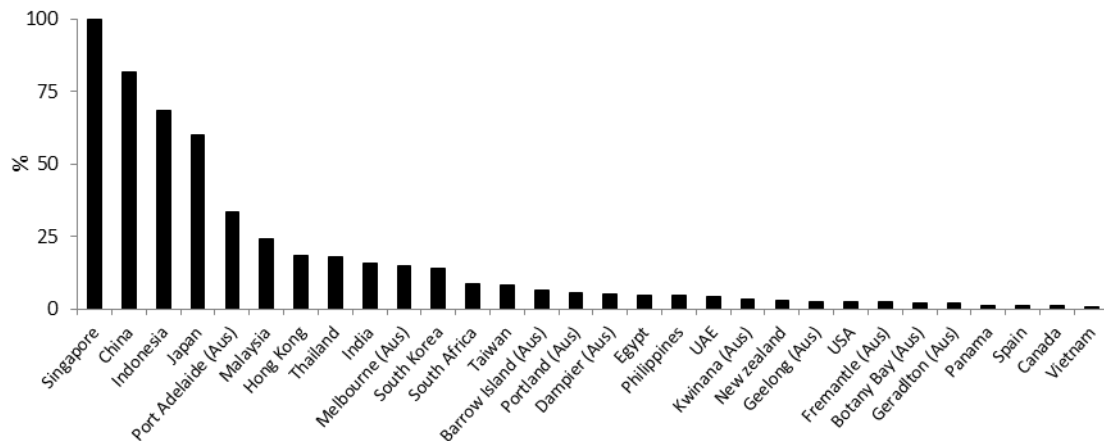
Introduced marine species detected during MBRM activities in this bioregion.

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>Arcuatata senhousia</i>	Mussel	Pest



INTRODUCED PESTS FIGURE 1

The last port of call locations of compatible IMPs for the West Coast Bioregion.



INTRODUCED PESTS FIGURE 2

Ranking of the infection and establishment risk posed to the West Coast Bioregion by international and domestic last ports of call. Each last port of call value is expressed as a relative percentage of the largest last port of call value (i.e. Singapore 100%).

FISHERIES

West Coast Rock Lobster Fishery Status Report

S. de Lestang, M. Rossbach, G. Baudains and F. Trinnie.

Main Features			
Status		Current Landings (Season 2013)	
Stock level	Adequate	Commercial catch	5641t
Fishing Level	Acceptable	Recreational catch (2012/13)	128 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 2009/10 a nominal Total Allowable Commercial Catch (TACC) was introduced. In 2010/11 the fishery began the transition to an Individually Transferable Quota (ITQ) fishery.

The fishery has historically been Australia's most valuable single species wild capture fishery and was the first fishery in the world to achieve Marine Stewardship Certification (MSC). In early 2012 the fishery was 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 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

Other subsidiary legislation

Recreational Fishing Licence

Consultation processes

Commercial

Under the *West Coast Rock Lobster Managed Fishery Management Plan 2012*, it is a requirement that consultation be undertaken with the Western Rock Lobster Council prior to the management plan being amended or revoked. In addition, the Department holds a series of Annual Management Meetings with licensees and security interest holders. These meetings are convened on behalf of the Department by the Industry Consultative Unit within the WA Fishing Industry Council (WAFIC).

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

Recreational

The recreational rock lobster fishery operates on a statewide 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 meters between North West Cape and Augusta. The majority of recreational lobster fishing occurs in the Perth metropolitan area and Geraldton.

Management arrangements 2013 Season Policy

Commercial

On 15 January 2013, a new management plan, the *West Coast Rock Lobster Managed Fishery Management Plan 2012* came into effect. This new management plan completed the fishery's transition to an ITQ system. Key elements of the management regime in place during the 2013 licensing period (15 January 2013 – 14 January 2014) included:

- a TACC of 5,554 tonnes (1,076 tonnes for Zone A, 1,921 tonnes for Zone B and 2,557 tonnes) for Zone C);
- fishing permitted all year in all zones, no closed season;

- facility for units for more than one zone to be held on a licence;
- separation of access to the Abrolhos Islands and Zone B into separate, individually transferrable units; and
- introduction of Fish Eye, the Department's electronic nomination and quota monitoring system.

In addition, the development of a Harvest Strategy and Control Rules was progressed with a final industry consultation phase commencing in December 2013.

Interactions with listed species, particularly humpback whales, became a significant issue in 2013 with 18 confirmed entanglements of humpback whales in rock lobster gear being recorded. The Commonwealth Government granting the fishery only a two year Wildlife Trade Operation (export approval) where previously five year exemptions had been granted. Several conditions have been placed on the fishery by the Commonwealth Government in relation to the need to take action to mitigate entanglements. A Ministerial Taskforce was formed in the second half of 2013 with a view to overseeing the development and implementation of research and management responses to the whale entanglement issue.

Recreational Fishery 2012/13

The recreational component of the western rock lobster fishery is managed under fisheries regulations. 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. In order to assist the recreational sector in increasing its catch a package of measures was introduced from the 2012/13 season. These changes were:

- an increase in the daily bag limit from six to eight rock lobsters per person;
- a decrease in the escape gap size on recreational pots from 55 mm to 54 mm;
- an increase in the number of recreational rock lobster licenses able to operate from a boat from two to three;
- an increase in the boat limit of rock lobsters to 24 when there are three or more licensed fishers on board;
- an increase in the number of recreational rock lobster pots which may be pulled on a boat trip to six, when there are three or more licensed fishers on board; and
- the removal of the prohibition on diving for rock lobster at the Abrolhos Islands.

Integrated Fisheries Management

In March 2008, through the Integrated Fisheries Management process, the Minister determined that the allocated shares of 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.

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 daily catch disposal records which contain a volunteer research section from fishers and monthly returns from processors, 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 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 in deep water (~40 m) off Leeman. Preliminary results of this research indicate a substantial increase in lobster biomass and average carapace length of lobsters within the unfished region. A key output of this research will be a greater understanding of the carrying capacity of deep-water reefs systems within the WRL fishery. A paper from this research was recently presented at the 10th International Conference and Workshop on Lobster Biology and Management in Cancun Mexico (<http://www.dmc-cancun.com/icwl2014/index.php/component/content/?view=featured>).

Another project examining lobster populations in fished and unfished zones is ongoing at Rottnest 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.

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 number of research projects were developed from this workshop to examine the cause of these low settlement levels in recent years. Six projects were subsequently funded by the Fisheries Research and Development Corporation (FRDC) and final reports are available:

Project 1. Identifying factors affecting the low western rock lobster puerulus settlement in recent years (http://www.fish.wa.gov.au/Documents/research_reports/fr255.pdf).

Project 2. Evaluating source-sink relationships of the Western Rock Lobster Fishery using oceanographic modelling (http://www.fish.wa.gov.au/Documents/research_reports/fr209.pdf).

Project 3. Evaluating the potential use of change-in-ratio and index removal techniques for determining harvest rates and efficiency increases in the Western Rock Lobster Fishery

(http://www.fish.wa.gov.au/Documents/research_reports/fr234.pdf).

Project 4. Evaluation of population genetic structure in the western rock lobster

(http://www.frdc.com.au/research/Documents/Final_reports/2009-020-DLD.pdf).

Project 5. Assessing possible environmental causes behind the reduced colonization of puerulus collectors by a wide suite of species

(http://www.fish.wa.gov.au/Documents/research_reports/fr218.pdf).

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

(http://frdc.com.au/research/Documents/Final_reports/2010-047-DLD.pdf).

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 the seven years of lower settlement. A paper on this research was recently presented at the 10th International Conference and Workshop on Lobster Biology and Management in Cancun Mexico and will be submitted to ICES Journal of Marine Science as part of the conference proceedings.

A project to assess the economic performance of the fishery was 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. A report from this project (Decision-support tools for economic optimization of Western Rock Lobster fishery. Fisheries Research Report # 257) will be published in mid-2014.

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 has been acknowledged 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 being different in their fishing behaviour and success than respondents). To reduce the impact of these biases on catch estimates, a phone-diary survey that is considered to suffer less from these biases (Baharthah, 2007)¹, has been conducted in concert with the mail survey for a number of seasons to develop a conversion factor (Thompson, A. 2013)². The resultant conversion factor has been used to

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 Thomson, Adrian Wilfred. 2013. An estimator to reduce mail survey nonresponse bias in estimates of recreational catch: a case study using data from the

standardise catch estimates from the far cheaper mail survey to that of the phone-diary survey.

Retained Species

Commercial landings (season 2013) 5641 tonnes

Lobsters: Trends in the annual catches from the West Coast Rock Lobster Managed Fishery are shown in West Coast Rock Lobster Figure 1. The catch landed by the WCRLF 2013 season (5641 t) was lower than in the previous report because an extended season was in place for 2011/13 (6647 t).

Octopus: Octopus are also caught in rock lobster pots within shallow water (<40 m). The catch rate of 0.009 octopus per pot lift recorded in 2013 in waters <40 m from the new Catch and Disposal Records (CDR) data was below the historical range of 0.02 – 0.045 per pot lift (1985/86 to 2009/10). Historical data was previously based on logbook data which represented both retained and returned octopus, whereas the new CDR data only reports retained catch. The cause of the lower catch rate of octopus may be related to high beach prices being paid for Western Rock Lobster resulting in fishes not bothering to retain octopus for additional income. The current performance indicator for octopus catch rates is therefore no longer applicable and has therefore been modified. A new performance indicator of the catch rates remaining within 10% of historical levels will now be applied. This indicator ensures that large variations in the catch rate of octopus, such as marked declines due to over fishing do not occur.

The catch rate of octopus (incidental landings) is an indicator for this fishery. Currently the catch rate is at 0.009 octopus retained per pot lift. As this is the first record of this index it cannot be compared to any historical catch rate and thus the performance indicator cannot be assessed in the current year. Comparisons will begin for the 2014 fishing season.

Recreational catch estimate (season 2012/13)

128 tonnes

The recreational catch of western rock lobster for 2012/13 was estimated at 128 t (with 95% confidence intervals ranging from 115-142t), with 95t (86-104 C.I.) by potting and 34 t (29-38 t C.I. by diving).

Comparative catch estimates for 2011/12 were 118 t, with 79 t by potting and 39 t by diving. The estimated recreational catch in 2012/13 was therefore 8.5% higher than the 2011/12 catch estimate.

Fishing effort/access level

Commercial

In 2013, 251 vessels fished for lobster which represented a decline of 9% from the 275 vessels that fished during the previous extended 2011/13 season. 2013 season's

Panulirus cygnus fishery of Western Australia. Ph.D. Curtin University, Department of Mathematics and Statistics.

management arrangements limited the maximum number of pots at 50% of a vessel's unit entitlement. In 2013, the fishery recorded 2,903,438 potlifts a 22% decline on the previous extended season's (2011/13) potlifts of 3,737,311. This decline primarily reflects the decreased season length (12 vs 14 months) and also reflects the changing behaviour of fishers as they continue to adapt to fishing under a quota based management system that encourages fishing in periods when the beach price is higher.

Recreational

A total of 39,702 licenses were sold that permitted fishing for lobsters during some part of the 2012/13 season with an estimated 13,529 (34%) 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 2012/13 was 6% higher than the number of active licences in 2011/12.

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 16 and 6 days, respectively during the 2012/13 fishing season. These rates were similar in the 2011/12 fishing season at 15 and 6 days, respectively.

Finally, the average diary-adjusted catch taken by active pot and diving fishers were 20 and 12 lobsters, respectively during the 2012/13 fishing season. In the 2012/13 season the average numbers of lobsters caught by pot and dive fishers were similar at 18 and 13, respectively.

Stock Assessment

Assessment complete: Yes

Assessment method:

Size-structured population model

Breeding stock levels: Adequate

Targeted commercial catch next season (2014):
5859 tonnes TACC¹

IFM allocated maximum recreational catch next season (2013/14): 418 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 formally used in the

harvest strategy 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.

The primary focus of management is 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.

The secondary focus for management is to determine what levels of harvest correspond to maximum economic outcomes, how these harvest rate scenarios affect catch rates and egg production levels and what would be the impacts of removing different biological management measures such as the setose rule.

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)

Another 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).

Historically 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

¹ Note this TACC covers a 12 month season.

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 (4.4, 2.0 and 1.6 kg/potlift in zones A, B and C, respectively) are close to record highs, well above the historical long-term levels in each zone (e.g. 2.5, 1.3 and 1.3 kg/potlift in zones A, B and C, respectively).

Recreational

The average recreational pot and diving diary-adjusted catch rates were 1.2 and 2.1 lobsters per person per fishing day in the 2012/13 fishing season. These catch rates are similar to the 1.2 lobsters for potting and 2.3 lobsters for diving calculated for the 2011/12 fishing.

Puerulus settlement

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 2008 identified the onset of spawning as a key factor (see Research Summary above).

The annual indices of puerulus settlement during the 2013/14 collection season increased dramatically and returned to the upper end of the historical range in all coastal sites. The Abrolhos site settlement was similar to last year at the lower end of the historical range.

This represents significant improvement compared with the recent seasons (West Coast Rock Lobster Figure 5). The 2013/14 settlement will mainly affect catch rates during the 2017 fishing season.

Non-Retained Species

By-catch species impact: Low

Commercial western rock lobster fishers were not allowed to retain finfish bycatch during the 2013 fishing season.

**Listed species interaction: Sealions (Low)
Leatherback Turtles (Low)
Whale Entanglements (Moderate)**

All WCRLF pots fished in waters less than 20 m within approximately 30 km of Australian Sea Lion (ASL) breeding colonies have to be fitted with an approved Sea Lion Exclusion Device (SLED) (see http://www.fish.wa.gov.au/Documents/recreational_fishing/additional_fishing_information/sea_lion_exclusion_devices.pdf). Video trials have indicated that this device is successful in stopping sea lion pups from entering lobsters pots and potentially drowning.

The performance measure for this fishery is that no increase in the rate of capture of sea lions occurs. During the 2013 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. During the 2013 fishing season there were three interactions with turtle and no deaths reported.

The performance measure for the fishery is that there is no increase in interactions with turtles. In 2013 three leatherback turtles were reported to have been entangled in lobster fishing gear. This incident rate is within the historical range of between two and five entanglements per season over the preceding five seasons. The fishery has therefore met this performance measure.

The humpback whale is the predominant species that interacts with the WCRLF, during both its northward migration to the North West Shelf calving grounds from May to August and then during its subsequent southward migration from September to November. Owing to the fishery’s historical closed season, there was a limited period for interaction. The combination of an increasing population of humpback whales, and the transition to a quota fishery which has seen a change in fishing effort as the season length increased to year-round, has seen the number of entanglements in commercial rock lobster gear rise to 18 in 2013.

Entanglements are reported by industry and other water users to the Department of Parks and Wildlife (DPaW) whose specialist team attempt to disentangle the animal, with a very high success rate. The western rock lobster fishing industry has developed a code of practice to minimise the interaction with whales in conjunction with DPaW and SeaNet. The Minister for Fisheries initiated a ministerial taskforce which included members of the Department, Minister’s office, Industry (WRLC, WAFIC), a commercial fisher and representatives of the federal Department of the Environment (DotE). Its main duty was to identify research projects and provide advice on possible mitigation measures to reduce whale entanglements.

An outcome of this process has been the development of two FRDC research projects, which in combination aim to assess the issue of whale entanglements both through the trial of gear modifications and by improving the collection of spatial and temporal data on the whale migration along the West Australian coast. The outcomes of these projects have and will continue to feed into future management arrangements to reduce whale entanglements.

For the 2014 whale migration season fishers will be required to use modified float rigs on all fishing gear used in waters deeper than 18 m.

The effectiveness of these modifications will be assessed at the conclusion of the 2014 whale migration season and will be used to inform management measures to reduce whale entanglements for the 2015 whale migration season in line with conditions placed on the fishery by the federal DotE.

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 (1990–2012),

commercial lobster fishing has resulted in zero to 13 whale/dolphin interactions per season. Eighteen whale entanglements with lobster gear were recorded during the 2013 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, due to 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 \$270 million. Employment is now year round, the fishing season being from 15 January to the following 14 January. During the year, 4 main processing establishments, located in the Perth metropolitan area (3) and Geraldton (1), and Cervantes (1) serviced practically every location where fishing occurred.

Recreational

With around 40,000 licenced to fish, of which about 13,500 people take 256,000 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 2012/13: \$271 million

The price that commercial fishers received for the western rock lobster in 2013 was an estimated to be \$48.02/kg averaged across all processors and all zones of the fishery. This was 32% increase on the \$36.33/kg paid in 2011/13, with the increase due to fishers only landing catch when the advertised beach price was high, the move to a 12-month season and a lower Australian dollar exchange rate. The overall value of the fishery increased from the previous season's value of \$241 million for the extended season and higher TACC as a result of the better beach price.

The majority of landed lobsters were exported to China with some product also going to Hong Kong, Taiwan, Japan, United States and some into Europe.

Fishery Governance

Commercial Current Fishing (or Effort) Level: Acceptable

Commercial catch target (2014): 5859 tonnes (TACC)

Between 1975/76 and 2013 commercial catches averaged 9,697 t with maximum catch of 14,523 t being landed 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. This ensured sufficient catch rates 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 different strategy was adopted for the 2009/10 and 2010/11 seasons, with defined overall catch limits set at 5,500 t ± 10 % and 5,500 t, respectively, being used to reduce catch rather than effort reductions. The 2011/13 season was a 14 month season therefore the catch target (TACC) was been increased in proportion to what previously would have been taken at the start of following season. The 2013 season represented the first season when industry, through the Western Rock Lobster Council, were provided with a range of biologically acceptable TACCs based on an assessment of maximum economic yield. From this range they were able to choose their TACC. For the 2013 season industry choose to take 5554 t. The same process occurred for the 2014 season with industry choosing to catch a TACC of 5859 t.

Recreational Current Fishing (or Effort) Level Acceptable
Target recreational catch limit (2013/14): 388 tonnes

Between 1986/87 and 2012/13 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 2008/09 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 limit recreational catch for 2013/14 based on a maximum allowable commercial catch (top of the MEY range of acceptable catches) of 7370 t was 388 t. ($7370 \times 5/95 = 3/8$ TARC).

New management initiatives (2014/15)

Following implementation of the West Coast Rock Lobster Managed Fishery Management Plan 2012 which finalised the fishery’s transition to quota management, 2013/14 is expected to see the adoption of a harvest strategy and control rules for the fishery. The harvest strategy and control rules will play an essential role in the TACC setting process.

External Factors

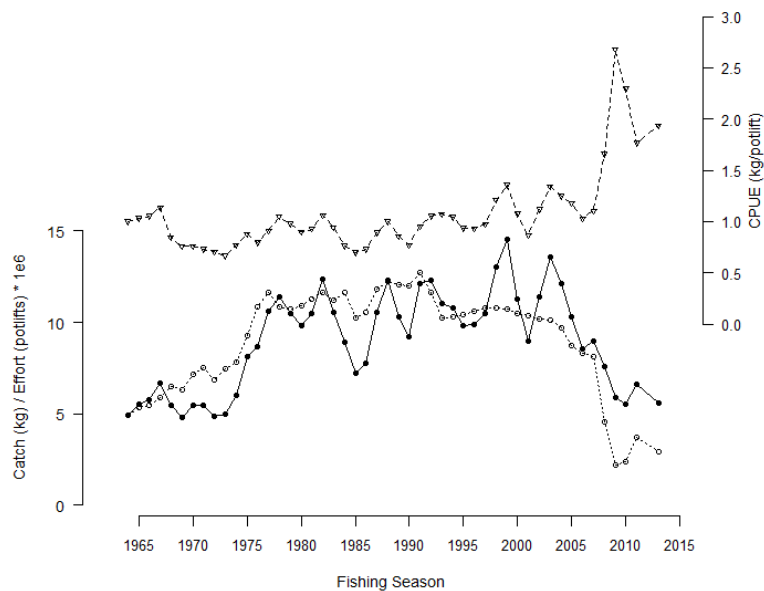
The variations in western rock lobster catches both commercially and recreationally are largely a result of variable levels of puerulus settlement. A positive relationship

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.

Investigation into the puerulus downturn have identified that when the spawning started early (temperature driven) and was coupled with low numbers of autumn and winter storms, the puerulus settlement was significantly lower and this matched the recent lows. These factors combined were able to explain 70% of the variation in historical puerulus settlement up to 2013/14, including the record low settlement of 2008/09. These environmental factors also explained the above-average settlement in 2013/14.

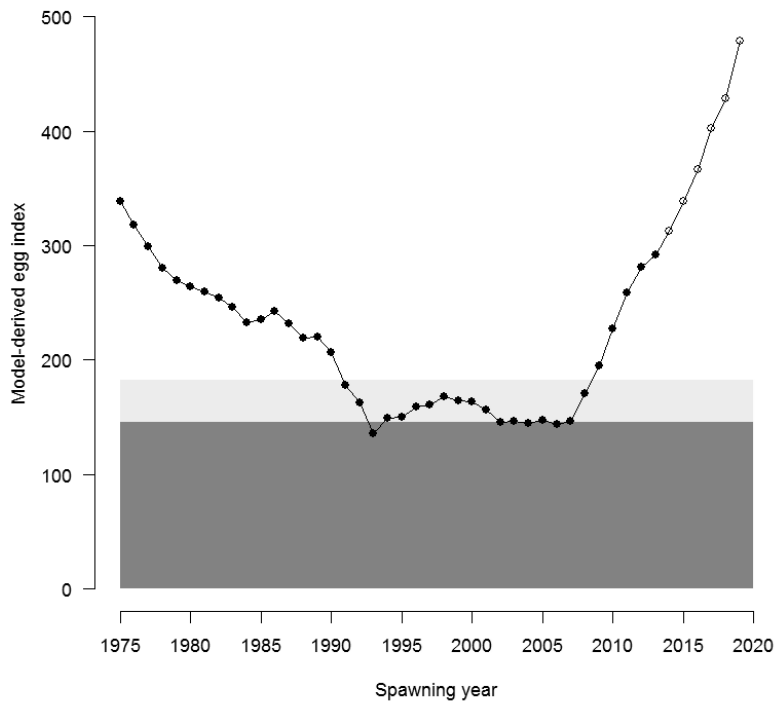
This new information from the comprehensive FRDC/Department-funded research project is available on the WA Fisheries Website for more detail about the work. http://www.fish.wa.gov.au/Documents/research_reports/fr255.pdf

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 ITQ and a 12-month season.



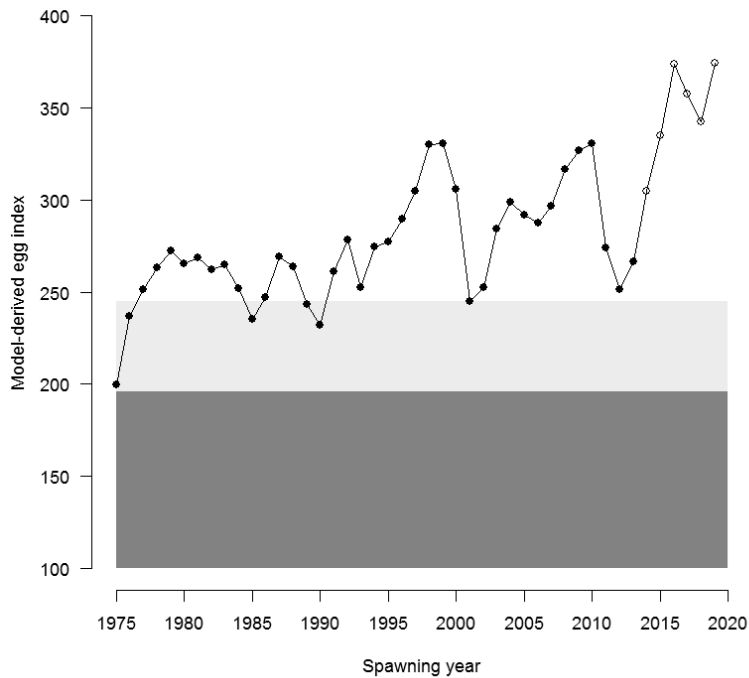
WEST COAST ROCK LOBSTER FIGURE 1

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 2013.



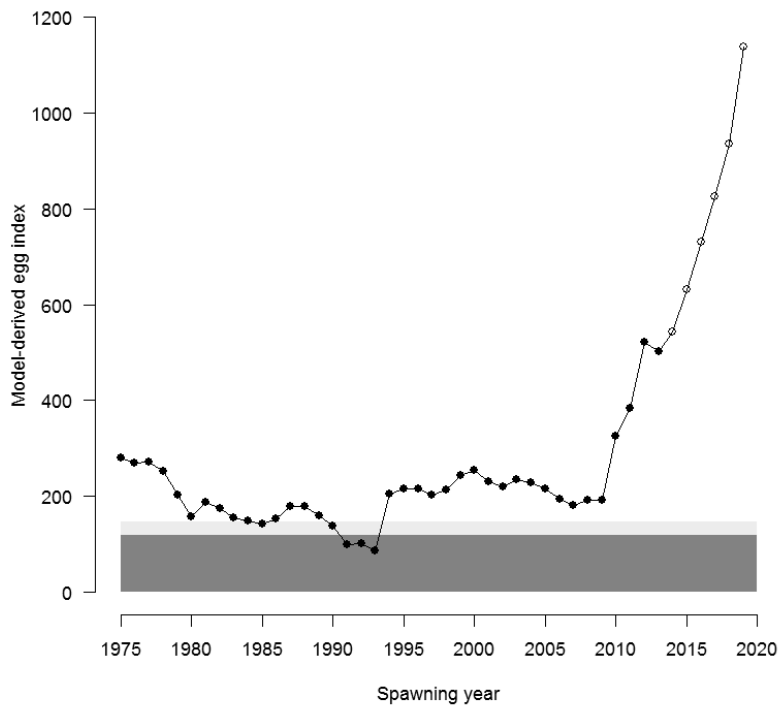
WEST COAST ROCK LOBSTER FIGURE 2

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 light grey region represents the 1980's threshold and the dark grey region the limit reference area.



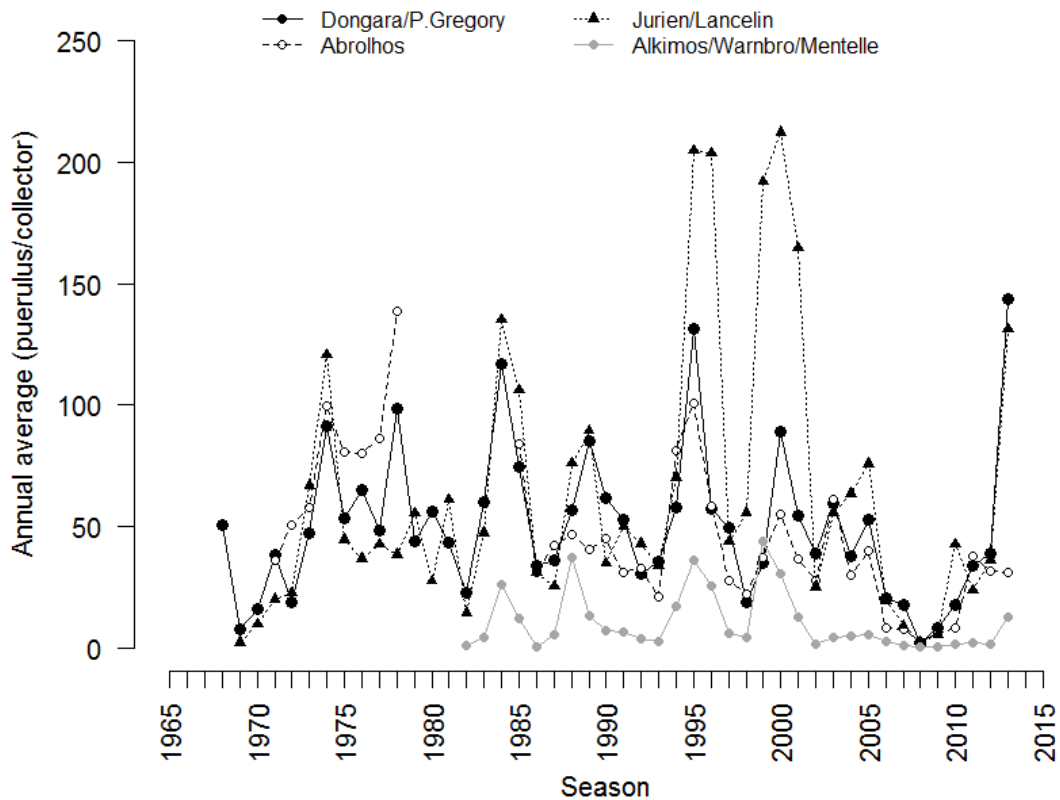
WEST COAST ROCK LOBSTER FIGURE 3

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 light grey region represents the 1980's threshold and the dark grey region the limit reference area.



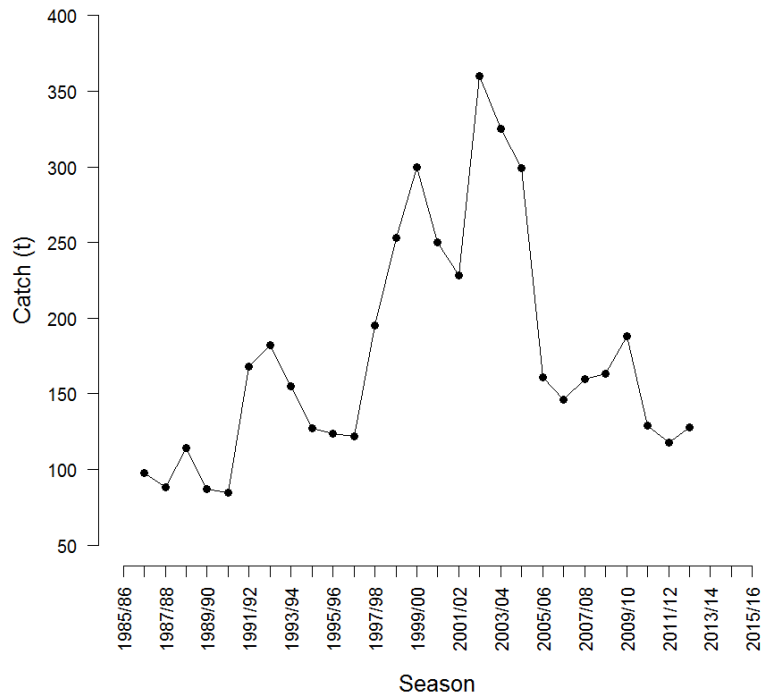
WEST COAST ROCK LOBSTER FIGURE 4

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 light grey region represents the 1980's threshold and the dark grey region the limit reference area.



WEST COAST ROCK LOBSTER FIGURE 5

Annual indices of puerulus settlement from 1968/69 to 2013/14 for the four main regions of the fishery.



WEST COAST 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	
Fishing level	Acceptable	West Coast	36 t
		Other	37 t
		Recreational Catch	
		West Coast	20 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).

WEST COAST BIOREGION

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 2013 was 92.8 t whole weight (note this small species is generally landed in the whole condition). This was the same TACC as 2012 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 the following year.

The legal minimum length for Roe's abalone is 60 mm shell length in most parts of the fishery. However, an 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 is 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 for the first Sunday of each month from November 2013 to March 2014, five days in total. 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 and possession 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 via statutory returns 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.

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.

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 control-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 Yanchep 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 trials with funding assistance from the Seafood CRC are underway to see whether translocation and restocking can assist the recovery of abalone stocks in the Kalbarri region affected by the marine heat wave 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 600 interviews in 2013), 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 statewide 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 the summer season.

Retained Species

Commercial production

Season 2013: 73 tonnes whole weight

Metro only: 36 tonnes whole weight

The TACC for the 2013 quota year was 93 t whole weight for Roe's abalone. The 2013 catch of 73t whole weight (Roe's Abalone Table 1) was 6 tonnes higher than 2012 and about 79% of the TACC. The reductions in catch are driven primarily by economic reasons and difficult weather conditions, particularly on the South Coast. The Area 8 fishery has still not been fished since the 2011 marine heat

wave time (Roe's Abalone Figure 1) as annual surveys show no recovery in this area.

Recreational catch

Season 2013: Roe's Metro Fishery 20.1 tonnes

**(Season 2007): Roe's rest of state 14 tonnes
(32% of total catch)**

The recreational catch for Roe's abalone from the Perth metropolitan area in 2013 was 20.1 t (Roe's Abalone Table 2). This was a slight increase of 8% from 2012 due to better weather conditions and an increase in effort.

Based on the Perth recreational fishery for 2013 (20.1 t), and using the 2007 phone diary estimate for the rest of the state (14 t), recreational fishing represented about 32% of the total (commercial and recreational) Roe's abalone catch (107 t) across the state in 2013.

Fishing effort/access level

Commercial

Total effort for dedicated Roe's abalone divers in 2013 was 457 diver days, an increase in last year's effort of 372 diver days (Roe's Abalone Table 1). However, the SCPUE of 24.1 kg per hour was the lowest on record and driven primarily by economic reasons, as divers targeted the largest sized abalone, which had reduced in abundance since 2011 marine heat wave.

Recreational

For the 2013 season, 15,949 licences were issued allowing abalone fishing which was 2% higher than last year (Roe's Abalone Figure 3). This was the third 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 2013 was 8,512 hours, a 7% increase from 2012 effort of 7,972 hours (Roe's Abalone Table 2) and the second lowest in the 14 years of data collection. This was primarily due to poor weather conditions. Since the introduction of the summer season in 2011/12 the average catch has been 20.3 t, 50% of the allocated TARC. This change to a summer season was part of ongoing adjustments in management as part of the resource sharing 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.

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 for the 2013/14 fishing season was 24.1 kg/hr, which was the lowest it has been (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).

As a consequence of the low SCPUE, TACC was lowered by 10% in the Area 2 and Area 7 fisheries for the 2014 fishing season.

The catch rate of recreational fishers in the Perth metropolitan fishery of 27 abalone/hour in 2013 was greater than the 2012 catch rate of 25 abalone per hour (Roe's Abalone Table 2).

Stock surveys: Densities of sub-legal animals (less than 60 mm in size) on the platform habitat of the fished stocks in 2014 were 18 abalone m⁻², a drop of 7 m⁻² compared with 2013 and a 35% drop since 2010 (Roe's Abalone Table 4). Within the subtidal habitat, densities of sub-legal animals have also decreased and are back to densities recorded in 2008. Densities of legal-sized animals (60+ mm) on the platform habitat are similar in 2014 (7 m⁻²), compared to 2013 (Roe's Abalone Table 4). With the significant decline in recreational catch in the last three years, legal-size densities should begin to recover towards historical levels.

In the subtidal habitat, legal-sized densities were 7 abalone m⁻² in 2014, which is similar to 2013 (8 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 approximately 3 times the densities in fished stocks, however have also declined significantly since 2009 (Roe's Abalone Table 4). For sub-legal animals on the platform habitat, densities have significantly declined between 2010 (58 m⁻²) and 2014 (17 m⁻²) and are now similar to that for fished stocks (18 m⁻²) (Roe's Abalone Table 4). In the sub-tidal habitat of the Waterman's Reserve, the major declines in 2013 have continued into 2014 with both legal (10 m⁻²) and sub-legal sized stocks (1 m⁻²) being 50% and 80% lower than in 2012. 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 2013 the standardised CPUEs were within the agreed ranges in most 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 and Area 7 fisheries, due primarily to poor economic and adverse weather conditions. TACC was reduced by 10% in the Area 2 and Area 7 fisheries as the performance indicator was below the threshold reference point.

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.

Listed species interaction: **Negligible**

The only potential listed 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 15,900 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 2013:

Level 2 - \$1 -5 million (\$1.9 million)

The estimated average price for Roe's abalone in 2013 was \$26.20/kg. This value was slightly higher than the value in 2012. On the basis of the average price, the fishery was worth approximately \$1.9 million. Overall, the price of Roe's abalone has dropped by over 50% since 2000, when it was \$55/kg whole weight. This is due largely to the value of the Australian dollar, which increased from \$US0.6 in 2000 to >US\$1.00 in 2011, and has since dropped back to an average of \$0.92 for the 2013 season. 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 457 diver days and SCPUE of 24 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. However abundance of large animals is also considered to have dropped, particularly in the Area 7 fishery, and consequently, TACC has been decreased by 10% in the Area 2 and Area 7 fisheries.

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 ± 2 t around the TARC (Total Allowable Recreational Catch) of 40 t.

The 5-year (2009-2013) moving average for 2013 was 31 t. This was outside the governance range, and was caused by significant reductions in effort from 2011 to 2013, due primarily to poor weather conditions coupled with a new fishing season.

As a result of reductions in legal-sized density of Roe's abalone on the platform habitats in the West Coast fishery (Roe's Abalone Table 4), the target catch range will be reviewed in this fishery during the 2014/15 season.

New management initiatives (2014/15)

The third year of the trial of a summer season for the West Coast Zone of the recreational fishery was undertaken for the 2013/14 summer. The season began on the first Sunday of November 2013 and extended till the first Sunday of March 2014, with fishing taking place between 7 and 8 am on the first Sunday of each month. Evidence from the first three seasons indicates a considerable drop in effort, due primarily to poor weather conditions, but also a reduction in effort, which occurred despite a relatively constant number of licenses, averaging around 15,500. For the 2014/15 season, the same number of fishing days will be kept, however a decrease in daily bag limit from 20 to 15 has been proposed. The objective of the bag limit decrease is to maintain low catches so as to promote an increase in density in the platform habitats, which have experienced significant declines in the last decade (Roes Abalone Table 4).

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

External Factors

During the summer of 2010/11, the West Coast experienced a marine heat wave with sea surface temperatures of up to 3 degrees above average (Pearce *et al.* 2011). 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 estimated 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. The effect of the heat wave on the Perth metropolitan area stock is being evaluated.

The other 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.

WEST COAST BIOREGION

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	
1992/93	105,000	111,341	735	134	27.6
1993/94	128,000	115,281	832	123	29.3
1994/95	125,960	117,835	908	113	26.6
1995/96	125,960	114,501	1,047	98	27.5
1996/97	125,960	118,715	1,004	106	26.9
1997/98	126,790	118,738	855	120	31.9
1998/99	93,960 ⁵	86,425	695	108	27.2
1999/00 ⁶	119,900	112,949	659	149	29.1
2000/01	115,900	107,735	647	144	29.8
2001/02	107,900	99,174	685	126	29.4
2002/03	107,900	100,471	700	125	29.1
2003/04	110,900	96,005	723	118	27.3
2004/05	110,900	107,593	736	126	30.9
2005/06	112,700	96,496	672	131	32.3
2006/07	112,700	98,370	625	136	32.3
2007/08	109,700	90,750	585	132	27.7
2008/09	106,700	93,197	580	133	29.4
2009/10	101,800	92,838	554	140	29.9
2010/11	101,800	91,418	567	134	29.0
2011/12	92,800	81,607	426	157	29.3
2012/13	92,800	67,029	372	147	25.8
2013/14	92,800	73,239	457	133	24.1

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
2013	8,512	27	17.4	226,071	20.1	89

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)

- Both areas are within the West Coast Bioregion.
- Survey area is South Coast Bioregion (i.e. east of Black Point).

ROE'S ABALONE TABLE 4

Mean densities^a (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	32	25	25	21	2.7	8	7	19
1998	34	18	31	26	2.8	7	9	31
1999	36	18	31	18	2.4	4	8	20
2000	35	16	17	27	1.7	6	6	23
2001	33	16	23	23	2.4	6	6	22
2002	27	19	27	30	2.0	5	5	22
2003	20	16	22	29	2.5	6	3	19
2004	19	12	21	41	2.2	5	3	14
2005	18	11	30	31	3.1	6	7	16
2006	16	10	36	30	3.8	6	4	13
2007	20	10	25	29	3.2	7	6	16
2008	21	11	50	31	3.7	7	4	14
2009	26	10	50	35	4.5	7	7	18
2010	28	8	58	28	5.7	8	6	17
2011	28	7	45	24	4.8	7	5	17
2012	33	6	39	15	5.6	7	8	18
2013	25	7	17	17	4.9	8	4	13
2014	18	7	17	21	3.9	7	1	10

& Note that the GLM model used to estimate density in this report has changed from previous years. The overall trends in density have not altered, however values are approximately 30% lower than in previous reports.

ROE'S ABALONE TABLE 5

Assessment against agreed performance measures for 2013.

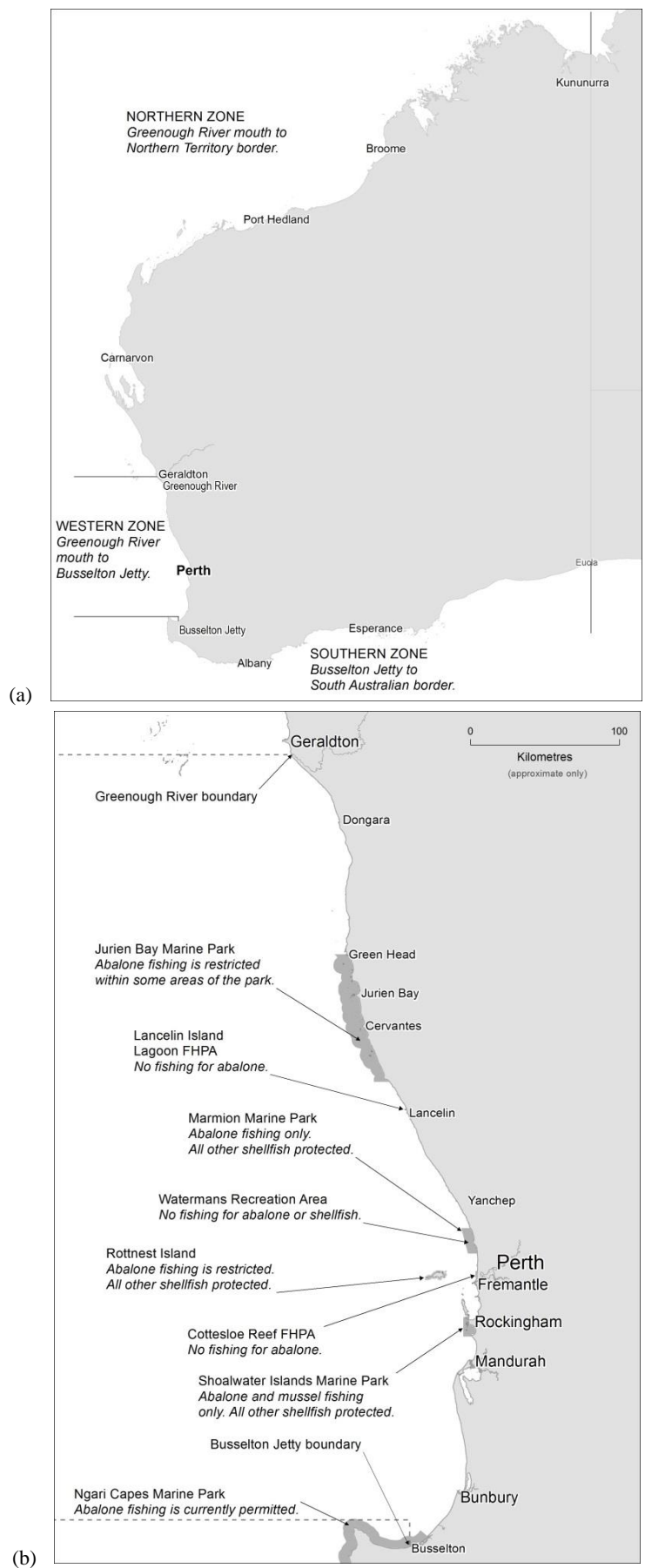
Performance Indicator	Performance Measure ¹	2013 Values	Assessment/Comments
Area 1			
Total catch (TACC)	5,000 kg	1,119 kg	Exploratory quota – limited fishing in 2013.
Effort range (Diver days)	14 – 43	2	See above.
Area 2			
Total catch (TACC)	19,800 kg	18,638	Met – 94% of quota caught.
Standardised CPUE	19 – 29	20	Met
Area 5			
Total catch (TACC)	20,000kg	10,487	Not Met – 52% of quota caught.
Standardised CPUE	15 – 23	17	Met
Area 6			
Total catch (TACC)	12,000 kg	6,992	Not Met – 58% of quota caught.
Standardised CPUE	17 – 25	14	Not Met
Area 7			
Total catch (TACC)	36,000 kg	36,000	Met – 100% of quota caught.
Standardised CPUE	29 – 42	29	Met.
Area 8			
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.



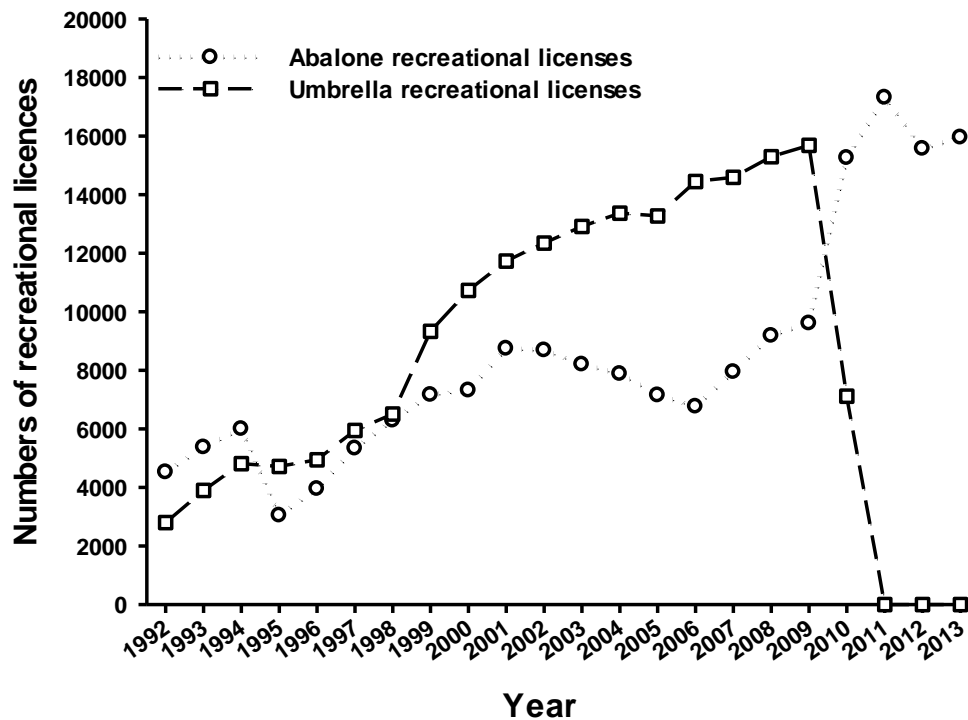
ROE'S ABALONE FIGURE 1

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, I. Koefoed, N. Blay, R. Oliver

Main Features			
Status		Current Landings	
Stock level	Abrolhos - Environ. Limited	AIMWTMF:	Scallops nil (whole weight)
Fishing level	Acceptable	SWTMF:	Scallops 8 t (whole weight)
			Prawns 4 t
		SCTF:	Scallops 253 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.

WEST COAST BIOREGION

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

Governing legislation/ fishing authority

Abrolhos Islands and Mid West Trawl Managed Fishery 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

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

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

Consultation process

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.

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: An exemption provides for the use of trawl gear to fish for scallops and certain demersal scalefish within the specified waters off the South Coast of the State between 115°30’ east longitude and 125° east longitude on the landward side of the 200m isobath.

Management arrangements

AIMWTMF

The AIMWTMF (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 336.5 m (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, each 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 amendment is under development to remove the current headrope unitisation from the management plan and standardise nets in the AIMWTMF. The licence holders which operate in the AIMWTMF, also operate in the Shark Bay Scallop Managed Fishery using the same net configuration (two 12.8 m nets), hence standardising the nets used in the AIMWTMF will make fishing more cost effective for licensees.

In 2013, the AIMWTMF was not opened for scallop fishing for the second consecutive year, due to low scallop abundance triggered by unfavourable environmental conditions.

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 fishing 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 these areas but there are guidelines for exploratory fishing before any commercial trawl fishing can be undertaken.

The Commonwealth Government’s Department of the Environment (DoE), has assessed the AIMWTMF under the provisions of the *Environment Protection and Biodiversity Conservation Act 1999*. A delegate of the Minister for Environment 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 13 MFLs operating in this fishery, with some operating in more than one zone. The fishing season operates between 1 January and 15 November in Zones A and B, while 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 Geopraphe Bay.

SCTF

The SCTF is managed primarily by limited entry with only four licences permitted to operate in the fishery. Additional management arrangements for the SCTF are set by conditions within the Instrument of Exemption and are aimed at ensuring the stock and environment are protected via gear restrictions and seasonal closures.

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

DotE has assessed the SCTF under the provisions of the EPBC Act and 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. Some pre-season surveys are also conducted by industry at Rottnest Island (as part of the SWTMF) and the South Coast to assess the abundance of scallops. An assessment of the marine heat wave effect, that commenced in the summer of 2010/11 and continued in the following two summers, on the scallop recruitment and spawning stock has been undertaken.

Retained Species**Commercial landings (season 2013)**

AIMWTMF: **Scallops Nil whole weight**

SWTMF: **Scallops 8 tonnes whole weight**

Prawns 4 tonnes

SCTF: **Scallops 253 tonnes whole weight**

AIMWTMF

No scallop fishing occurred in this fishery during 2013 because the annual pre-season scallop survey showed scallop abundance below the limit reference level of the harvest strategy to commence fishing (West and South Coast Scallop Figure 1).

SWTMF

The recorded landings in the SWTMF for the season comprised 4 t of western king prawns and 8 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 after 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 2). Being a multi-species fishery, other products retained included 4 t of mixed whiting spp., and 1 t of blue swimmer crabs (*Portunus armatus*). All other landings (mixed fish) combined totalled 1 t.

SCTF

The scallop catch was 253 t (whole weight), which was higher than last year's catch of 116 t. There is generally low effort expended in this fishery and variable recruitment (West and South Coast Scallop Figure 3). Byproduct species landings were negligible, with Balmain bugs, cuttlefish, squid, octopus and mixed fish comprising a total landed byproduct catch of less than 1 t.

Recreational catch:

Nil

Fishing effort/access level**AIMWTMF**

In 2013 no commercial otter trawl fishing was undertaken in the AIMWTMF (West and South Coast Scallop Figure 4) including the Port Gregory area as a result of low abundance of scallops.

SWTMF

A total of 83 boat days were fished in the SWTMF in 2013; a decrease compared to 2012 (176 boat days). This is very low compared to the effort levels of previous years, especially the period between 1990 and 2003, where typically over 400 boat days per year were recorded. Low effort reflects the availability of boats to fish in this fishery; inclement weather conditions that restrict fishing time; and the rising cost of fishing. There has also been a reduction of boats fishing because of a buy-out of commercial licenses in two zones of the fishery. This allows one licensee to operate one boat whilst owning all three licenses in each zone, resulting in a reduction of effort and improved economic efficiency. There is, however, still potential for effort to increase markedly because of latent effort in this fishery.

SCTF

For the 2013 season five boats fished for scallops between January and July, recording a total of 193 boat days (West and South Coast Scallop Figure 5). 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 (2014)

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

WEST COAST BIOREGION

protected to ensure that recruitment is dependent mainly 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, water temperature. A pre-season survey is undertaken annually with very low recruitment since 2011. The 2012 recruitment survey abundance was the lowest observed since 1997, which is believed to be due to environmental conditions such as the La Niña climate pattern, strong Leeuwin Current which are associated with high water temperatures as well as the spawning stock due to the low recruitment the previous year. This low recruitment resulted in predicted landings that were less than the target range (95-1830 t whole weight) and therefore, the fishery was not opened for 2013. The very low recruitment would have also resulted in subsequent low breeding stock in 2012/13. The 2013 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 2014 were again below the target range so the fishery will not open. It may take a number of years of good environmental conditions for the spawning stock and recruitment to improve.

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 2013 fishing season was not fished due to the low stock available, which was all left as breeding stock.

Bycatch species impact: Low

The AIMWTM trawl fleet operates over a small portion of the licensed fishing area, focusing on scallop aggregations in several different areas or fish grounds. Fishing activity is largely dependent on how widespread settlement is each season, with scallops settling on relatively bare sand habitats. The overall extent of the fishery is 3808 square nautical miles, with 2420 square miles (64% of the overall extent) being the permitted trawl area. No fishing was undertaken in 2013.

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) represent a very small percentage of the fishing area within the SCTF waters, therefore bycatch species impact is considered to be minimal.

Listed species interaction: Low

While turtles do occur in the Abrolhos Islands, it is towards the southern extent of their range, and they do not breed in the Abrolhos Islands area because water temperatures are generally too low. Consequently, interactions with turtles were always minimal and their capture should be negligible now that grids are compulsory in the fishery. Aside from

migrating humpback whales that usually avoid trawl boats; and occasional white sharks, few other endangered, threatened and protected species are sighted in this area. In the SWTMF and SCTF endangered, threatened and protected species do not occur regularly in the fishing areas, despite frequenting the surrounding waters. There were no recorded captures of listed species in 2013 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 is 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 2013 was nil in the AIMWTM, 6 in the SWTMF and 12 in the SCTF.

Economic Effects

Estimated annual value (to fishers) for year 2013:

AIMWTM	Level 1 - \$ Nil
SWTMF:	Level 1 - \$0.1 million
SCTF:	Level 1 - \$1.5 million

For the SWTMF and the SCTF the estimated value of the scallop catch is based on the wholesale price per kilogram (beach price) obtained from these fisheries, which is \$5.8/kg whole weight respectively. The South West trawl is a niche fishery resulting in the king prawn price being higher value than the major fisheries and was deemed to be \$22.50/kg.

Fishery Governance

Target catch range:

AIMWTM: 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 2013.

New management initiatives (2014)

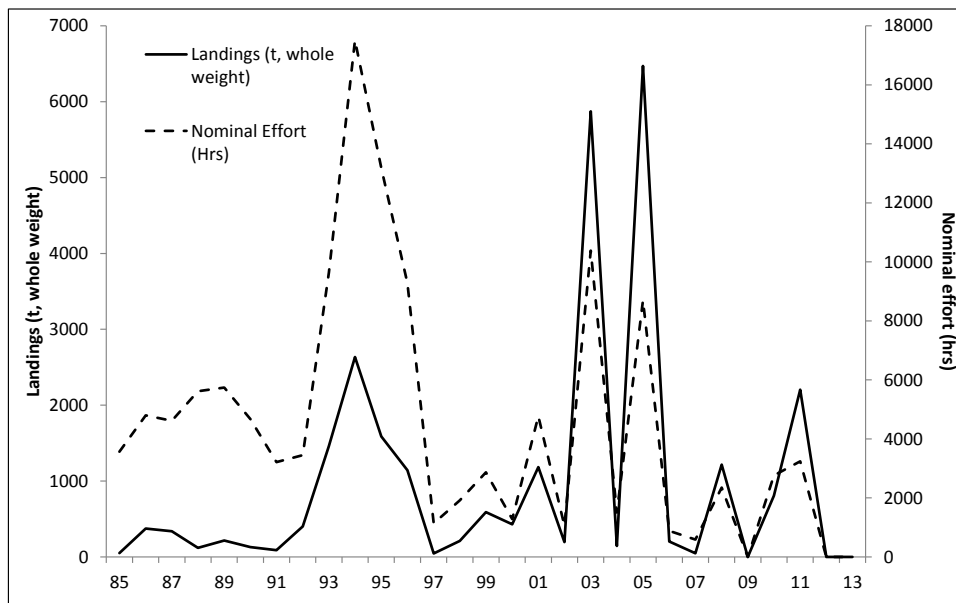
Pre-assessment phase for the Marine Stewardship Council approval system is underway for all three fisheries.

The Department is continuing to progress a management plan amendment in consultation with licensees to incorporate changes to gear arrangements for the AIMWTMF to standardise gear specifications with the Shark Bay Scallop Managed Fishery and eliminate the need for the current licence conditions and exemption.

External Factors

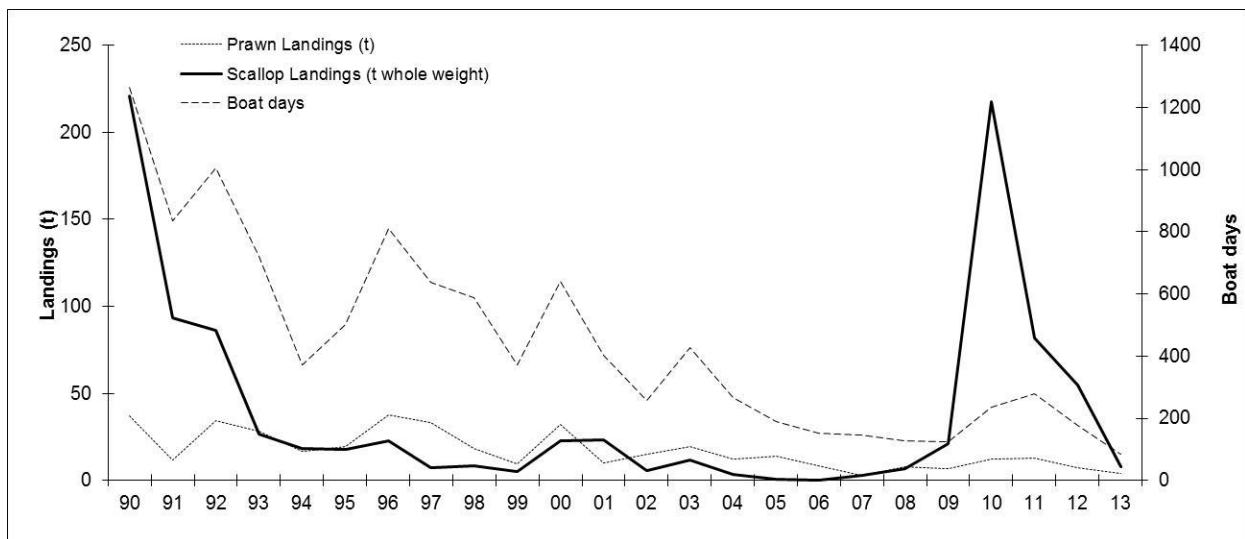
High variability in the level of recruitment highlights the dependence of recruitment success upon environmental conditions, such as the Leeuwin Current, rather than spawning stock levels. The relationship between environmental factors and recruitment success is being

evaluated for all these regions. The low 2011 recruitment is believed to be mainly due to environmental conditions such as the La Niña climate pattern and strong Leeuwin Current. This very low recruitment would have resulted in subsequent low breeding stock in 2011/12. The low 2012 and 2013 recruitments were probably influenced by environmental conditions as well as the continuance of low breeding stock from the previous year. 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, as well as the importance of meat quality and size (for marketing purposes) in the current economic climate also factor in determining the amount of effort expended in these fisheries.



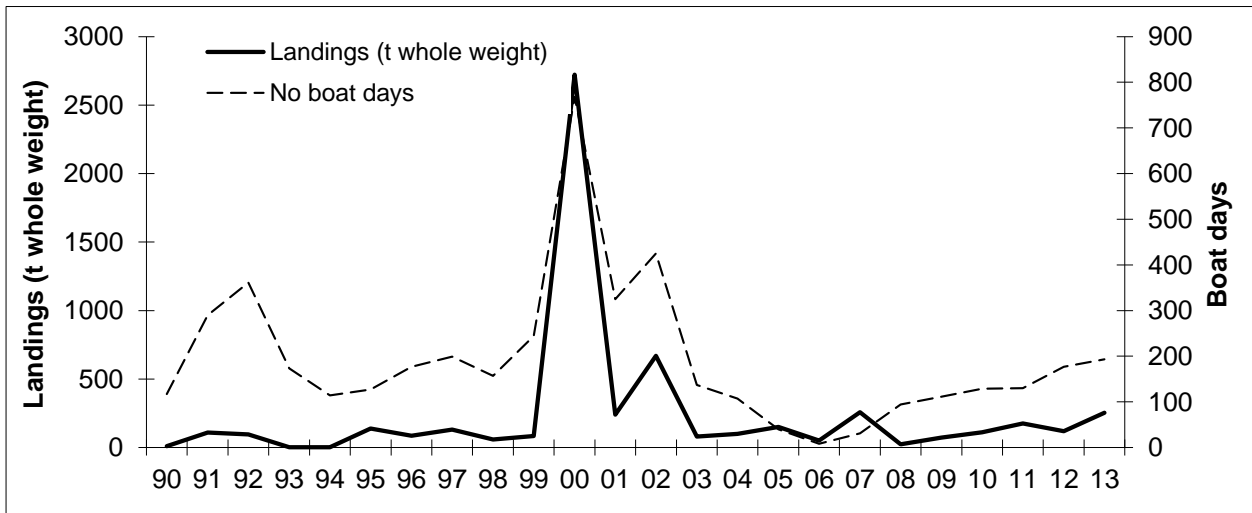
WEST AND SOUTH COAST SCALLOP FIGURE 1

Annual Scallop Landings and Nominal Effort for the Abrolhos Islands and Mid West Trawl Managed Fishery, 1985 – 2011. Note no fishing in 2013.



WEST AND SOUTH COAST SCALLOP FIGURE 2

Annual Scallop and Prawn Landings and number of boat days for South West Trawl Fishery, 1990 – 2013.



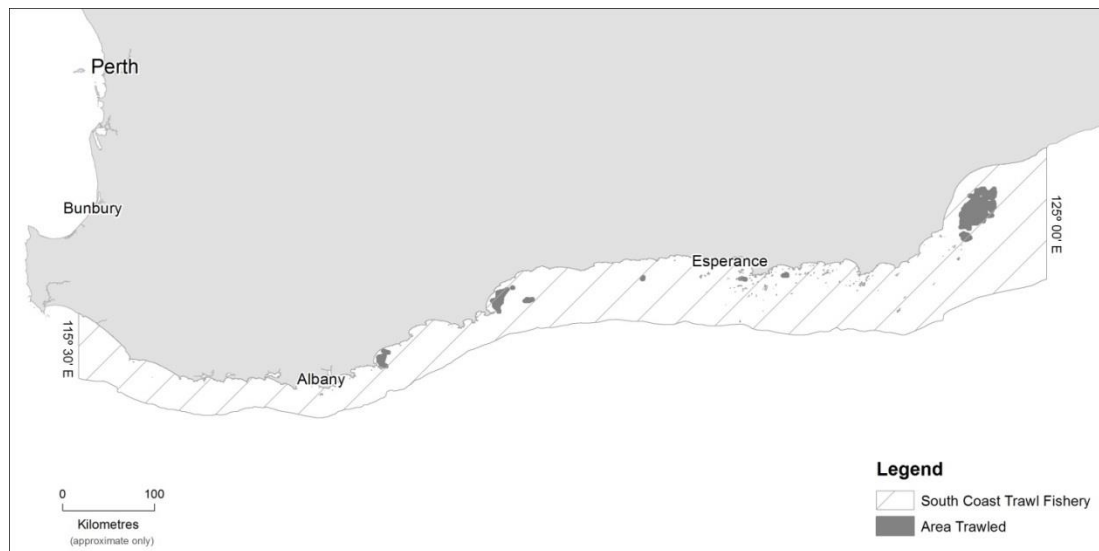
WEST AND SOUTH COAST SCALLOP FIGURE 3

Annual Scallop Landings and number of boat days for South Coast Fishery, 1990 – 2013.



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 2013.



WEST AND SOUTH COAST SCALLOP FIGURE 5

Boundaries of the South Coast Trawl Fishery and extent of fishing in 2013.

West Coast Blue Swimmer Crab Fishery Status Report

D. Johnston, R. Evans, M. Foster, N. Blay and B. Rome

Main Features			
Status		Current Landings	
Stock level		Total Commercial catch (2012/13)	215 t
Cockburn Sound	Environmentally Limited	Cockburn Sound	62 t
Peel-Harvey Estuary	Acceptable	Peel-Harvey Estuary	102 t
Fishing Level		Catch by other commercial fisheries	51 t
Cockburn Sound	Acceptable	Total Recreational catch	
Peel-Harvey	Acceptable	West Coast Bioregion (boat-based) (Mar 11 - Feb 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 inter-tidal zone to at least 50 metres in depth. However, the majority of the commercially and recreationally fished stock is concentrated in the coastal embayments between Geographe Bay (in the south) and Port Hedland (in the north).

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 1 (the Swan-Canning Estuary) and Area 2 (the Peel-Harvey Estuary) of the West Coast Estuarine Managed Fishery and Area 1 (Comet Bay) and Area 2 (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 by-product by trawlers operating in Comet Bay (Zone D of the South West Trawl Managed Fishery), and occasionally by trawlers operating in the waters from Fremantle to Cape Naturaliste (Zone 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.

WEST COAST BIOREGION

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 1994 and Fish Trap Restrictions Notice 1990

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 (Area 1) and the waters of the Peel Inlet and Harvey Estuary, together with the Murray, Serpentine, Harvey and Dandalup Rivers (Area 2).

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°16' 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 two 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 address 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 – 130 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) (West Coast Blue Swimmer Crab Table 1).

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 (Crab) Managed 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.*, 2011a¹, 2011b², 2014³; State of Fisheries Reports, 2010, 2011, 2012 and 2013).

1 Johnston, D., Harris, D., Caputi, N. and Thomson, A. 2011a. 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. 2011b. Status of the Cockburn Sound Crab Fishery. Fisheries Research Report No. 219. Department of Fisheries, Western Australia. 104pp.

3 Johnston, D., Chandrapavan, A., Wise, B. and Caputi N. 2014. Assessment of blue swimmer crab recruitment and breeding stock levels in the Peel-Harvey Estuary and status of the Mandurah to Bunbury developing crab fishery. Fisheries Research Report No. 258.

There was slight easing of commercial 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 as 2011/12 season).

The following management controls were implemented:

- a commercial size limit of 130 mm for male crabs and 130 mm for female crabs;
- a recreational size limit of 127 mm;
- a limited commercial season from 15 December 2012 to 15 June 2013; and
- a limited recreational season from 15 December 2012 to 31 August 2013.

In October 2013, a review of the stock status of the crab stock in the Fishery was conducted. The review highlighted a number of concerns with the crab stock, including a low level of recruitment a decrease in the breeding stock and overall abundance of crabs. In response to these concerns an adaptive management approach was introduced at the start of the 2013/14 season. This management approach involved conducting regular on-board monitoring surveys, as well as collecting monthly catch and effort information from the commercial fishery. An additional review of the data from these surveys was conducted in March 2014 resulting in an early closure to the fishery. Commercial fishers voluntarily ceased fishing on 16 April 2014 and a closure to recreational fishing was implemented on 1 May.

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 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 provides information on stock size structure and sex ratios.

In addition, fishery-independent direct surveys generating recruit (0+ year), residual (1+) and breeding stock indices, along with data on the general crab population, have been conducted in Cockburn Sound for approximately 12 years and in the Peel-Harvey for 7 years. The biological indices of abundance have been used in the stock assessment and management of the Cockburn Sound crab fishery for many years. An internal review of the egg production index and the subsequent stock-recruitment-environment relationship is currently underway. In addition, biological parameters such as growth and maturity are under review, and an integrated model will be developed in the future to incorporate the abundance indices along with biological information.

Biological indices of abundance for recruit (catch rate of juveniles as defined by size at maturity males <87.1 mm CW and females <86.9 mm CW) and breeding stock (catch rate of sexually mature females) are being developed for the Peel-Harvey crab fishery for the future stock assessment of this fishery.

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.*, 2011a). 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.*, 2011b). Reports on the population status of the Peel-Harvey Estuary crab stock, and the 2007/08 recreational crabbing survey in the Peel-Harvey Estuary, have been finalised (Johnston *et al.*, 2014). The latest summary of the stock status, current research and stock assessment analyses of crab fisheries in the Swan River, Cockburn Sound, Peel-Harvey, Warnbro Sound, Mandurah-Bunbury and Comet Bay is presented in stock assessment reports generated for the Marine Stewardship Council assessment process.

A new 3-year project funded through the Recreational Fishing Initiatives Fund commenced in July 2013 to obtain data on recreational catch and effort and crab stocks in the important recreational fisheries of Swan-Canning River, Geopraphe Bay and Leschenault Estuary. This project incorporates a logbook program for recreational fishers in each area and through fishery-independent surveys is investigating recruitment and breeding stock in the three areas.

Retained Species

Commercial landings (season 2012/13):

	Total 215 tonnes
Cockburn Sound	62 tonnes
Peel-Harvey Estuary	102 tonnes
Other west coast commercial fisheries	51 tonnes

The total commercial catch from the West Coast Bioregion in 2012/13 was 215 t, representing a 15% increase on the 188 t taken in 2011/12. This increase was primarily due to significant increases in crab catch from Cockburn Sound and the Peel-Harvey Estuary. This catch accounted for 78% of the state commercial blue swimmer crab catch of 277 t for 2012/13 (West Coast Blue Swimmer Crab Figure 1).

The commercial catch from the Cockburn Sound Crab Managed Fishery for 2012/13 was 62 t, a 35% increase from the 46 t caught during the 2011/12 season (West Coast Blue Swimmer Crab Figure 2).

The commercial catch from the Peel-Harvey Estuary (Area 2 of the West Coast Estuarine Managed Fishery) for 2012/13 was 102 t. This represents a 26% increase on the 81 t landed in 2011/12 and similar to the highest catch achieved in 2006/07 (West Coast Blue Swimmer Crab Figure 3).

The Mandurah to Bunbury Developing Crab Fishery (Area 1 and Area 2) reported a total annual catch for 2012/13 of 15 t, representing an 11% decrease on the 17 t reported for the 2011/12 financial year (West Coast Blue Swimmer Crab Figure 4). The trap fishery accounted for 13.5 t thus providing the majority of the Mandurah-Bunbury catch with only 1.6 t being taken by the South West Trawl Fishery.

Recreational catch estimate for West Coast Bioregion (boat-based) (Mar 11 - Feb 12)

87 tonnes

Recreational catch estimate: Peel-Harvey Estuary (boat and shore) (Nov 07 - Oct 08)

107-193 tonnes

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 statewide survey of boat-based recreational fishing in 2011/12 coming from this area (Ryan *et al.* 2013)¹. The survey was conducted between 1st March 2011 and 29th February 2012 and was collaboration between the Department of Fisheries, Edith Cowan University and Recfishwest. Approximately 3,000 fishers from the "Recreational Fishing from Boat" license database participated in a 12 month phone-diary survey in conjunction with boat ramp surveys of boat-based fishers. Catch data were recorded in numbers of crabs, and have been converted to weight for this report using a mean statewide estimate of 229 g/crab (based on 382 crabs weighed during the boat ramp surveys). The survey provided a statewide boat-based recreational estimate of retained blue swimmer crabs for the 12-month period of 97 t. The boat-based estimate for the West Coast Bioregion was 87 t, compared with total landings of 174 t by the commercial sector over the same period.

A 12-month recreational catch and effort survey in the Peel-Harvey Estuary was completed in October 2008. This survey covered fishing from boats, shore, canals, and houseboats. Recreational catch for the Peel-Harvey Estuary from November 2007 to October 2008 was estimated to be between 107-193 t, compared to the recreational catch estimate of 251-377 t from the last survey 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 (Sumner and Williamson 1999²; Sumner and Malseed 2004³; Bellchambers *et al.* 2005⁴). However, the recreational catch for the 2005/06 financial year was estimated to be just 4 t (Sumner and Lai 2012⁵). It should be noted that these figures are likely to under-estimate the total recreational blue

swimmer crab catch in each of these years, as the surveys commenced at various times between 7am and 9am and finished between 4pm and 8pm so missed any crabbing activity that potentially occurred before or after the survey began or finished.

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 commercial and 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 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 resulting in a total recreational catch estimate of 34 t. 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 annual boat-based recreational fishing effort as 22,265 fisher days, with 44% of this effort targeting blue swimmer crabs (Sumner and Malseed 2001⁶). The total annual shore-based recreational fishing effort was estimated to be 8,073 fisher days, with only 9% of this effort targeting blue swimmer crabs. The estimated total recreational blue swimmer crab catch between August 1998 and July 1999 was 7.3 t, which 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 low crab stocks, the Cockburn Sound (Crab) Managed Fishery partially re-opened from the 2009/10 fishing season. Commercial fishers in Cockburn Sound reported a total of 78,515 trap lifts for the 2012/13 season, a 3% increase on the 76,190 trap lifts during the 2011/12 season (West Coast Blue Swimmer Crab Figure 2).

1 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.

2 Sumner, N.R. and Williamson, P.C. 1999. A 12-month survey of coastal recreational boat fishing between Augusta and Kalbarri on the west coast of Western Australia during 1996-97. Fisheries Research Report No. 117. Department of Fisheries, Western Australia. 52 pp.

3 Sumner, N. R. and Malseed, B. E. 2004. Quantification of changes in recreational catch and effort on blue swimmer crabs in Cockburn Sound and Geographe Bay. Final Report on FRDC Project No. 2001/067. Fisheries Research Report No. 147. Department of Fisheries, Western Australia.

4 Bellchambers, L., Sumner, N. and Melville-Smith, R. 2005. Development of stock allocation and assessment techniques in Western Australia blue swimmer crab fisheries. Final Report to the Fisheries Research and Development Corporation on Project No. 2001/068. Department of Fisheries, Western Australia. 205 pp.

5 Sumner, N. and Lai, E. (2012). Boat-based Recreational Fishing Catch and Effort in Cockburn Sound and Owen Anchorage during 1996/97, 2001/02 and 2005/06. Fisheries Research Contract Report No. 23. Department of Fisheries, Western Australia. 16p.

6 Sumner, N. R. and Malseed, B. E. 2001. A 12-month survey of recreational fishing in the Peel-Harvey Estuary of Western Australia during 1998-99. Fisheries Research Report No. 127. Department of Fisheries, Western Australia. 52p.

Commercial fishers in the Peel-Harvey Estuary reported 68,646 trap lifts during the 2012/13 season – representing a 42% increase on the 48,263 trap lifts in the previous year and the second highest on record (West Coast Blue Swimmer Crab Figure 3).

Commercial effort in Area 1 and Area 2 of the Mandurah to Bunbury Developing Crab Fishery decreased by 19% in 2012/13, with a total of 17,178 trap lifts reported compared to 21,172 trap lifts the previous year (West Coast Blue Swimmer Crab Figure 5), primarily due to the decrease in fishing effort in Comet Bay.

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	Environmentally limited
Peel-Harvey	Adequate
Other West Coast fisheries	Adequate

Catch rates from fisheries within the West Coast Bioregion generally provide an index of abundance that can be used to assess individual fishery performance from year-to-year. 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 approximately twelve years and in the Peel-Harvey for seven years.

Cockburn Sound: Historically, natural variations in stock abundance have resulted in large fluctuations in the annual commercial blue swimmer crab catch from Cockburn Sound. This fluctuation relates 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 (326 t) the catch declined over the next few years to the point where the low stock abundance required closure of the fishery (in December 2006) for three years.

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 in 2006 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 gillnets 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 during winter/spring 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 partially re-open the crab fishery for the 2009/10 fishing season.

The catch in 2012/13 of 62 t was higher than the previous year's catch of 46 t from a similar level of effort (78,515 trap lifts) due to the lowering of the minimum size for female crabs from 135 to 130 mm, and the moulting of the majority of sublegal crabs to legal size (130 mm CW) in December and January. The relatively low catch of 46 t in 2011/12 was generated by the very high proportion of undersize crabs present in Cockburn Sound which resulted in only a low proportion of legal-sized crabs being present through the season. The reason for this was suggested to be from a reduced level of moulting.

Nominal CPUE at the beginning of the 2012/13 season were high (January, February and March; 0.9-1.0 kg/traplift) but decreased significantly (to 0.5 and 0.4 kg/traplift) by May and June. These low values of CPUE are similar to those observed in the years immediately preceding the closure of this fishery in 2005 and 2006. This indicated that residual legal stock levels were lower in 2013 compared to the high levels in 2012 but still higher than the low levels occurring up to the mid-2000s. This was confirmed by information obtained by observers on board commercial vessels which found crab numbers for June in particular, were very low. The overall nominal catch rate for 2012/13 was 0.8 kg/traplift for this fishery.

Juvenile index: Based on the juvenile (0+) catches sampled in research trawls, the recruitment of juvenile crabs within Cockburn Sound in 2013 was very low. The juvenile index for 2013 of 0.15 is considerably lower than the past six years (2007-2012), and similar to the level observed when the fishery was closed in 2006 (West Coast Blue Swimmer Crab Figure 6).

Residual index: The abundance of residual crabs (1+), as observed in commercial monitoring length frequencies, was relatively low in 2013. The RI of 7.2 is lower than the previous four years (2009-2012), but higher than during the period when the fishery was closed between 2006 and 2009 (West Coast Blue Swimmer Crab Figure 6).

Egg Production index: The egg production (breeding stock) index during 2012/13 of 1.17 is lower than the previous three years but higher than the levels (2004/05-2007/08) that resulted in recruitment failure. The low levels of juvenile abundance observed in 2013 suggest, however, that the spawning potential of the breeding stock in the latter half of 2012 and early 2013 may have been impaired (West Coast Blue Swimmer Crab Figure 7).

The total number of sexually mature females (>87 mm CW) observed during commercial monitoring surveys between September 2012 and January 2013 and on the Research Vessel Naturaliste survey (October – December 2013) were within historical range. However, the proportion of berried females observed during commercial monitoring surveys between September 2012 and January 2013 was low

compared with historical surveys, and at its lowest level (31%) for Naturaliste surveys undertaken between October and December since sampling began in 2007. Significantly, the cohort with the lowest relative numbers of berried females was that just above size at maturity (>87 mm CW) that would be spawning for the first time. Scaling the nominal egg production index using the proportion of berried females generates a substantially lower effective egg production index in 2012/13, which is consistent with the very low subsequent recruitment observed in 2013. The cause of low proportion of berried females is being investigated, particularly the effect of the lack growth to legal-size observed in the previous summer.

Peel Harvey: Annual commercial catches of blue swimmer crabs in the PHEF since 2000/01 have fluctuated between 45 t from 895 fisher days in 2002/03 and 104 t from 1657 fisher days in 2006/07. Crab catches have remained high in recent years, with a total commercial catch of 102 t (from 1517 fisher days) recorded in 2012/13 (West Coast Blue Swimmer Crab Figure 3).

Since complete gear conversion from nets to traps in 2000/01, annual commercial catch rates have fluctuated between 0.7 and 1.4 kg/trap lift, but have generally remained above 1 kg/trap lift. The nominal annual catch rate for 2012/13 in the Peel-Harvey Estuary was 1.49 kg/trap lift (West Coast Blue Swimmer Crab Figure 3). The 2012/13 catch rate is slightly lower than the 2011/12 catch rate of 1.68 kg/trap lift, which represented the highest catch rate since the fishery converted to crab traps.

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 fishery-independent surveys to complement the commercial logbook and monitoring data.

Mandurah to Bunbury: The Mandurah to Bunbury Developing Crab Fishery (Area 1 Comet Bay and Area 2 Mandurah-Bunbury) reported a total annual catch for 2012/13 of 15 t, representing an 11% decrease on the 17 t reported for the 2011/12 financial year (West Coast Blue Swimmer Crab Figure 4). The trap fishery reported 13.5 t and represents the majority of the Mandurah-Bunbury catch with only 1.6 t being taken by the South West Trawl Fishery.

Mean annual trap catch rates (kg/traplift) in Area 1 and Area 2 of 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 catch rate did decrease in 2010/11 but has remained relatively steady since, with a mean catch rate for 2012/13 of 0.79 kg/trap lift – a 0.6% increase on the 2011/12 catch rate of 0.78 kg/trap lift (West Coast Blue Swimmer Crab Figure 5).

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. This will need to be closely monitored to ensure overfishing the breeding stock does not occur.

Non-Retained Species

Bycatch species impact: **Negligible**

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

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

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

Listed species interaction: **Negligible**

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

Ecosystem Effects

Food chain effects: **Low**

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

Habitat effects: **Negligible**

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

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

Social Effects

During 2012/13, 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

2012/13: Level 2 - \$1-5 million (\$2 million)

The commercial blue swimmer crab catch in the West Coast Bioregion for 2012/13 was valued at approximately \$2 million, a 21% increase on the \$1.65 million generated in 2011/12. Most of the catch from the West Coast Bioregion was sold through local markets. Price data was generated by collecting monthly returns recording prices paid to fishers by fish processors, a weighted average price is then calculated for the financial year from the monthly data collected. Calculations for 2012/13 were set at \$9.23 per kg for blue swimmer crabs in Western Australia.

The economic value of the total commercial blue swimmer crab catch for the State of Western Australia for the 2012/13 financial year was estimated to be \$2.56 million – a 1% increase on the estimated \$2.53 million generated in 2011/12.

Fishery Governance

Current fishing level

Cockburn Sound: Under review

Peel Harvey: 45 - 104 tonnes

Other West Coast fisheries: Under review

A catch range for Cockburn Sound crabs will need to be developed when the management arrangements and stock levels have 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 (2014/15)

In March 2013, the West Coast Estuarine (Interim) Management Plan cessation date was extended to expire on June 2014. The Minister for Fisheries approved transitioning the fishery from an interim managed fishery to a managed

fishery and the new *West Coast Estuarine Managed Fishery Management Plan 2014* was gazetted in March 2014 and came into effect on 1 July 2014.

The new management plan increases the scope of the Fishery to incorporate Hardy Inlet and the sole fisher into the managed fishery. The licence holder in the Hardy Inlet has previously operated under an exemption to the Closed Waters Professional Netting (Rivers, Estuaries, Inlets and Lakes South of 23°) and has not operated in the West Coast Estuarine Interim Fishery. The new management plan formalises fishery management arrangements and strengthens access rights for licence holders in the Fishery.

In response to concerns over the stocks within the Cockburn Sound fishery commercial fishers voluntarily ceased fishing on 16 April 2014 and a closure to recreational fishing was implemented on 1 May.

The Department is currently progressing formal management arrangements of the Mandurah to Bunbury Developing Crab Fishery through the development of an (Interim) Management Plan for the fishery. This is scheduled to be completed in early 2015.

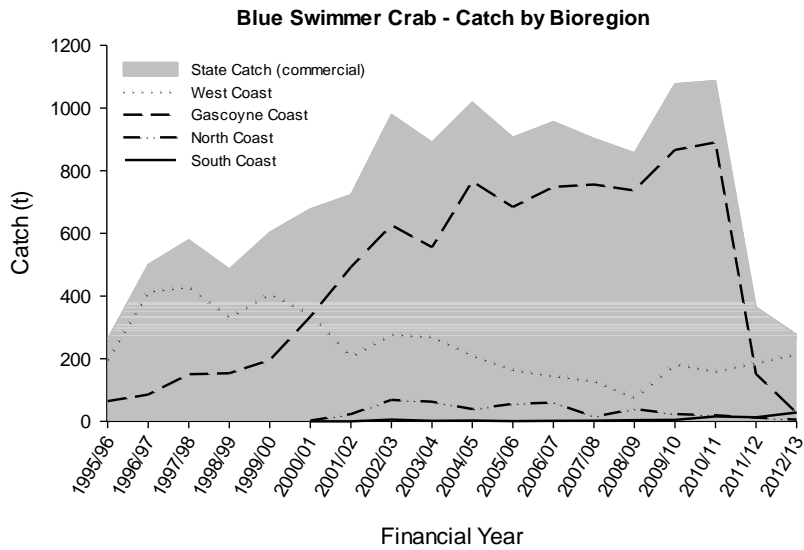
External Factors

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. The climate change implications associated with these environmental variables are also under consideration. The effect of the heat wave in the summer of 2010/11 and above average water temperatures on the following two summers on the spawning and juvenile phase of the crabs will be investigated as well as the cause of the low proportion of berried females in the 2012/13.

WEST COAST BLUE SWIMMER CRAB TABLE 1

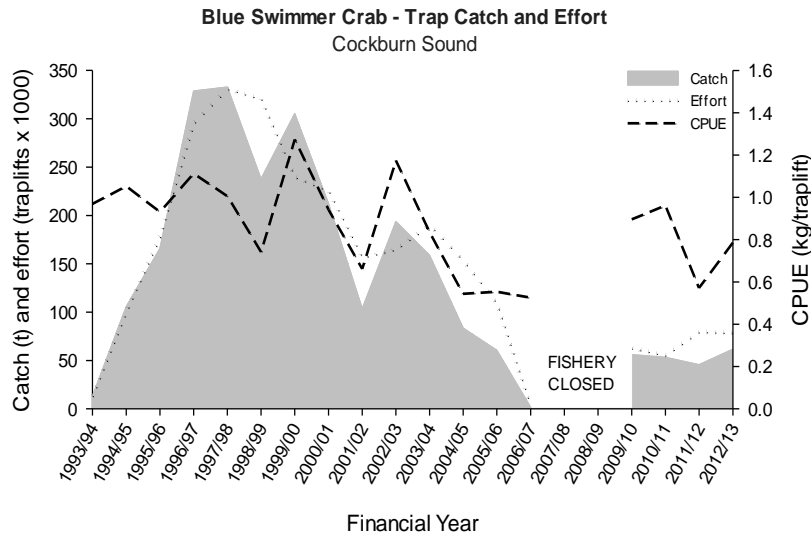
Minimum legal size (carapace width) for the West Coast Bioregion blue swimmer crab fisheries.

West Coast Bioregion Fishery	Minimum Legal Carapace Width
Area 1 of West Coast Estuarine Fishery (Swan-Canning Estuary)	127 mm
Area 2 of the West Coast Estuarine Fishery (Peel-Harvey Estuary)	127 mm
Cockburn Sound (Crab) Managed Fishery	130 mm
Warnbro Sound (Crab) Managed Fishery	127 mm
Mandurah to Bunbury Developing Crab Fishery (Area 1 - Comet Bay; Area 2 - Mandurah to Bunbury)	128 mm



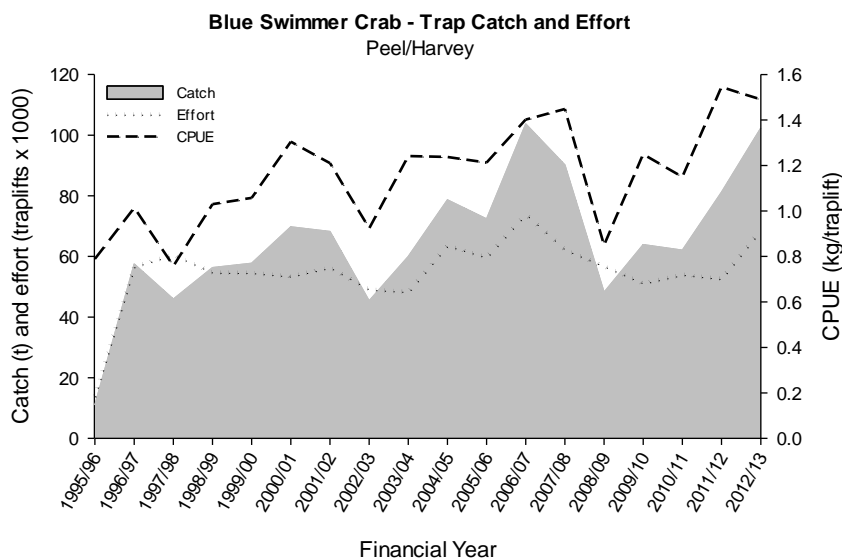
WEST COAST BLUE SWIMMER CRAB FIGURE 1

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



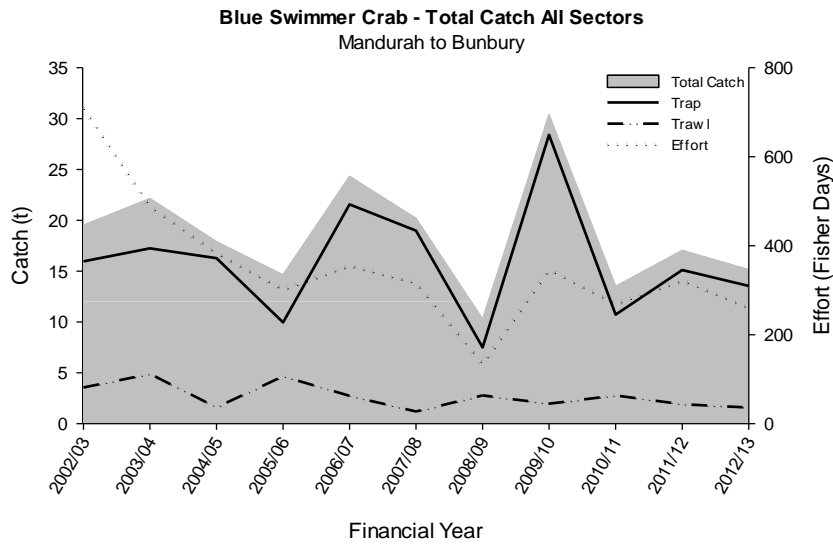
WEST COAST BLUE SWIMMER CRAB FIGURE 2

Blue swimmer crab catch (t), effort (traps x 1000) and catch per unit effort (kg/traplift) in the Cockburn Sound (Crab) Managed Fishery using crab traps since 1993/94.



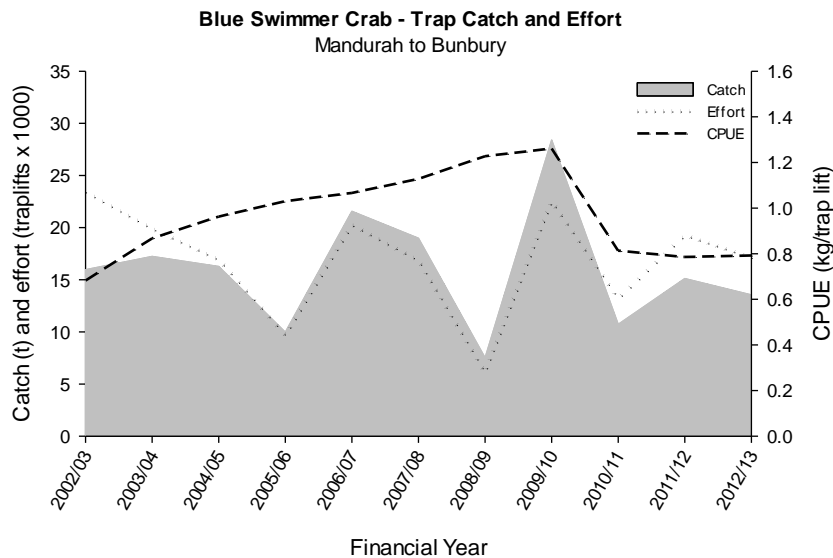
WEST COAST BLUE SWIMMER CRAB FIGURE 3

Blue swimmer crab catch (t), effort (traps x 1000) and catch per unit effort (kg/traplift) in Area 2 of the West Coast Estuarine Managed Fishery (Peel-Harvey Estuary) using crab traps since 1995/96.



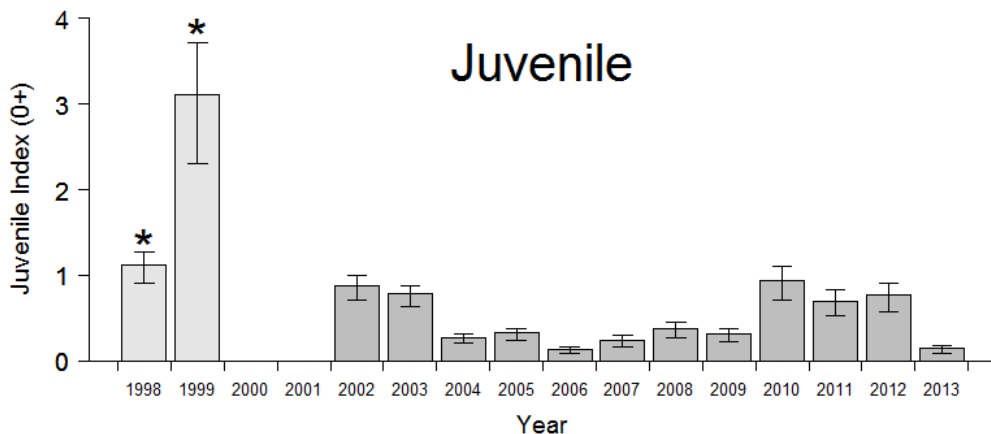
WEST COAST BLUE SWIMMER CRAB FIGURE 4

Blue swimmer crab total commercial catch (t), distinguishing between trap and trawl methods and total effort (fisher days) in Area 1 and Area 2 of the Mandurah to Bunbury Developing Crab Fishery since 2002/03.



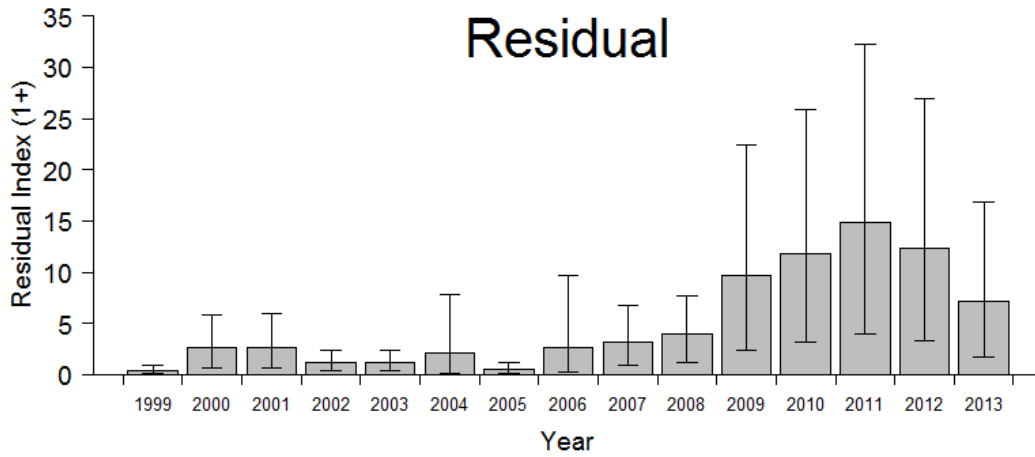
WEST COAST BLUE SWIMMER CRAB FIGURE 5

Blue swimmer crab trap catch (t), effort (trawlifts x 1000) and catch per unit effort (kg/trawlift) in Area 1 and Area 2 of the Mandurah to Bunbury Developing Crab Fishery since 2002/03.



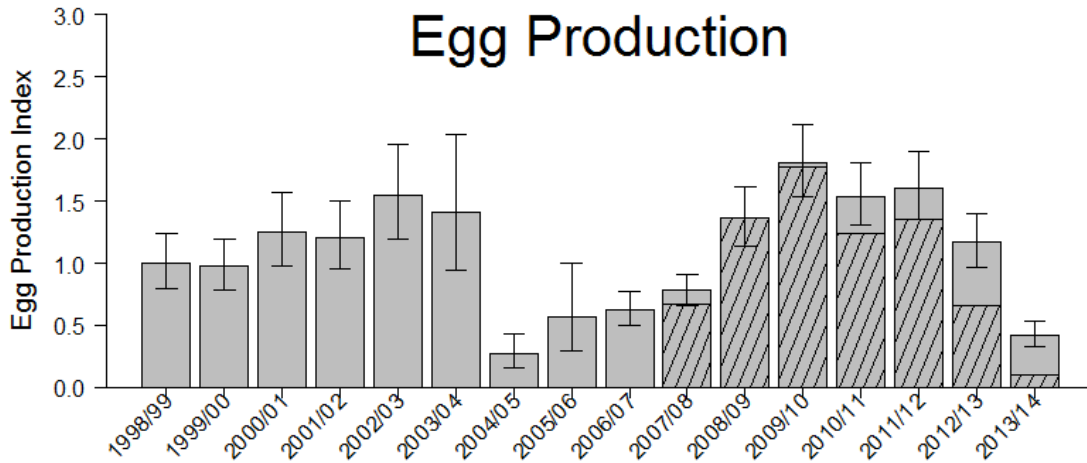
WEST COAST BLUE SWIMMER CRAB FIGURE 6

Annual standardised index of juvenile (0+) recruitment and residual (1+) blue swimmer crabs in Cockburn Sound calculated using data from juvenile research trawl conducted in April, May and June of each year. 95% confidence intervals are shown. * Daytime trawling (conversion factor (5.84) used for comparison with night trawling).



WEST COAST BLUE SWIMMER CRAB FIGURE 7

Annual standardised index of residual (1+) blue swimmer crabs in Cockburn Sound derived from catch monitoring surveys aboard commercial crab vessels in August and September of each year. 95% confidence intervals are shown.



WEST COAST BLUE SWIMMER CRAB FIGURE 8

Annual standardised breeding stock (egg production) index based on female crabs caught during all trawl surveys aboard the *RV Naturaliste* (2001-2013) and all catch monitoring surveys aboard commercial crab vessels in Cockburn Sound (1999-2013). This nominal Egg Production Index (EPI) is based on a size-fecundity relationship which assumes all sexually mature females will contribute to egg production (berried). However the proportion of berried females from *Naturaliste* surveys between 2007/08 and 2012/13 indicated a maximum of 55% in 2008 and was used as a reference year. An effective EPI was obtained through scaling the nominal EPI by the proportion of berried females relative to the reference year for the years berried data was available (diagonal lines). Note that 2013/14 index is preliminary as the data is only available to April 2014. 95% confidence intervals are shown.

West Coast Nearshore and Estuarine Finfish Resources Status Report

K. Smith, A. Quinn, M. Holtz and K. Nardi

Main Features			
Status	Current Landings (2013)		
Stock level:	Commercial total		346 t (finfish only)
Australian herring	Inadequate	South West Coast Salmon Fishery	93 t (salmon only)
Southern school whiting	Adequate	West Coast Beach Bait & South West Beach Seine	
Tailor	Adequate	Fisheries	19 t (whitebait only)
Southern garfish	Inadequate	West Coast Estuarine Fishery	136 t (finfish only)
King George whiting	Adequate	Recreational total	
Sea mullet	Adequate	Most recent survey 2000/01	940 t (key species only)
Whitebait	Environ. Limited	Recreational boat-based	
Black bream (Swan-Canning)	Adequate	Most recent survey 2011/12	108 t (key species only)
Cobbler (Peel-Harvey)	Adequate		
Fishing level:			
Australian herring	Unacceptable		
Whitebait	Unacceptable		
Garfish (Cockburn Sound)	Unacceptable		
Other stocks	Acceptable		

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 gillnets and beach seine nets.

The Cockburn Sound (Fish Net) Managed Fishery uses haul nets in Cockburn Sound. The main target species are southern 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 beach 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

The West Coast Estuarine Managed Fishery (WCEF) operates in the Swan/Canning and Peel/Harvey estuaries, and in the Hardy Inlet. 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 gillnets and seine nets.

Five operators have a condition on their Fishing Boat Licence to operate in the Vasse/Wonnerup Estuary and Toby Inlet. The latter estuary system is only occasionally fished, yielding small quantities of sea mullet. These estuaries are not included in the WCEF management plan.

Recreational

Most finfish caught recreationally in West Coast Bioregion estuaries and nearshore waters are taken by shore or boat-

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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.

Governing legislation/fishing authority

Commercial

West Coast Estuarine Fishery Management Plan 2014

West Coast Estuarine 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 - 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.

Commercial - Estuarine

WCEF: The management plan encompasses all estuaries in the West Coast Bioregion between 27° S and 34°22.715' S. Complex closures exist for both the Swan/Canning and Peel/Harvey commercial fisheries (refer to management plans, related legislation and regulations). 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).

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.

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'¹ 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 gillnets, seine nets and haul nets.

Recreational

Recreational fishers in West Coast Bioregion nearshore and estuarine waters take a diverse array of finfish species. Size

¹http://www.fish.wa.gov.au/Documents/recreational_fishing/licences/rec_licence_netting.pdf

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 (*Cnidogobius macrocephalus*) are indicators for the estuarine finfish suite. Although not indicators, 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 statutory 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, archived biological samples are used to estimate historical F levels to provide information on trends in fishing mortality.

A WA 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). In this project, the species composition of 'whiting' (*Sillago* spp.) landings within the West Coast Bioregion was investigated. 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 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.

Retained Species

Total commercial finfish landings (2013):

210 tonnes in nearshore waters

137 tonnes in estuarine waters

Commercial landings by fishery (2013):

South West Coast Salmon:

93 tonnes (western Australian salmon only)

WC Beach Bait + SW Beach Seine:

19 tonnes (whitebait only)

West Coast Estuarine: 136 tonnes (finfish only)

In 2013, 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 (29% by weight), western Australian salmon (27%), Australian herring (14%), whitebait (5%) and yelloweye mullet (5%) (West Coast Nearshore and Estuarine Table 1).

Catches are taken by these fisheries using gillnets, haul nets and beach seines. The minor quantities of the same species taken by other methods (e.g. purse seine, demersal gillnets and long-lines) are not included in Table 1, although the total catch by all methods and fisheries is taken into account during stock assessments.

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 are typically taken in the South Coast Bioregion, with the remaining 10-20% taken in the West Coast Bioregion. Consistent with this pattern, the 2013 South Coast Bioregion catch share was 84% with the majority of commercial landings taken by the ocean beach-based herring trap net fishery (also see South Coast Nearshore and Estuarine Finfish Resources Report). In 2013, this fishery reported 77% of the total commercial herring catch in WA and 91% of the total commercial herring catch in the South Coast Bioregion. In 2013, the remainder of the South Coast commercial catch was taken in estuaries (7%) and in nearshore ocean waters (2%).

Within the West Coast Bioregion in 2013, 51% of Australian herring landings were taken in the Geographe Bay/Bunbury area, 31% taken in Cockburn Sound and 6% taken in the Peel-Harvey Estuary.

In the South Coast Bioregion, the total annual commercial Australian herring catch reached an historical peak of 1,427 t in 1991 and then steadily declined to an historical low of 110 t in 2011 (West Coast Nearshore and Estuarine Figure 1). In

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

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2013, the South Coast total Australian herring catch was 251 t. Recent low catches in the South Coast Bioregion reflect 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 (West Coast Nearshore and Estuarine Figure 1). Annual landings 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) in response to the reduced availability of fish. In 2013, the West Coast total catch was 47 t.

Nationally, commercial landings of Australian herring peaked at approximately 1,800 t per year in the late 1980s and early 1990s and steadily declined thereafter. 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 2013, total WA landings were 298 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 40% 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 24 t taken commercially in 2013.

Relatively low quantities of southern school whiting are taken commercially in the West Coast Bioregion (less than 5 t in 2013).

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 2013, the total WA commercial catch of tailor was 31 t, the majority of which was taken in the Gascoyne Coast Bioregion (49% by weight), with the remainder from the West Coast Bioregion (44%) and South Coast Bioregion

(7%).

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 2013, the Gascoyne catch was 15 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 14 t in 2013. The majority (89%) of West Coast landings in 2013 were taken in the Peel-Harvey Estuary.

Southern garfish: In 2013, 24% 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. A historic minimum catch of 4 t was taken in 2013. 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 2013).

The long-term decline in Cockburn Sound catch was partly due to a reduction in commercial effort. However, annual effort levels have been stable since 2003, and so the recent catch decline is believed to be due to a decline in the availability of fish driven by a combination of environmental factors and fishing pressure.

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 WA stock.

Annual landings of King George whiting are typically highly variable, mainly reflecting variations in juvenile recruitment due to environmental factors. In 2013, 2 t of King George whiting was taken commercially in the West Coast Bioregion, representing 15% of the total annual commercial catch in WA with the remainder taken in the South Coast Bioregion.

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 2013, the WA total catch was 172 t. In 2013, 57% of the total WA catch was taken in the West Coast Bioregion, 22% in the Gascoyne Coast Bioregion and 21% in the South Coast Bioregion.

¹ Fowler, A.J., McGarvey, R., Steer, M.A. & Feenstra, J.E. (2013). The South Australian Marine Scalegfish Fishery Status Report - Analysis of Fishery Statistics for 2012/13. Report to PIRSA Fisheries and Aquaculture. South Australian Research and Development Institute (Aquatic Sciences), Adelaide. SARDI Publication No. F2007/000565-8. SARDI Research Report Series No. 747. 44 pp.

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 3). After 1988, the total annual catch in the West Coast Bioregion gradually declined. The relatively steep decline during 1988-2004 was attributable to an ongoing reduction in commercial effort in estuarine and nearshore waters as a result of VFAS (licence buy-backs) operating since 1990. Minor variations in the catch since 2004 are due to annual changes in targeted effort. In 2013, total West Coast Bioregion landings were 97 t. In 2013, 71% of total commercial landings of sea mullet in the West Coast Bioregion were taken in the Peel-Harvey Estuary and the majority of 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 2013, the catch was 37 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 2013, 54% of total commercial landings of sea mullet in the South Coast Bioregion were taken in Wilson Inlet, 27% in Oyster Harbour, 6% in Stokes Inlet, 4% in Beaufort Inlet and 2% in Princess Royal Harbour. Minor sea mullet landings were also reported in 4 other estuaries in 2013.

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. The majority of landings are taken during December-March. 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 2012/13, the total catch was 13 t, all of which was landed in Area 1. This is the lowest whitebait catch since the commencement of the fishery in the early 1970s.

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 2003/04, virtually all (98%) whitebait landings have been in Area 1. Annual landings in this Area followed a relatively stable trend (i.e. non-directional over the long term) from the late 1980s until 2009/10. In the past three years (2010/11 to 2012/13), historically low catches have been reported from Area 1, likely due to low stock abundance. Record high sea temperatures in recent years may have been unfavourable for whitebait recruitment, resulting in low

abundances.

Perth herring: Perth herring is endemic to the West Coast Bioregion of WA and constitutes a single stock over this range¹. 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 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 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 2013, 2 t of cobbler was reported from 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

¹ 'Perth herring' previously reported from the Gascoyne Coast Bioregion are now believed to be a different species

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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 2013, 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 (2013): N/A

Key species

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

Boat-based nearshore + estuarine catch (most recent estimate 2011/12): 108 tonnes

The recreational catch levels of finfish in nearshore and estuarine waters of the West Coast Bioregion were not completely estimated for 2013. The statewide surveys of recreational fishing were conducted in 2011/12 and 2013/14 (see below), but these estimated boat-based catches only. Shore-based catches were not included in these surveys and so total recreational catches of nearshore and estuarine finfish are not known.

The most recent complete estimates are from the National Recreational and Indigenous Fishing Survey conducted in 2000/01. 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.

A statewide survey of boat-based recreational fishing was conducted in 2011/12 (Ryan *et al.* 2013¹). During this survey, nearshore species including southern school whiting (20% of the West Coast catch by number) and Australian herring (16%) were the most common species caught in the West Coast Bioregion. A second statewide survey of boat-based recreational fishing was conducted from May 2013 to April 2014, and the resultant data is being analysed. This statewide survey is scheduled to be repeated biennially in future. It is important to note that this survey provides information on catches from boat-based recreational fishers only. Catches from shore-based fishers, who take the majority of nearshore species, are not estimated. Thus recreational estimates from the statewide survey underestimate recreational catches of nearshore and estuarine species.

In addition to the statewide surveys in 2011/12 and 2013/14, boat-based recreational fishing in the West Coast Bioregion was surveyed in 1996/97, 2005/06, 2008/09 and 2009/10. 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 2).

The Department of Fisheries 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.* 2011²). During this survey, the most frequently retained species were Australian herring, southern garfish and whiting (combined species). The same survey of shore-based fishers in the Perth metropolitan area was repeated from April to June 2014. It is anticipated that this 3-month survey will now be repeated at regular intervals to provide information about shore-based recreational catch and effort trends in the West Coast Bioregion.

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.

1 Ryan, K.L., Wise, B.S., Hall, N.G., Pollock, K.H., Sulis, 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.

2 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. 60 pp.

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 permitted 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 1,200 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 2013 (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. 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 6 in the early 1990s to 1 in 2003 and subsequent years. All effort by this fishery is spent targeting finfish.

Lancelin 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 2013 was 285. In 2013, 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 2 of the 8 teams reported salmon catches in 2013.

West Coast Beach Bait and South West Beach Seine Fisheries: In 2013, 9 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.

Statewide surveys of boat-based recreational fishing were conducted in 2011/12 and 2013/14. 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. Results from the 2013/14 survey are not yet available.

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. Recent surveys of shore-based fishing in 2010 (Smallwood *et al.* 2011) and 2014 (Department of Fisheries, unpublished data) only investigated 3 months of metropolitan recreational fishing and so the results cannot be used to estimate total shore-based effort levels in the Bioregion.

Stock Assessments

Assessments complete: Yes for key species

Assessment level and method:

Level 3 - Fishing mortality

Breeding stock levels:

Australian herring	Inadequate
Southern school whiting	Adequate
Southern garfish (Cockburn Sound)	Inadequate

Assessment level and method:

Level 2 - Catch rates

Breeding stock levels:

Tailor	Adequate
King George whiting	Adequate
Sea mullet	Adequate
Whitebait	Environmentally Limited
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.* 2013a¹). 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 F level estimated from data collected in 2009/10 and 2010/11 was well above the limit reference point for this species. Relatively low annual recruitment was also observed in most years over the previous decade. The fishery was found to be catching predominantly young fish, with >50% of total landings (commercial and recreational) 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 (Jones 2013²). The assessment recommended a reduction of at least 50% in the total catch of Australian herring.

In 2013, another level 3 assessment of the stock was completed, based on age structure data collected in 2011/12 and 2012/13. This assessment estimated that the F level remained above the limit reference point (and the 95% confidence intervals were entirely above the threshold level), indicating that the stock status had not changed significantly since the previous assessment.

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 ocean warming and the fluctuations in the strength of the Leeuwin 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.* 2011³). 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, but then declined in 2013 to the second lowest recorded level.

Southern school whiting: A level 3 assessment of the West Coast Bioregion component of the stock was completed in 2012 (Brown *et al.* 2013⁴). The stock level was assessed as adequate. The rate of fishing mortality (F) was estimated from the age structure of recreational landings in the West Coast Bioregion during 2011. The estimated 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.* 2013b⁵). 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 since then 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, were below their target ranges in 2013, but this is attributed to lack of targeting rather than low stock abundance (see *Inner Shark Bay Scalefish Fishery Status Report*). Tailor in Shark Bay are believed to be part of the same breeding stock as those within the West Coast Bioregion.

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.* 2002⁶) 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.* 2009⁷, 2010⁸). 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 the limited data from the shore-based component of the fishery. 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 2005⁹). For these reasons, the sustainability of garfish in Cockburn Sound is at higher risk than other populations in WA.

A level 3 assessment of the Cockburn Sound stock was

1 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.

2 Jones, K. (2013). Review of report on the "Status of nearshore finfish stocks in south-western Western Australia: Australian herring and tailor" prepared by Keith Jones, Sillago Research Pty Ltd for the Department of Fisheries, Western Australia. Fisheries Occasional Publication No. 116. Department of Fisheries, Western Australia. 52 pp.

3 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.

4 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.

5 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.

6 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.

7 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.

8 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.

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

completed in 2013. The rate of fishing mortality (F) was estimated from the age structure of commercial landings during 2010 and 2011. The estimated F and 95% confidence intervals were well above the limit reference point for this stock. Other available evidence also suggests the stock level is inadequate. During 2010 and 2011, the majority (~95%) of the current Cockburn Sound garfish catch (commercial and recreational) was comprised of mature fish. However, the average size of fish in the commercial catch had declined since the late 1990s (the trend in the recreational catch is unknown). Commercial catch rates suggest the abundance of garfish in Cockburn Sound has been declining gradually since 1996 (West Coast Nearshore and Estuarine Figure 6). Recreational catch rates in the Perth region, available since 2006, also suggest a decline (West Coast Nearshore and Estuarine Figure 7). Catch rates dropped sharply between 2011 and 2012, and remained very low in 2013, which suggests a negative impact arising from the 2011 'heatwave' event.

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 8). The annual commercial catch rate in Oyster Harbour suggests an increase in the availability of sea mullet in the South Coast Bioregion since 2000. This increase coincides with a period of ocean warming around south-western Australia, including a strong spike in abundance after the 2011 heatwave event. In the Gascoyne Coast Bioregion, catch rates in Shark Bay are used as an index of local sea mullet 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 were historically correlated with the strength of the Leeuwin Current in the previous year and with rainfall (Gaughan *et al.*

1996¹). The total commercial catch of 13 t in 2012/13, which was taken entirely within Area 1 (i.e. around Bunbury), was the lowest since the commencement of the commercial whitebait fishery in the early 1970s (West Coast Nearshore and Estuarine Figure 4). The 2012/13 catch rate in Area 1 was also the lowest recorded (West Coast Nearshore and Estuarine Figure 9).

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 persistent low abundance of whitebait in the Perth area in recent years due to poor juvenile recruitment (West Coast Nearshore and Estuarine Figure 4). Until recently, the annual catch and catch rate trends in the Bunbury area suggested a relatively stable long term abundance of whitebait in this area (West Coast Nearshore and Estuarine Figure 4). However, recent catch and catch rates suggest sharply declining stock abundance over the past 3 years the Bunbury area, reaching a historically low level in 2012/13.

The onset of the decline coincided with a 'heatwave' event along the west coast in autumn 2011 (Pearce *et al.* 2011). It is possible that this event contributed to spawning failure by whitebait in winter 2011, which (when accompanied by fishing mortality) could explain the sudden decline in stock level. Whitebait has a lifespan of only 3-4 years, and so trends in stock level (and catches) are strongly linked to recruitment variability.

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 2006²). Voluntary recreational logbook fisher catch rates suggest stable availability of black bream in this estuary from 2004 to 2013 (West Coast Nearshore and Estuarine Figure 10). 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 2013 was stable (i.e. non-directional) (West Coast Nearshore and Estuarine Figure 11). 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

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

2 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.

WEST COAST BIOREGION

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.

Listed species interaction: **Negligible**

Interactions with listed species by the fishing gear used in these commercial fisheries are 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 listed species.

Recreational fishers using line-fishing methods are unlikely to capture listed 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 primarily due to environmental factors. 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.* 2012¹).

Habitat effects: **Low**

The operation of gillnets and haul nets over predominantly sand and mud bottoms is unlikely to have any impact on these habitats in estuaries 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 2013, 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 2013, there were 2 licensees (involving up to 10 fishers) operating within the West Coast Salmon Fishery during the western Australian salmon season. There were 6-30 commercial fishers per month employed in various fisheries targeting Australian herring during 2013. Australian herring and western Australian salmon fishers in the West Coast Bioregion supply local bait and human consumption markets.

Commercial - estuarine

In 2013, there was an average of 14 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 2013:

Level 1: <\$1 million (finfish only)

Fishery Governance

Commercial

Current Fishing (or Effort) Level:

West Coast Estuarine Fishery **Acceptable**

Cockburn Sound (Fish Net) Fishery
Not Acceptable

South West Salmon Fishery **Acceptable**

West Coast Australian herring fisheries
Under review

¹ 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.

Whitebait (West Coast Beach Bait + South West Beach Seine Fisheries) Not 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 in 2013, and MSC pre-assessments for all West Coast and South Coast Bioregion fisheries in 2014, management arrangements, governance, and catch ranges will be reviewed. However, the 2013 catches are reported (below) against their current governance arrangements.

In the Peel-Harvey Estuary, the commercial catch of finfish in 2012 was 120 t, which was within the target range.

In the Cockburn Sound Fish Net Fishery the total catch of finfish in 2013 was below the target range. The Cockburn Sound finfish catch has been below the target range for 6 of the past 8 years.

The total catch of western Australian salmon (West Coast and South Coast landings combined) in 2013 (229 t¹) was well below the target range. The catch has now been below the target range for 7 consecutive years.

The West Coast herring catch by all fisheries in 2013 (47 t) was below the target range. The West Coast herring catch has been below the target range for 9 of the past 10 years (similar to the trend in the South Coast herring catch, which has been below the target range for 11 consecutive years). Recent research outcomes regarding stock status are being used as a basis for reviewing management arrangements to ensure the sustainability of this iconic species.

In 2012/13, the commercial catch of whitebait (13 t) was well below the target range. Management arrangements are being reviewed to ensure the sustainability of this species.

Recreational Current Fishing (or Effort) Level NA

Target catch range: Not developed

New management initiatives (2014/15)

The Department of Fisheries is in the process of consulting with Recfishwest, the Western Australian Fishing Industry

Council and relevant licence holders regarding management responses to ensure the long-term sustainability of the Australian herring stock.

The West Coast Estuarine (Interim) Management Plan expired on 30 June 2014. The new West Coast Estuarine Management Plan was gazetted in March 2014 and came into effect on 1 July 2014. The new management plan incorporated Hardy Inlet into the Fishery. It also formalised fishery management arrangements and strengthened access rights for licence holders in the Fishery.

West Coast nearshore and estuarine fisheries underwent pre-assessment for Marine Stewardship Council (MSC) certification. Outcomes are expected during late 2014. In addition, the sea mullet and blue swimmer crab fisheries within the Peel-Harvey Estuary were undergoing MSC full assessment at the time of writing.

An application to the Commonwealth Department of the Environment has been submitted to maintain export accreditation for the western Australian salmon fisheries (South Coast Salmon Managed Fishery and South West Coast Salmon Managed Fishery), effectively declaring these fisheries exempt from Part 13 and 13A of the EPBC Act for a period of 5 years. The current exemption expires on 15 November 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 recruitment into each fishery (Lenanton *et al.* 2009³).

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 appears to have affected the catch levels of these species in 2011 and in subsequent years. Trends in catch and catch rates suggest that the distribution and abundance of southern garfish, whitebait, Australian

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.

3 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.

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.

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herring, western Australian salmon and sea mullet were affected by the 2011 heatwave.

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.

WEST COAST NEARSHORE AND ESTUARINE TABLE 1

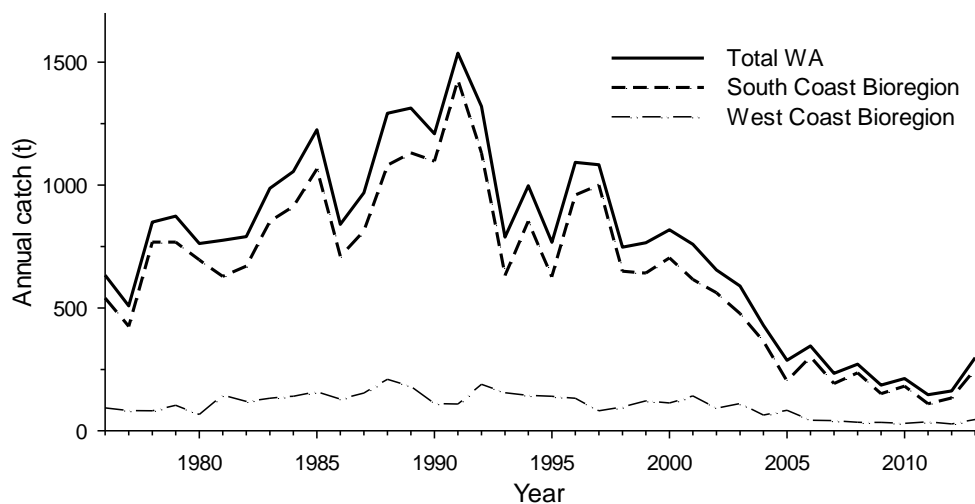
Total annual catches of finfish (except sharks and rays) from the estuarine and beach-based nearshore commercial fisheries in the West Coast Bioregion, 2009 to 2013.

Species	Scientific name	Catch (tonnes)				
		2009	2010	2011	2012	2013
Australian salmon	<i>Arripis truttaceus</i>	494.6	69.0	6.3	47.1	92.7
Whitebait	<i>Hyperlophus vittatus</i>	139.6	100.6	34.8	65.7	18.6
Sea mullet	<i>Mugil cephalus</i>	103.0	102.1	77.7	103.0	100.1
Australian herring	<i>Arripis georgianus</i>	34.6	30.6	36.3	28.4	47.1
Yellow-eye mullet	<i>Aldrichetta forsteri</i>	26.1	24.7	16.2	22.5	18.6
Whiting species	<i>Sillago</i> spp.	23.9	22.5	24.6	19.6	25.8
Southern sea garfish	<i>Hyporhamphus melanochir</i>	15.7	15.8	19.2	5.8	4.3
Cobbler	<i>Cnidoglanis macrocephalus</i>	9.2	5.4	7.4	5.2	1.8
Perth herring	<i>Nematalosa vlamingi</i>	1.6	0.1	0.4	1	1.5
Tailor	<i>Pomatomus saltatrix</i>	7.1	4.8	7.2	8.8	14.2
Hardyheads/Silversides	Atherinidae	-	4.1	4.7	3.5	1.2
Scaly mackerel	<i>Sardinella lemura</i>	-	0.9	-	3	5.7
Trumpeters/Grunters	Teraponidae	-	0.5	1	1.6	2.8
King George whiting	<i>Sillaginodes punctata</i>	2.0	5.9	5.1	3.7	2
Trevally	Carangidae	2.1	3.5	2.4	2.3	2.8
Yellowtail scad	<i>Trachurus novaezelandiae</i>	1.2	0.9	1.2	0.9	1.5
Black bream	<i>Acanthopagrus butcheri</i>	1.1	2.6	0.7	1.4	1.3
Blue sprat	<i>Spratelloides robustus</i>	7.1	0.1	0.3	0.3	0.8
Other finfish	Teleostei	0.2	0.2	0.3	0.1	3.4
TOTAL		869.1	394.3	245.8	323.9	346.2

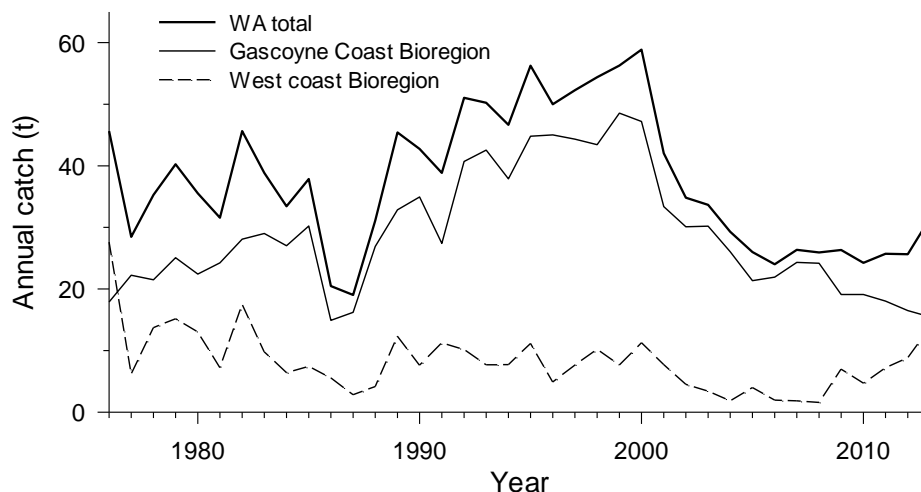
WEST COAST NEARSHORE AND ESTUARINE TABLE 2

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. (*estimated to be ~90% southern school whiting)

Species	Scientific name	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>Hyporhamphus melanochir</i>	6	2	4	3	2

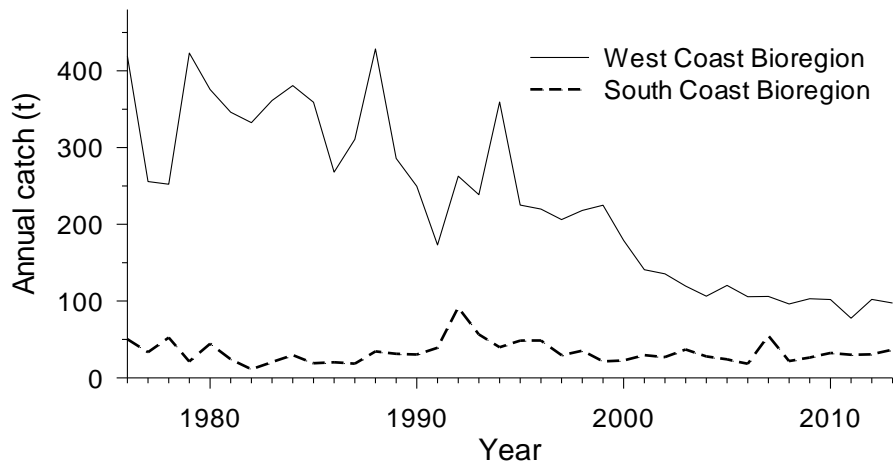
**WEST COAST NEARSHORE AND ESTUARINE FIGURE 1**

Annual commercial catches of Australian herring, by Bioregion, 1976–2013.

**WEST COAST NEARSHORE AND ESTUARINE FIGURE 2**

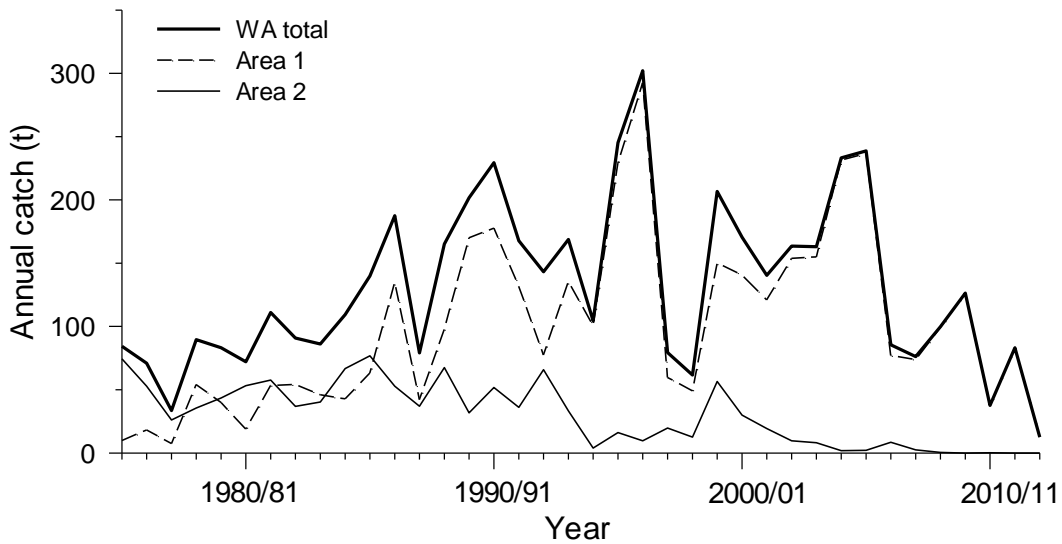
Annual commercial catches of tailor, by Bioregion, 1976–2013. Minor catches in South Coast Bioregion are not shown, but are included in WA total.

WEST COAST BIOREGION



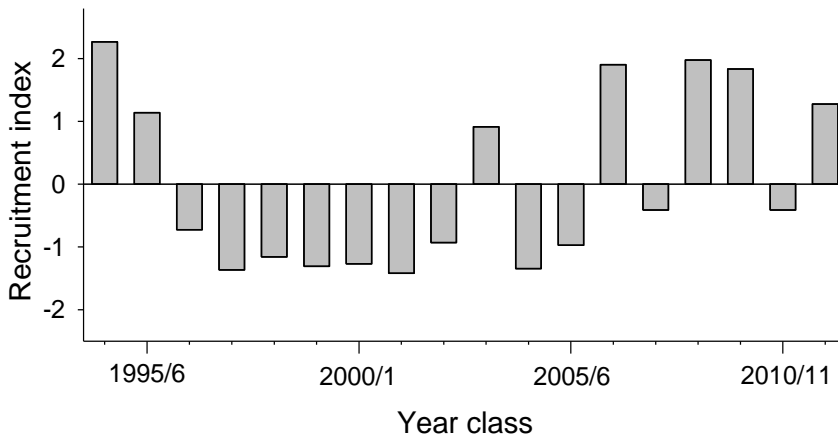
WEST COAST NEARSHORE AND ESTUARINE FIGURE 3

Annual commercial catches of sea mullet, by Bioregion, 1976 –2013.



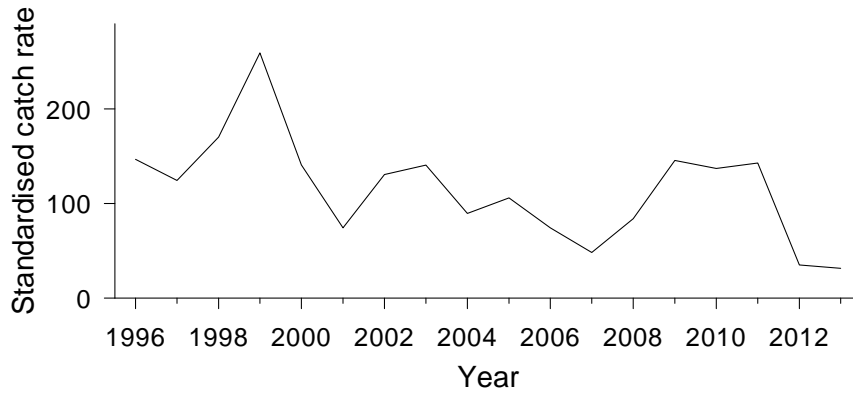
WEST COAST NEARSHORE AND ESTUARINE FIGURE 4

Annual commercial catches of whitebait in West Coast Bioregion, by fishing area, 1975/76 –2012/13. Area 1 = Bunbury; Area 2 = Perth/Mandurah.



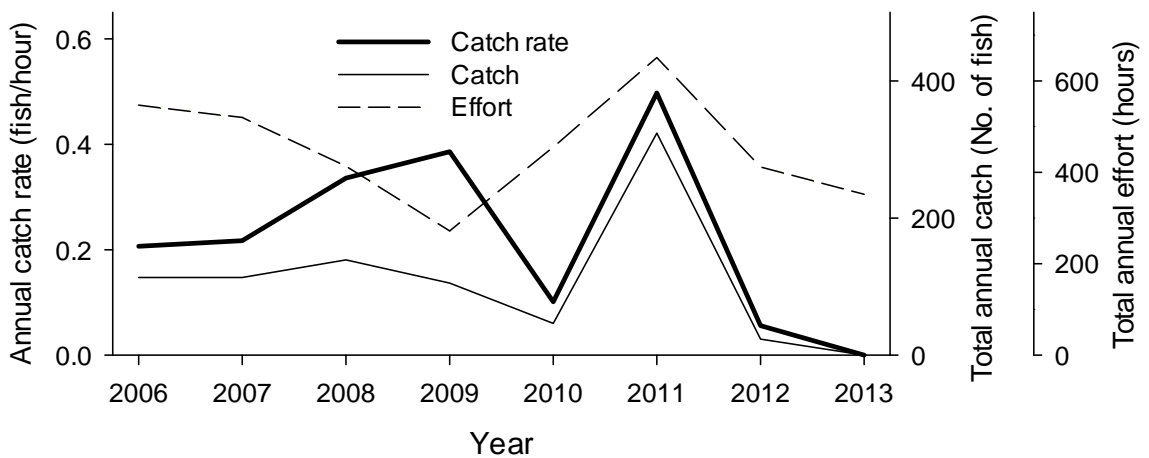
WEST COAST NEARSHORE AND ESTUARINE FIGURE 5

Annual recruitment index for tailor in the West Coast Bioregion, 1996 – 2013, 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



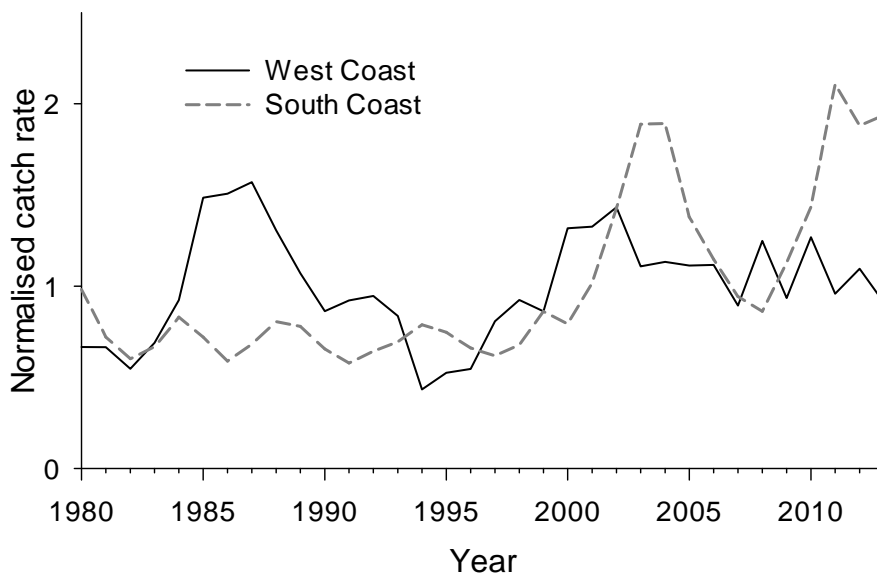
WEST COAST NEARSHORE AND ESTUARINE FIGURE 6

Annual commercial catch rate of southern garfish in Cockburn Sound, 1996 – 2013.



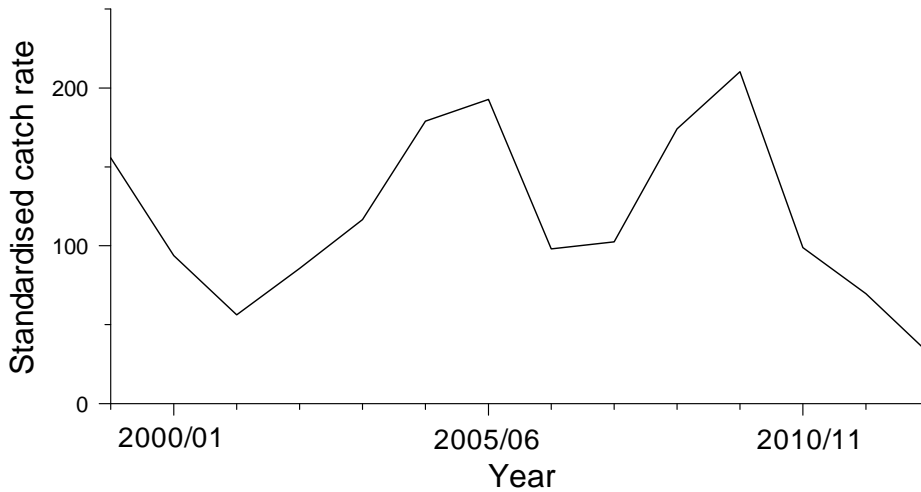
WEST COAST NEARSHORE AND ESTUARINE FIGURE 7

Total annual catch, effort and catch rate of southern garfish by shore-based voluntary recreational logbook fishers in the Perth metropolitan area, 2006 – 2013.



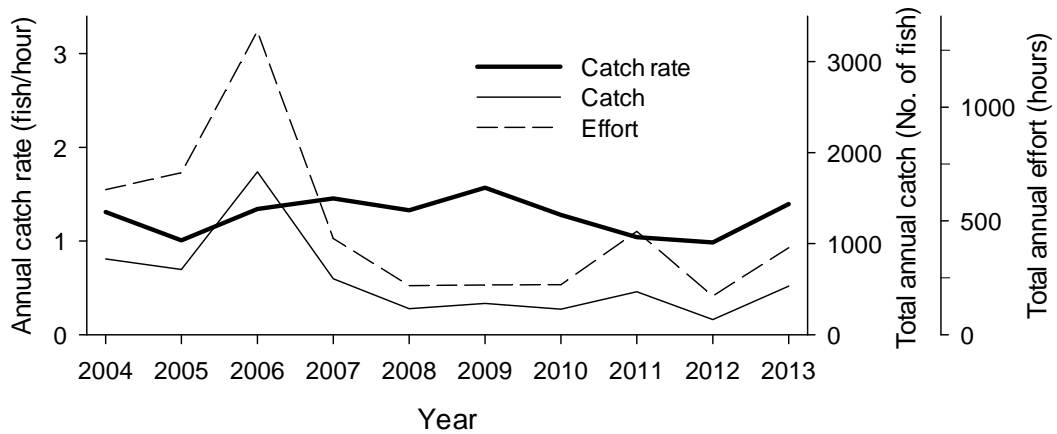
WEST COAST NEARSHORE AND ESTUARINE FIGURE 8

Annual commercial catch rates of sea mullet in West Coast and South Coast Bioregions, 1980 – 2013.



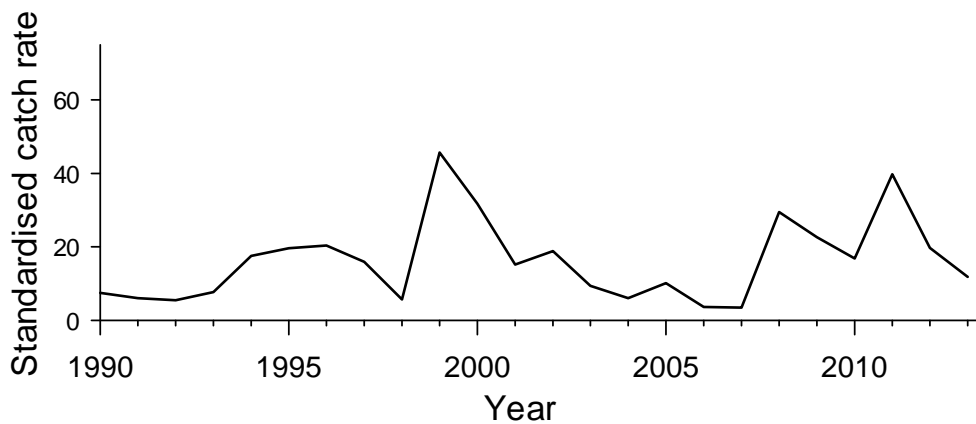
WEST COAST NEARSHORE AND ESTUARINE FIGURE 9

Annual commercial catch rate of whitebait in Area 1 (Bunbury) 1999/2000 – 2012/2013.



WEST COAST NEARSHORE AND ESTUARINE FIGURE 10

Total annual catch, effort and catch rate of black bream by voluntary recreational logbook fishers in the Swan-Canning Estuary, 2004 – 2013.



WEST COAST NEARSHORE AND ESTUARINE FIGURE 11

Annual commercial catch rate of cobbler in the Peel-Harvey Estuary, 1990 – 2013.

West Coast Purse Seine Fishery Report: Statistics Only

B. Molony, E. Lai, M. Holtz and S. Walters

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 Limited Entry Fishery Notice 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 of 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 a 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: **705 tonnes**

For the 2013 reporting year, catches from all zones of the West Coast Purse Seine Fishery are reported. Fishery effort and catches are not reported separately for each zone as fewer than 3 vessels fished in a single zone. Thus effort and catch levels reflect total fishery effort and catches.

Effort levels again increased in 2013 to 522 fishing days

undertaken by seven vessels. Total catches of pilchards and sardinella exceeded 705 t in 2013. The 2013 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, 689.7 t) with approximately 16 t of pilchards landed.

Approximately 7.5 t of other species were landed, mainly comprising yellowtail scad.

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.* 2012) 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 at low levels in recent years.

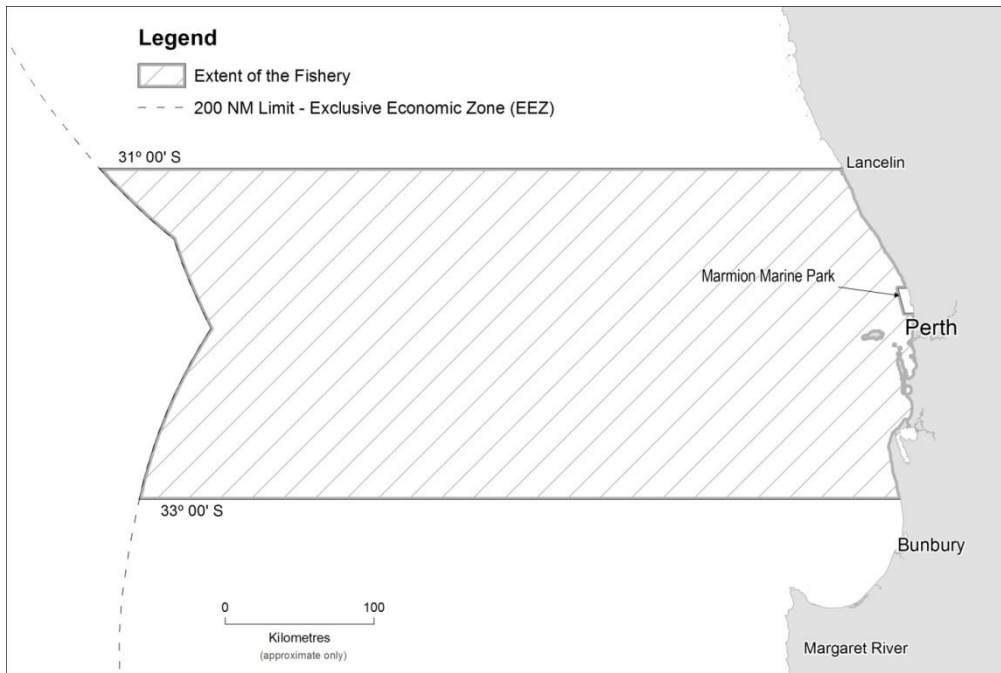
New management initiatives (2014/15)

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.

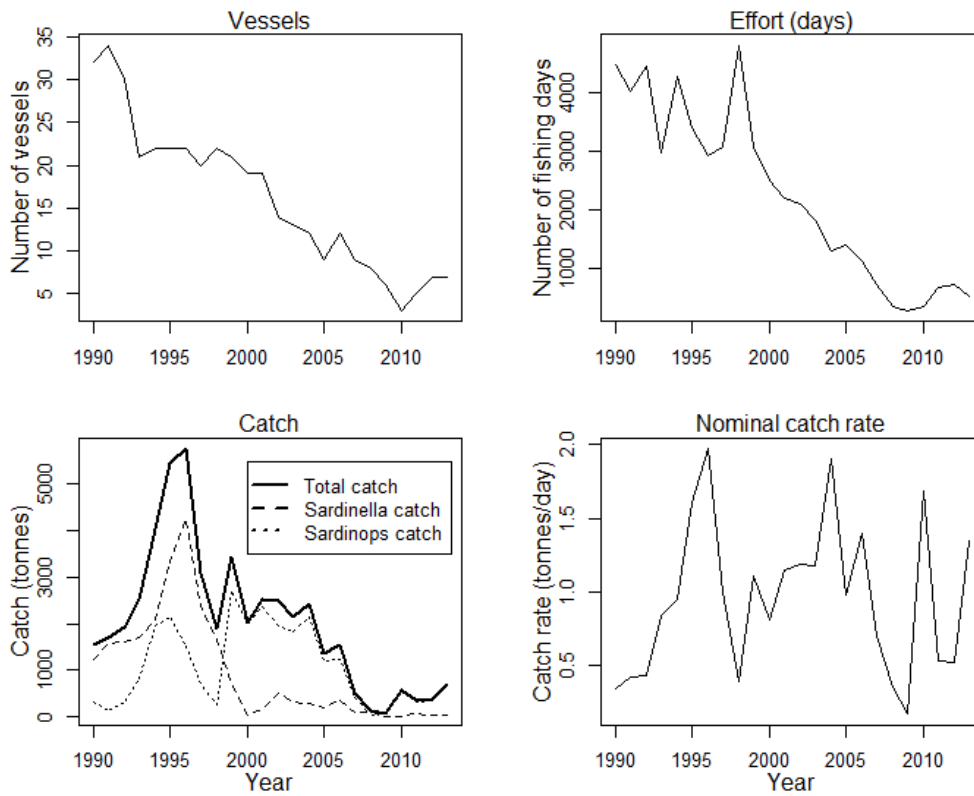
This fishery is scheduled to undergo MSC pre-assessment in mid 2014.

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

Number of vessels, total effort (days), annual catches of pilchards (*Sardinops*) and sardinella and nominal daily catch rate in the West Coast Purse Seine Fishery, 1975 –2013.

West Coast Demersal Scalefish Resource Status Report

D. Fairclough, E. Lai, M. Holtz, T. Nicholas and S. Walters.

Main Features			
Status		Current Landings	
Stock level	Recovering	Commercial sector	
Fishing Level		All scalefish:	
Commercial:	Not Acceptable (Pink snapper)	WCDSIMF (2013)	379 t
Recreational:	Not Acceptable (Pink snapper and baldchin groper)	Demersal suite:	
		WCDSIMF (2013)	357 t
		Other (TDGDLF, WCRLF, CSLPF, SWTMF; 2013 or 2012/13)	38 t
		Total demersal suite	395 t
		WCDSIMF	Other
	Indicator species	(2013)	(2013 or 2012/13)
	West Australian dhufish	63 t	9 t
	Pink snapper	185 t	9 t
	Baldchin groper	11 t	< 1 t
	Redthroat emperor	44 t	< 1 t
	Bight redfish	14 t	< 1 t
	Boat-based recreational fishers (2011/12)		
	Top 15 species:		159 t
	Indicator species:		
	West Australian dhufish		74 t
	Pink snapper		33 t
	Baldchin groper		29 t
	Redthroat emperor		1 t
	Bight redfish		1 t
	Charter fishers (2012/13)		
	Top 15 species		42 t
	Indicator species:		
	West Australian dhufish		13 t
	Pink snapper		9 t
	Baldchin groper		10 t
	Redthroat emperor		< 1 t
	Bight redfish		1 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 West Australian dhufish (*Glaucosoma hepbraicum*) and Pink snapper (*Chrysophrys auratus*) with other species captured including Redthroat emperor (*Lethrinus miniatus*), Bight redfish (*Centroberyx gerrardi*) and Baldchin groper (*Choerodon rubescens*). The West Coast

WEST COAST BIOREGION

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 (TDGDLF), target sharks and rays but also retain demersal scalefish. Other commercial fisheries that may take a small amount of demersal species in the WCB under exceptions to the West Coast Demersal Scalefish (Interim) Management Plan 2007. These include the West Coast Rock Lobster Managed Fishery (WCRLF), the Cockburn Sound Line and Pot Managed Fishery (CSLPF) 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 who 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 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 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 TDGDLF 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 management objective for the WCDSIMF is to maintain the catches of all scalefish and 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 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 (TDGDLF, 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 percentage (~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*.

Since August 2013, fishers in the WCRLF have been permitted exceptions to prohibitions in the WCDSIMF Management Plan to retain and transport demersal scalefish caught in rock lobster pots for personal consumption only, i.e. not permitted to be sold or retained for a commercial purpose.

Fishing and Aquatic Tour Industry (Charter)

There are two types of fishing tour licence categories.

Fishing Tour Operators Licence: The focus of a tour is on fishing activities, after which fish can be taken home.

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 statewide 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) will be used in future assessments. Annual Level 1 assessments of catch are also used to monitor these species and the indicator species for the West Coast Demersal Offshore Suite (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 are calculated and stock status determined. The

WEST COAST BIOREGION

third stock assessment of West Australian dhufish, Pink snapper and Baldchin groper was completed in 2013 (see Fisheries Management Paper 262¹ and Fairclough *et al.*, 2014²).

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 (TDGDLF, 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 (Ryan *et al.*, 2013³). A second survey is underway and is due for completion in late 2014. 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 in 2011/12 with previous boat ramp surveys (i.e. creel surveys).

Surveys of the numbers of Pink snapper eggs present in Cockburn Sound during the annual spawning aggregations may in the future be capable of producing estimates of spawning stock biomass for this embayment using a daily egg production model (DEPM). A study using molecular methods is underway to validate the visual identification of snapper eggs (given visually similar eggs of other species are present in this region), before spawning stock biomass can be estimated with this approach.

A State Natural Resource Management (NRM) -funded project, focused on juvenile West Australian dhufish (< 150 mm in length), has identified the habitat types that juvenile dhufish occupy. A final report is due in late 2014.

A State NRM funded project to assess the stock status of indicator species (Bight redfish, pink snapper and Blue morwong) for the demersal suite in the South Coast Bioregion is due for completion at the end of 2015. This includes an assessment of the stock status of Bight redfish in the South-west Management Area of the WCB.

Retained Species

Commercial production

All scalefish

WCDSIMF (2013) 379 tonnes

Demersal suite

WCDSIMF (2013) 357 tonnes

1 Department of Fisheries Western Australia (2013). Key findings of the 2013 West Coast Demersal Scalefish Resource stock assessment. Fisheries Management Paper No. 262. Department of Fisheries, Western Australia. 36 pp.

2 Fairclough, D.V., Molony, B.W., Crisafulli, B.M., Keay, I.S., Hesp, S.A., Marriott, R.J. (2014). Status of demersal finfish stocks on the west coast of Australia. Fisheries Research Report No. 253. Department of Fisheries, Western Australia. 96 pp.

3 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, Perth.

TDGDLF, WCRLF, CSLPF, SWTMF

(2013 or 2012/13) 38 tonnes

Total 395 tonnes

Indicator species

WCDSIMF (2013)

West Australian dhufish 63 tonnes

Pink snapper 185 tonnes

Baldchin groper 11 tonnes

Redthroat emperor 44 tonnes

Bight redfish 14 tonnes

TDGDLF, WCRLF, CSLPF, SWTMF

(2013 or 2012/13)

West Australian dhufish 9 tonnes

Pink snapper 9 tonnes

Baldchin groper < 1 tonne

Redthroat emperor < 1 tonne

Bight redfish < 1 tonne

Total

West Australian dhufish 72 tonnes

Pink snapper 194 tonnes

Baldchin groper 12 tonnes

Redthroat emperor 44 tonnes

Bight redfish 14 tonnes

Landings

Catches are reported from the most recent complete season of statutory return data for each commercial fishery that lands demersal species in the WCB. This includes 2013 for the WCDSIMF, CSLPF and SWTMF and 2012/13 for the TDGDLF and WCRLF. Note that the WCRLF were only permitted to retain pot-caught demersal scalefish after 23 August 2013, when the *West Coast Demersal Scalefish (Interim) Management Plan 2007* was amended to allow the retention of such fish for personal consumption only.

Catches of all scalefish by the WCDSIMF decreased by 10 t from 389 t in 2012 to 379 t in 2013. Catches of inshore demersal species fell from 352 t in 2012 to 347 t in 2013, while offshore demersal species' catches increased marginally, from 9 t in 2012 to 10 t in 2013. The 2013 catch of about 7 t of nearshore/estuarine species and 15 t of pelagic species each fell by about 3 t from their respective 2012 catches.

In 2013, the catch of demersal species by the WCDSIMF in the Kalbarri Area was 156 t, an increase of 23 t from the 133 t landed in 2012. In contrast, the WCDSIMF catch of 159 t of demersal species in the Mid-west Area in 2013 fell by 17 t from 176 t in 2012. Similarly, in the South-west Area, catches of demersal species fell by 11 t, i.e. from 43 t in 2012

to 32 t in 2013.

The WCDSIMF catch in 2013 comprised 73 scalefish species or species groups, fifty four from the inshore and offshore demersal suites and 19 from the pelagic and nearshore/estuarine suites. Four demersal species/species groups comprised 81 % of the total catch of the WCDSIMF, i.e. Pink snapper (185 t), West Australian dhufish (63 t), Redthroat emperor (44 t) and redfish species (*Centroberyx* spp., 16 t). As in previous years, catches of offshore demersal species were low, i.e. Hapuku, 5 t, Eightbar grouper, 3 t; Bass groper, Blue-eye trevalla and Ruby snapper, each ≤ 1 t.

Catches of demersal scalefish by the TDGDLF in the WCB decreased to 37 t in 2012/13 from 45 t in 2011/12. Less than 1 t was landed by the other commercial fisheries combined.

West Australian dhufish: The total catch of West Australian dhufish by the WCDSIMF was essentially the same in 2013 (63 t) as in 2012 (64 t). In the Kalbarri Area, catches of WA dhufish in 2013 were similar to 2012, i.e. about 4 t. In the Mid-west Area, catches increased to 47 t in 2013, from 44 t in 2012, while in the South-west Area, catches fell from 16 t in 2013 to 13 t in 2012 (West Coast Demersal Scalefish Figure 2). Catches of WA dhufish by the TDGDLF remained steady at 9 t in 2012/13, while the SWTMF and CSLPF did not report any landings of this species.

Pink snapper: The total catch of Pink snapper by the WCDSIMF increased from 170 t in 2012 to 185 t in 2013. This was due predominantly to the catch of Pink snapper in the Kalbarri area increasing from 78 t in 2012 to 105 t in 2013. In contrast, catches of Pink snapper in 2013 decreased from those in 2012 in both the Mid-west Area and South-west Area, i.e. from 87 t to 77 t and 4 t to 3 t, respectively (West Coast Demersal Scalefish Figure 3). The 9 t of Pink snapper caught by the TDGDLF in the WCB in 2012/13 fell slightly from the 10 t landed in 2011/12. As in recent years, Pink snapper landings by the other commercial fisheries combined were very low (< 1 t).

Baldchin groper: The WCDSIMF reported landings of 11 t of Baldchin groper in 2013, a decrease of 5 t from the 16 t caught in 2012 (West Coast Demersal Scalefish Figure 4). The vast majority of this catch was taken in the Kalbarri and Mid-west Areas. Almost 6 t of the catch was taken in the Abrolhos Zone A of the WCRLF, a decrease from 10 t in 2012. Less than 1 t of Baldchin groper was caught in the most recent season of fishing (2013 or 2012/13) by the other commercial fisheries combined.

Redthroat emperor: A total of 51 t of emperors (Lethrinidae) was landed by the WCDSIMF in 2013, which was less than the 55 t landed in 2012. The catch of emperors by the WCDSIMF comprises predominantly Redthroat emperor, with 44 t landed in 2013 and 46 t in 2012 (West Coast Demersal Scalefish Figure 5). In 2013, 29 t of the WCDSIMF Redthroat emperor catch was taken in the Kalbarri Area and 15 t in the Mid-west Area, which was similar to the 32 t and 14 t landed in 2012 in those areas, respectively. Catches of Redthroat emperor by other commercial fisheries in 2013 were less than 1 t.

Bight redfish: A total of 16 t of redfishes (Berycidae) was landed by the WCDSIMF in 2013, which was less than the 24 t landed in 2012. The catch of redfishes by the WCDSIMF comprises predominantly Bight redfish, which is taken

almost exclusively in the South-west Area. 14 t of Bight redfish were landed by the WCDSIMF in 2013, which is less than the 21 t landed in 2012 (West Coast Demersal Scalefish Figure 5). Catches of Bight redfish by other commercial fisheries in 2013 were less than 1 t.

Charter fishing (2012/13)

Top 15 demersal scalefish species/species groups	42 tonnes
Indicator species	
West Australian Dhufish	13 tonnes
Pink snapper	10 tonnes
Baldchin Groper	9 tonnes
Redthroat emperor	< 1 tonne
Bight redfish	1 tonne

A total of 42 t of the top 15 demersal species/species groups were landed by charter fishers in 2012/13, which is similar to the 41 t landed in 2011/12 (see West Coast Demersal Scalefish Figure 6). The catches of each of the indicator species in 2012/13 were also similar to 2011/12, i.e. West Australian dhufish: 13 t in both years, Pink snapper: 9 t in 2012/13 vs 10 t in 2011/12, Baldchin groper: 10 t vs 9 t, Redthroat emperor: < 1 t in both years, Bight redfish: ca 1 t in both years. As in 2011/12, charter catches in 2012/13 in the WCB comprised ≤ 1 t of offshore demersal species, such as Eightbar grouper.

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

Top 15 demersal scalefish species	159 tonnes
Indicator species	
West Australian Dhufish	74 tonnes
Pink snapper	33 tonnes
Baldchin Groper	29 tonnes
Redthroat emperor	1 tonne
Bight redfish	1 tonne

The catch by boat-based recreational fishers in the WCB of the top 15 demersal species/species groups was estimated to be about 159 t in 2011/12 (West Coast Demersal Scalefish Figure 6). Estimated catches of the indicator species in 2011/12 included 74 t of West Australian dhufish, 33 t of Pink snapper, 29 t of Baldchin groper and 1 t each of Redthroat emperor and Bight redfish. These results were determined via an integrated phone-diary survey and are not directly comparable with previous estimates of catch derived using different survey methods. Less than 1 t of offshore demersal species was estimated to have been landed in 2011/12.

Fishing effort/access level

Commercial

In 2013, 44 licensed fishing boats fished in the WCDSIMF. Twelve vessels fished in the Kalbarri Area, 36 in the Mid-west, 8 in the South-west and 13 nominated to fish in the

WEST COAST BIOREGION

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 on which fishing occurred by all vessels in the WCDSIMF in 2013 (1,381) declined from that reported in the previous two years (about 1,570 days), in conjunction with a decrease in the amount of fishing entitlement (hours) consumed from 67 % to 61 %. This was reflected in the decrease in the total number of hours fished (hours searching + hours fishing) from 18,800 h in 2012 to 16,000 h in 2013. Entitlement consumed in the Kalbarri Area increased from 77 % in 2012 to 80 % in 2013, while in the Mid-west Area it decreased from 64 % in 2012 to 61 % in 2013. Similarly, in the South-west Area, entitlement consumed fell from 51 % in 2012 to 38 % in 2013 and in the Offshore Area it decreased from 86 % to 49 %.

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*.

Recreational

Fishing effort by boat-based recreational fishers during 2011/12 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 three charter licenses were reported to have undertaken fishing operations in 2012/13, which is one less than in 2011/12. In contrast, the number of fisher days increased from about 21,500 in 2011/12 to 23,500 in 2012/13.

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 three inshore demersal indicator species (West Australian dhufish, Pink snapper and Baldchin groper) in the WCB and its different management areas was conducted in 2013. This was an assessment of fishing mortality rates (F) 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. Assessments of Redthroat emperor and Bight redfish will form part of the next full assessment of demersal indicator species in the WCB. Methods for estimating F included some that have previously been independently reviewed and additional new methods, which have fewer assumptions, but have also been peer-reviewed (O'Neill, 2009; Fisher, 2012; Fairclough *et al.*,

2014)¹. The F estimates were compared with internationally accepted biological reference points to determine the change in status of stocks over time. Estimates of spawning potential ratios (SPR) were also determined.

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 the time of the current assessment, stocks had not yet recovered to an appropriate level, i.e. the threshold, where F is equivalent to the rate of natural mortality. The recovery trend was consistent among management areas for both species. However, the level of F for Pink snapper stocks in the northern management areas (Kalbarri and Mid-west) is higher than in the southern management areas (Metropolitan and South-west), indicating better status of stocks in the southern half of the WCB.

The F estimate for Baldchin groper was beyond the limit reference point and thus at unacceptable levels. The F and SPR levels have not changed significantly 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 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.

Offshore Demersal: A Level 1 assessment using catch is 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. In addition, some aggregate to spawn and most suffer barotrauma when caught due to the depths in which they are fished (> 250 m). Spawning by Eightbar grouper does not occur in the WCB and stocks are reliant on recruits dispersing to the WCB from spawning in the northern bioregions (Wakefield *et al.*, 2013²). However, given the current low level of catches, risks to the biological sustainability of the stocks of each 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.*, 2010³). The inshore suite still has high risks associated with meeting social and

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.

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/>

2 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

3 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

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 selective¹ for demersal fishes. Other demersal species that are caught but not normally retained during demersal fishing 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 deep², and this is likely to be similar for many species caught but not retained in this fishery.

Listed species interaction Negligible

As line fishing is highly selective for demersal fishes, interactions with listed species by commercial, charter and recreational fishers in the WCDSF are minimal. Commercial WCDSIMF and charter fishers are required to record listed species interactions in their statutory returns. During 2013, one white shark and two grey nurse sharks were caught by the WCDSIMF and all released alive. In 2012/13, charter fishers caught one grey nurse shark and two Estuary cod (greater than the maximum legal size limits of 1 m or 30 kg). Each was released alive.

Ecosystem Effects

Food chain effects Low

An FRDC study³ 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.

¹ Bycatch interactions of the gillnet and longline sector are presented in the relevant report.

² see Fisheries Research Report No. 191
http://www.fish.wa.gov.au/Documents/research_reports/frr191.pdf

³ 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.

Social Effects

Commercial

The total number of crew members (excluding the skipper) employed per trip on permitted vessels that fished in the WCDSIMF in 2013 ranged from zero to six, with the majority employing two or three. Over 100 people are therefore directly employed by this fishery.

Fishing and Aquatic Tour Industry (Charter)

In 2012/13, 99 charter operators were licensed to operate in the WCB via a Fishing Tour Operators Licence, compared with 100 in 2011/12. Sixteen held a Restricted Fishing Tour Operators Licence in 2012/13 vs 17 in 2011/12. The number of people employed in the charter industry has not been estimated.

Recreational Fishing

Approximately 134,000 Recreational Fishing from Boat Licenses were current in Western Australia as at 30th June 2013.

Economic Effects

Estimated annual value (to fishers) for 2013:

Level 2 - \$1-5 million

The estimated economic value of the WCDSIMF in 2013 was in the range of \$1-5 million, as in 2012.

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 410 tonnes

All fisheries combined (WCDSIMF, TDGDLF,

WCRLF, CSLPF, SWTMF) 450 tonnes

The primary management objectives for the WCDSIMF are to reduce the total catch of all scalefish, of the demersal suites and of each of the indicator species, i.e. West Australian dhufish, Pink snapper and Baldchin groper, by at least 50 % (the 'benchmark') of those caught by wetline fishers in the WCB during 2005/06. This is also proposed for the two newly-adopted indicator species, Redthroat emperor and Bight redfish. In addition, catches of the demersal suites in the WCB by all fisheries, i.e. WCDSIMF, TDGDLF, WCRLF, CSLPF and the SWTMF, should remain at or below 50 % of those in 2005/06.

In 2013, catches of all scalefish (379 t) and of the suite of demersal species (357 t) by the WCDSIMF remained below 50 % of those of 2005/06, i.e. 449-469 t and 410 t, respectively. The total catch of demersal species in a full year of fishing (either 2012/13 or 2013) by the WCDSIMF, TDGDLF, WCRLF, CSLPF and the SWTMF was 395 t,

which is below the 450 t benchmark.

Although the WCDSIMF catch of 63 t of West Australian dhufish in the WCB in 2013 was below the 72 t benchmark, the catch of 47 t in the Mid-west Area was slightly above the benchmark of 44 t. As in previous years, the WCDSIMF catch of Baldchin Groper (11 t) in 2013 remained below the benchmark of 17 t. Catches of both Redthroat emperor and Bight redfish have remained at around or below their respective 50 % of 2005/06 catches, i.e. proposed as 95 t and 37 t, since the commencement of the WCDSIMF in 2008. However, the catch of 185 t of Pink snapper in 2013 was above the 120 t benchmark for the whole fishery and has been consistently greater than the benchmark since 2010. This catch was comprised of 77 t in the Mid-west Area and 105 t in the Kalbarri Area, each of these being above the benchmark for each area of 43 t and 65 t, respectively.

In 2013, as in previous years, WCDSIMF entitlements were not fully utilised. This latent effort leaves potential for further increases in effort and therefore catches in subsequent years if catch rates remain similar or increase. As stocks begin to recover, catches of Pink snapper and the other indicator species will need to be monitored closely to determine whether this trend continues. The effect of any changes to management to reduce catch will also need to be monitored closely to ensure they have that effect and allow continuation of stock recovery.

Charter/recreational Current Fishing level

Demersal suite

Acceptable

Catch (or effort) limit range:

250 tonnes (from adjusted IFAAC values)

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 250 t (50 % of 2005/06 catches, as adjusted by the Integrated Fisheries Allocation Advisory Committee, IFAAC, 2013¹).

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 for 2005/06 (plus those from charter fishers) are now being used for comparison.

The estimated catch of the top 15 species/species groups by both 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 the 2005/06 catch of 126 t, as were catches of Redthroat emperor and Bight redfish. 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.

¹ Integrated Fisheries Allocation and Advisory Committee (2013). West Coast Demersal Scalefish Allocation Report. Fisheries Management Paper No. 249. Department of Fisheries, Western Australia. 60 pp.

New management initiatives (2014/15)

Commercial

A new management plan to transition the WCDSIMF to a managed fishery is planned to be progressed following impending changes to the WCDSIMF management arrangements in response to outcomes of the 2013 stock assessment of key indicator species in the WCB and current catches of snapper in relation to their current management targets.

Formal catch management guidelines are being developed to establish clear and specifically articulated performance levels and associated management actions designed to achieve agreed objectives for the ecological/aquatic resources and relevant fishery sectors. The catch management guidelines determine how the various target catch adjustments by the different sectors that take demersal species will be most efficiently achieved.

The WCDSIMF is currently undergoing Marine Stewardship Council pre-assessment. Outcomes are expected in late 2014.

The *West Coast Demersal Scalefish (Interim) Management Plan 2007* was amended on 23 August 2013 to allow the retention and transport of demersal scalefish caught in commercial rock lobster pots for personal consumption only.

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 boat based fishers 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 was undertaken during 2013, following the results of the Statewide Recreational Boat Fishing Survey and the outcomes of the stock assessment of indicator species. It was considered that the current management arrangements should be maintained to ensure recovery is achieved. On 1 February 2013 a simplified set of statewide recreational fishing rules were implemented. The major changes being a reduction from 13 to four 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 2010². The Minister for Fisheries has 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

² See Fisheries Management Papers 237 and 247 <http://www.fish.wa.gov.au/About-Us/Publications/Pages/Fisheries-Management-Papers.aspx>.

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 in the fishery are characterised by strong and weak recruitment years, which may influence catch rates. This is likely to be similar for other long-lived demersal species in the WCB.

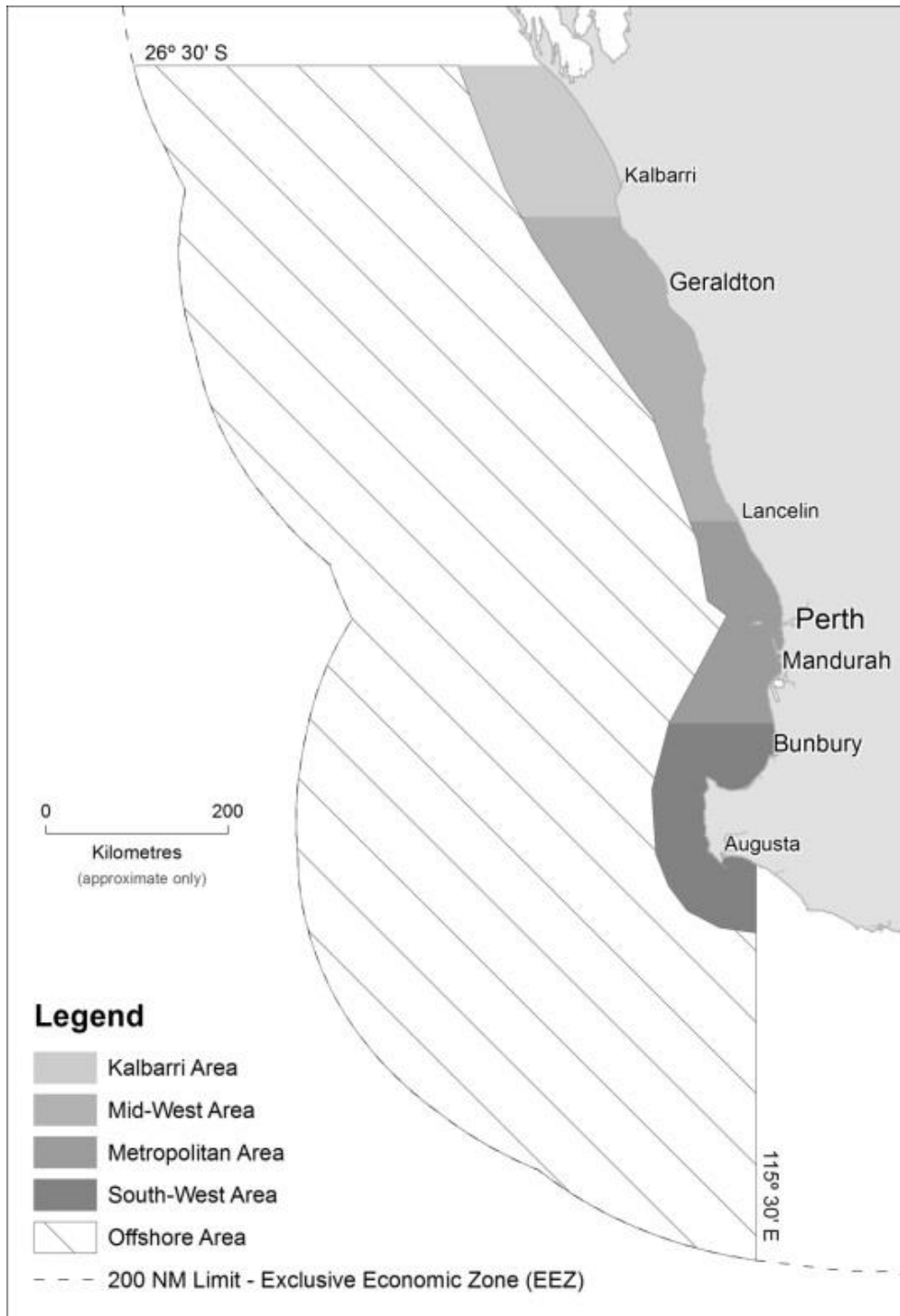
Cockburn Sound is the only known spawning aggregation location for Pink snapper in the WCB. Juveniles also use the area as a nursery for approximately one and a half years following settlement, before leaving Cockburn Sound. Ongoing industrial development in the area may have detrimental effects on the 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 are very small in the WCB. A current WA NRM funded 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 proposed 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. A compensation package will be offered to fishers for losses associated with closure to fishing in different areas. A public consultation period requesting comment on the guidelines for the operation of the package closed on July 1 2013. However, although the management plans for the Commonwealth's South-West Marine Bioregional Plan were intended to come into effect on 1 July 2014 they are currently under review.

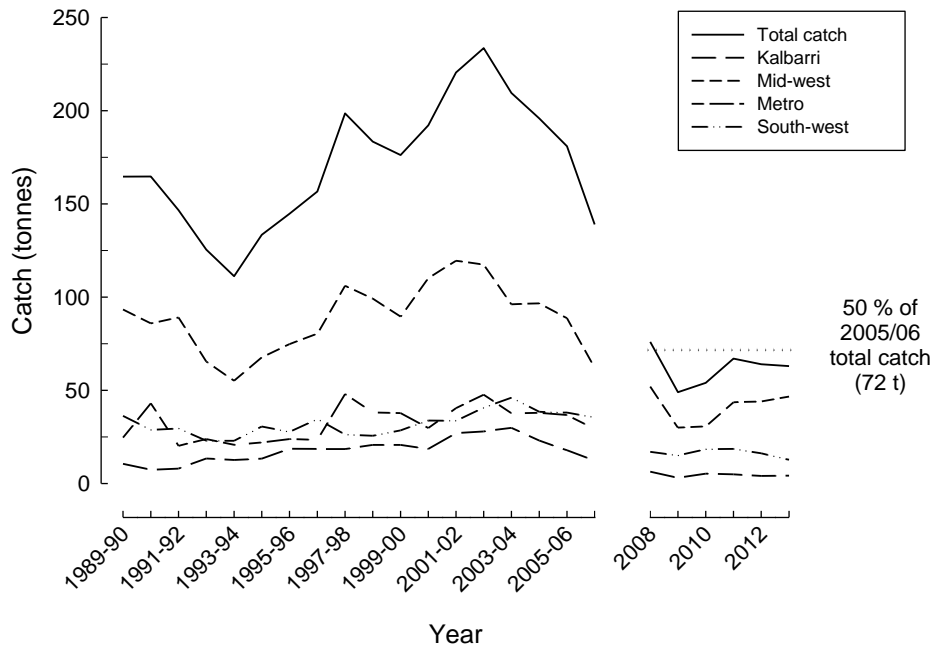
Climate change may lead to a range of impacts (e.g. increased water temperatures, acidification) which could influence aspects of the biology of demersal species, such as spawning success, settlement patterns and thus recruitment patterns. Extreme events, such as the marine heatwave in 2011¹, may have severe negative effects, including increased mortalities.

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



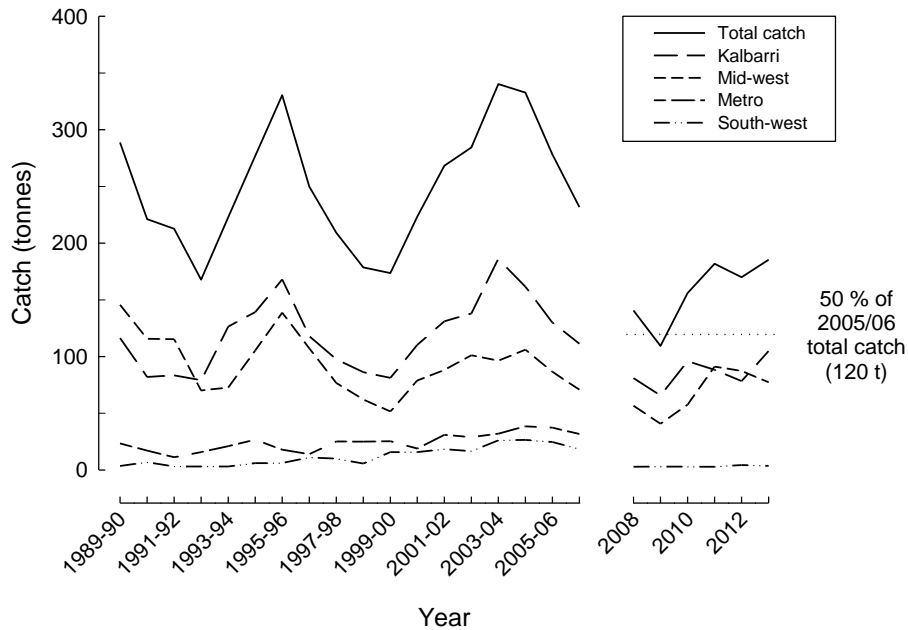
WEST COAST DEMERSAL SCALEFISH FIGURE 1

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 and from 26°30' S to 115°30' E. Note the Metropolitan Area is currently closed to fishing by the WCDSIMF.



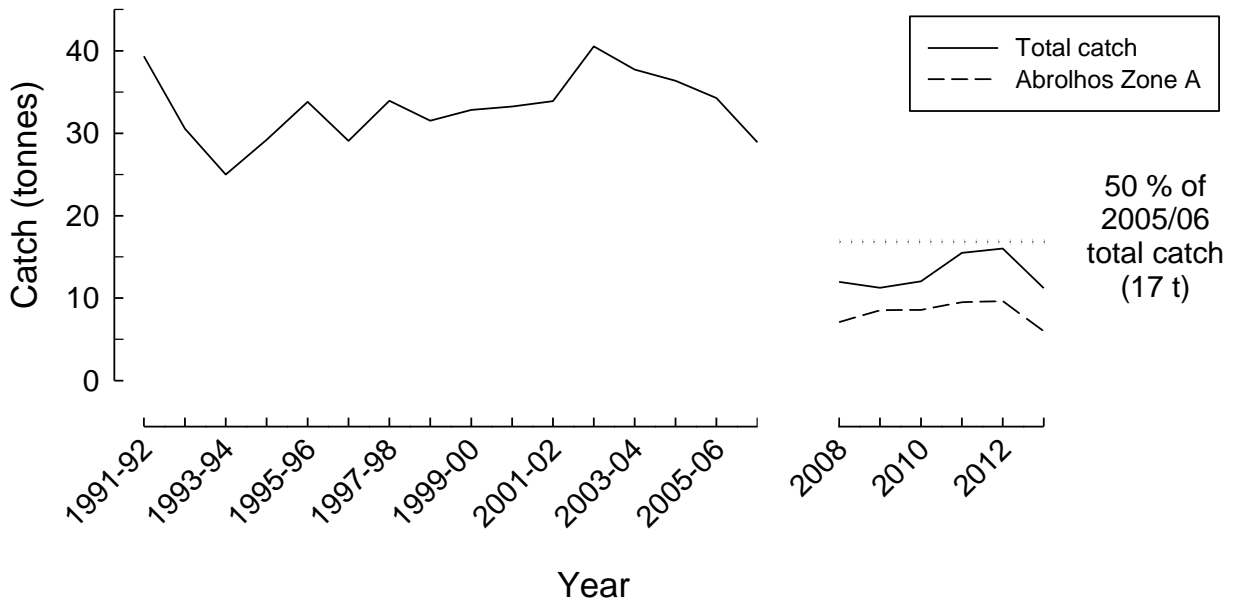
WEST COAST DEMERSAL SCALEFISH FIGURE 2

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 2013.



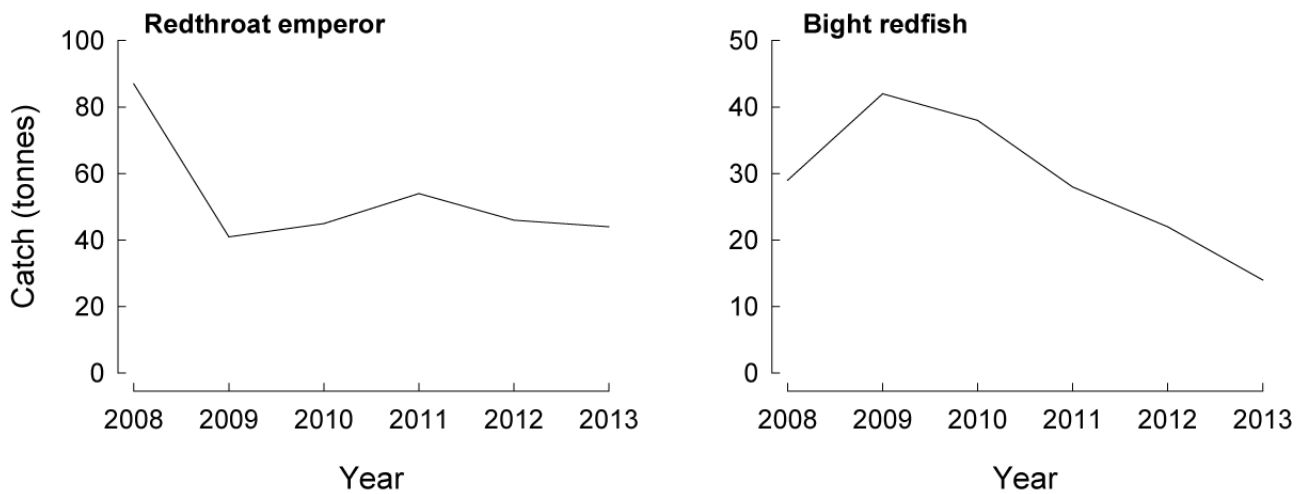
WEST COAST DEMERSAL SCALEFISH FIGURE 3

Total catch and catch by area of Pink snapper *Chrysophrys 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 2013.



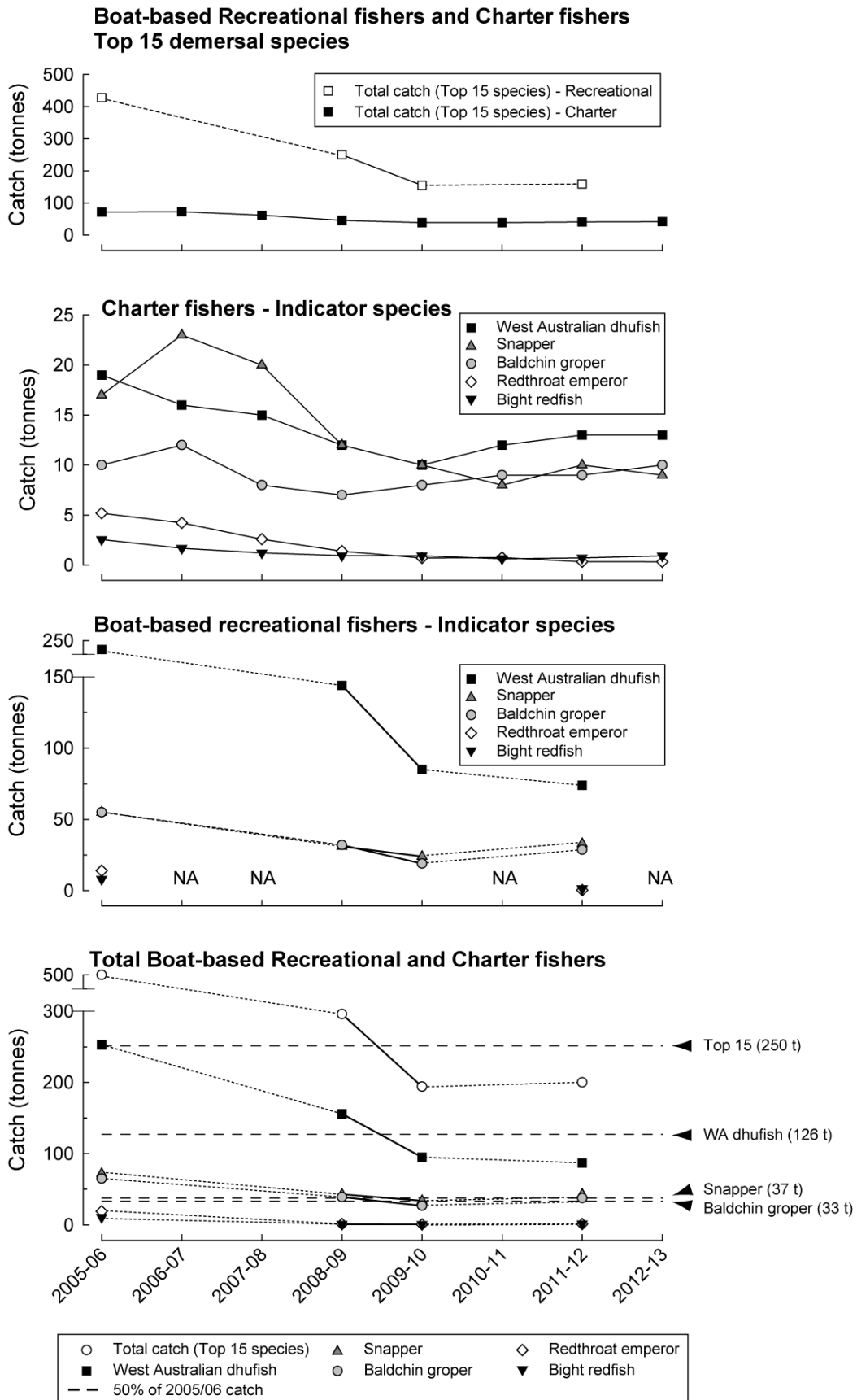
WEST COAST DEMERSAL SCALEFISH FIGURE 4

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 2013.



WEST COAST DEMERSAL SCALEFISH FIGURE 5

Total catches of Redthroat emperor *Lethrinus miniatus* and Bight redfish *Centroberyx gerrardi* in the West Coast Bioregion by the West Coast Demersal Scalefish (Interim) Managed Fishery between 2008 and 2013. Note: catches of each species in the WCB prior to the WCDSIMF commencing in 2008 are not shown, as emperors and redfish species were reported using a range of common names and name groups and thus cannot be accurately estimated.



WEST COAST DEMERSAL SCALEFISH FIGURE 6

Catch of the top fifteen demersal species and of the indicator species (West Australian dhufish, Snapper, Baldchin groper, Redthroat emperor and Bight redfish) by boat-based recreational and charter fishers in the West Coast Bioregion between 2005/06 and 2012/13. N/A, catch estimates not available. Estimates not available for boat-based recreational catch of Redthroat emperor and Bight redfish in 2008/09 and 2009/10.

Octopus Fishery Status Report

A. Hart, D. Murphy, L. Joll, S. Walters, L. Pickles

Main Features

Status		Current Landings	
Stock level	Adequate	Commercial – Statewide	226 t
Fishing level	Acceptable	Recreational – Statewide (2011/12 estimate)	1.4 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 (CSLPPF), 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) Limited Entry Fishery Notice 1995

Cockburn Sound (Line and Pot) Managed Fishery Licence

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

West Coast Rock Lobster Managed Fishery Management Plan 2012

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 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

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 CSLPPF 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 the South Australian border. 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 CSLPPF 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. It is expected that pot allocations for the DOF will be finalised in 2014.

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 recently completed a research project with funding from the Fisheries Research and Development Corporation (FRDC). The project was titled "FRDC 2010/200: Innovative development of the *Octopus tetricus* fishery in Western Australia". Results from this project are being used to advise industry and government on sustainable harvest levels and pot allocations appropriate for an expansion of the octopus fishery into the future. Methods of assessing the Octopus fishery were also developed as part of this project and will be employed in future stock assessments. These methods include age estimation techniques, fishery independent surveys, and age-based per recruit methods that account for semelparity.

Retained Species

Commercial landings (season 2013):

226 tonnes (live weight)

Recreational catch estimate (season 2011/12):

1.4 tonnes (live weight)

Landings

Commercial: In 2013 the total commercial octopus catch was 226 t live weight, a 10% increase over last year's catch of 206 t (Octopus Figure 1).

On a sector-specific level, octopus catch from the WCRLF declined between 2011 and 2013, from 38 to 23 tonnes. Catch from the CSLP has the most dramatic increase; up by 100% (41 t in 2013) from 2012 (20 t). Catch from the DOF has increased by 380% between 2009 (33 t) and 2013 (160 t; Octopus Figure 1).

The DOF has steadily risen from 4% of the total catch in 2001 to an average of 70% between 2010 and 2013 (Octopus Table 1). At the same time, share of catch from the lobster fishery has declined from 86% to 10%, primarily as a result of effort reductions, which have occurred in that fishery.

Recreational: Annual estimates of recreational catch by boat-based fishers at both the statewide 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. It must be noted that this estimate represents a decrease from the 2012 estimate of 17 t. The 17 t figure was derived from the national recreational and indigenous fishing

survey¹ wide estimate conducted 15 years ago (2001), and this estimate is considered no longer valid for WA.

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. Days fished is a reasonable indicator of effort in the DOF and CSLP fisheries, but not in the WCRLF because octopus is bycatch in that fishery. Days fished in the CSLP and DOF were 398 and 988 respectively, an increase of 73% and 7% respectively, from 2012 (Octopus Table 1).

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 3.7 kg/day, which was a 19% reduction from 2012 (Octopus Figure 2). The large increases in octopus CPUE from 2009 to 2011 in the WCRLF 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 the increases in CPUE are 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, and 2011 to 2013. There is a clear anomaly in SCPUE for trigger pots in 2010, with a significantly high level. This is hypothesized to have been 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 stock assessment will include a more in-depth assessment using techniques currently under development.

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.

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.

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.

Listed species interaction: **Low**

In 2013 there were three reported whale entanglements (Humpback whale: *Megaptera novaeangliae*) in octopus fishing gear. This was the same amount as reported in 2012. 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 2013, ~ 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, 6 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 2013:

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

The estimated annual value for 2013 was \$2.1 million based on the total catch of 226 t and an average product price of \$9.31 /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 226 tonnes is within the target range. The fishery governance ranges will be reviewed in 2014 using outcomes of FRDC project 2010/200 “Innovative development of the *Octopus* (cf *tetricus*) fishery in Western Australia”.

New management initiatives (2014/15)

The Department is currently in the process of developing an interim management plan for the DOF, following the recommendations of the Independent Panel on access and allocation. It is anticipated that that allocation process will be finalised in late 2014 and the interim plan in place in 2014/15.

The CSLP limited entry fishery notice is currently under review following the Minister for Fisheries’ decision on octopus pot entitlement allocation in the CSLPF. The Department of Fisheries is aiming to implement management plan amendments to introduce an octopus pot entitlement scheme during 2014 in preparation for the start of the 2015 season.

Also in 2013, the Department approved exemptions to commence trials on two new traps; a recreational trigger trap, and commercial trap prototype known as a “Sliding Door Trap” or SDT. In 2015 the Department intends to conduct a review of the new traps 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

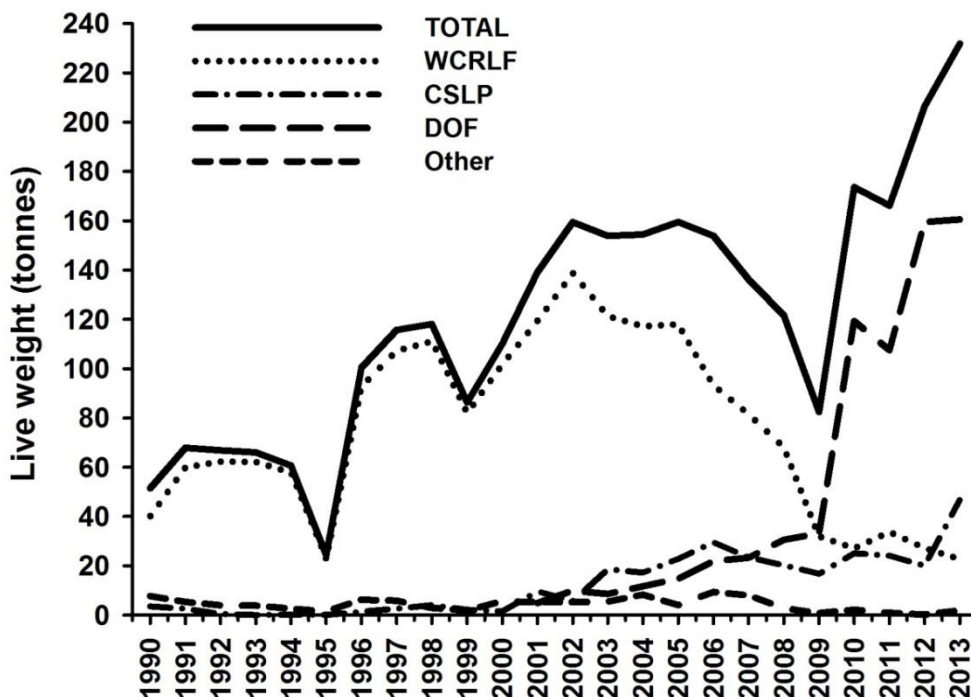
Cephalopods in general, including octopus, are known to be subject to large environmentally-driven fluctuations in abundance. If the fishery expands to reach a catch level approaching maximum sustainable yield, this year-to-year variability in abundance may prove a significant issue for the fishery. In particular, a “marine heatwave” experienced on the West Coast in the summer of 2010/11, where water temperatures reached 3 degrees Celsius 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.

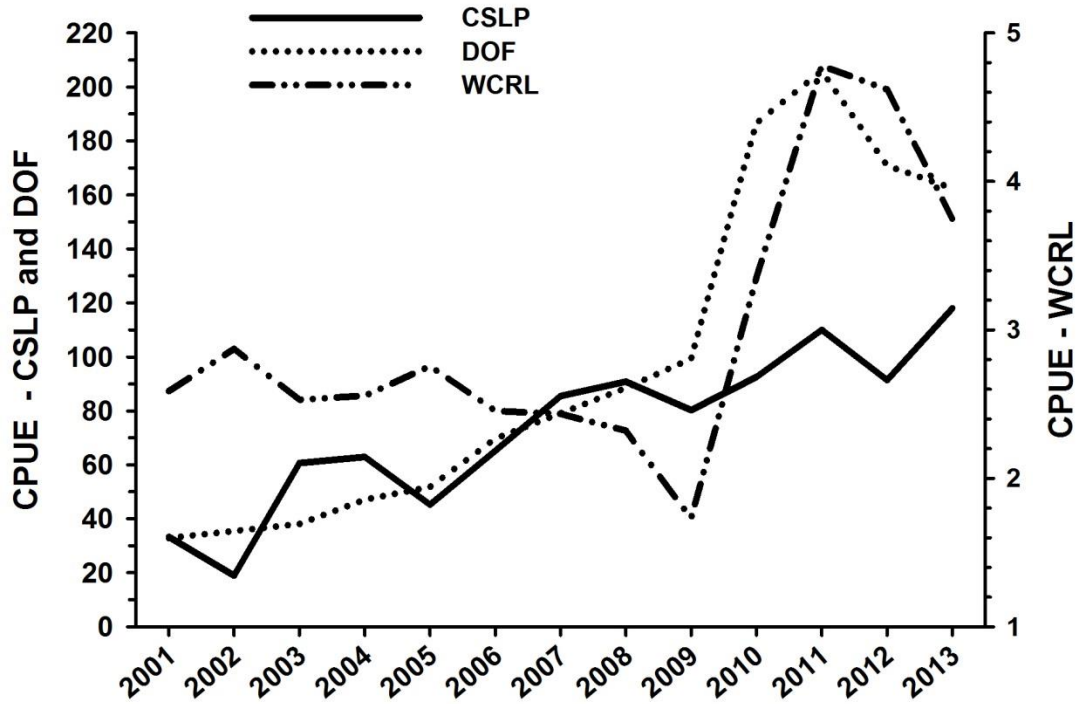
OCTOPUS TABLE 1

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	WCRLF	Percentage of total catch			Effort (total days fished)	
		CSLPF	DOF	Other	CSLPF	DOF
2001	86	6.9	3.5	3.8	287	149
2002	87	3.6	6.2	3.2	300	278
2003	79	12.1	5.6	3.6	306	225
2004	76	11.1	7.6	5.3	273	249
2005	74	14.3	9.2	2.5	505	284
2006	62	19.7	11.6	6.3	451	250
2007	63	18.1	12.9	6.1	274	211
2008	61	18.0	19.0	2.4	222	241
2009	39	20.3	40.0	1.0	256	248
2010	16	14.4	68.7	1.2	271	639
2011	20	14.5	64.7	0.5	218	522
2012	13	11	76	0.1	230	927
2013	10	18	71	1.0	398	988

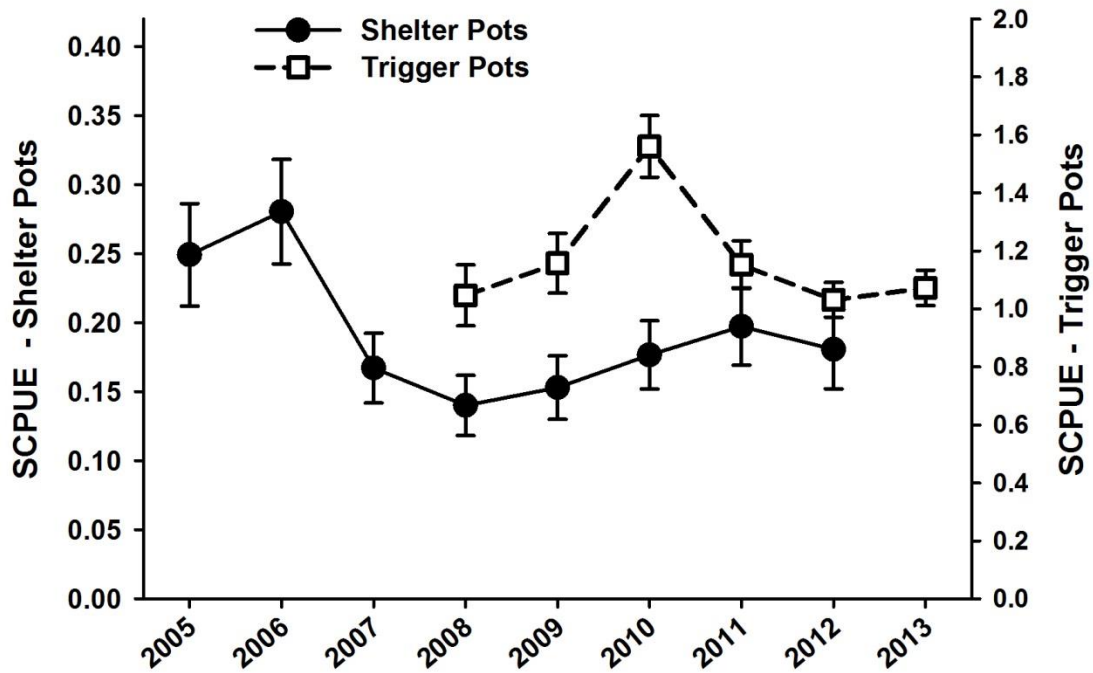
**OCTOPUS FIGURE 1**

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 then Department of Environment and Conservation. 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). The Department has provided 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 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.

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.

A second-stage project, which has recently received funding through the Royalties for Regions Regional Grants Scheme package, will trial the grow-out of up to 30,000 yellowtail kingfish. A collaboration between the Marine Fishfarmers Association and Indian Ocean Fresh Australia Pty Ltd, and being undertaken on behalf of the Mid West Development Commission, the trial will be located at a licensed aquaculture site in Champion Bay.

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 progressing well and the initial sampling work in the identified study areas started on schedule in May 2014.

The Department’s review of aquaculture licence conditions is continuing. The outcome of the review will deliver higher levels of consistency, transparency and certainty in licensing and compliance arrangements across all aquaculture industry sectors.

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

COMPLIANCE AND COMMUNITY EDUCATION

Compliance and community education in commercial and recreational fisheries in the West Coast Bioregion is undertaken by Fisheries and Marine Officers (FMOs) based at the Busselton, Bunbury, Mandurah, Rockingham, Fremantle, Hillarys, Lancelin, Jurien, Dongara and Geraldton offices, statewide mobile patrol units and officers aboard the large ocean-going patrol vessels P.V’s Houtman and Walcott. The Department’s community 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 volunteers based in some regional centres within the Bioregion.

Services provided by land-based officers include processing inspections, landing and gear inspections, licensing checks, wholesale/retail checks and 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.

WEST COAST BIOREGION

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), Shoalwater and Marmion Marine Parks (Metropolitan), and Jurien Bay Marine Park (Midwest). These functions are primarily related to the integrity of management arrangements for the different zoning within the Parks.

Activities during 2012/13

During 2012/13, Fisheries and Marine Officers delivered a total of 24,428 hours of compliance and community education services in the field (West Coast Bioregion Compliance Table 1). This represents a 2.5% decrease 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 on this fishery. In addition to the rock lobster fishery, FMOs 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 third quota year for the rock lobster fishery was the introduction of FishEye, electronic 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.

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.

Overall, compliance in the West Coast Bioregion by commercial fishers was good, however there were increases in the number of prosecutions from 60 to 70, infringements from 18 to 41 and infringement warnings from 47 to 90 compared to 2011-12.

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, marron, blue manna crabs and minor finfish species. Demersal scalefish closures and fishing within the bioregion is supported by statewide recreational mobile patrol units.

Field contacts with the recreational fishing community decreased from 88,162 to 82,531. Overall compliance was good with decreases in prosecutions from 295 to 227, infringements from 1,004 to 841 and infringement warnings from 1,476 to 1,227.

The Department continues to work collaboratively with the Department of Parks and Wildlife (DPaW) 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 predominately within the Marmion Marine Park), and in the Jurien Marine Park, where DPaW 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 Parks and Wildlife in the disentanglement of whales in the West Coast Bioregion. 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, FMOs provided support to incident responses and other program activities.

Initiatives in 2013/14

The fourth year of the Quota Management System commencing on 15 January 2014 in the West Coast Rock Lobster fishery will see the introduction of gear restrictions to mitigate against whale entanglements. The Department will undertake a significant field education and compliance program to support this initiative.

The increased focus on recreational fishing compliance will continue, particularly with the ongoing operation of the recreational mobile patrols operating within the bioregion. 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. One significant change in the bioregion will be the extension of the West Coast Rock Lobster season for recreational fishers. Another is the deployment of artificial reefs off Bunbury and Dunsborough in the South West around April 2013. 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 Parks and Wildlife 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 2012/13 financial year.

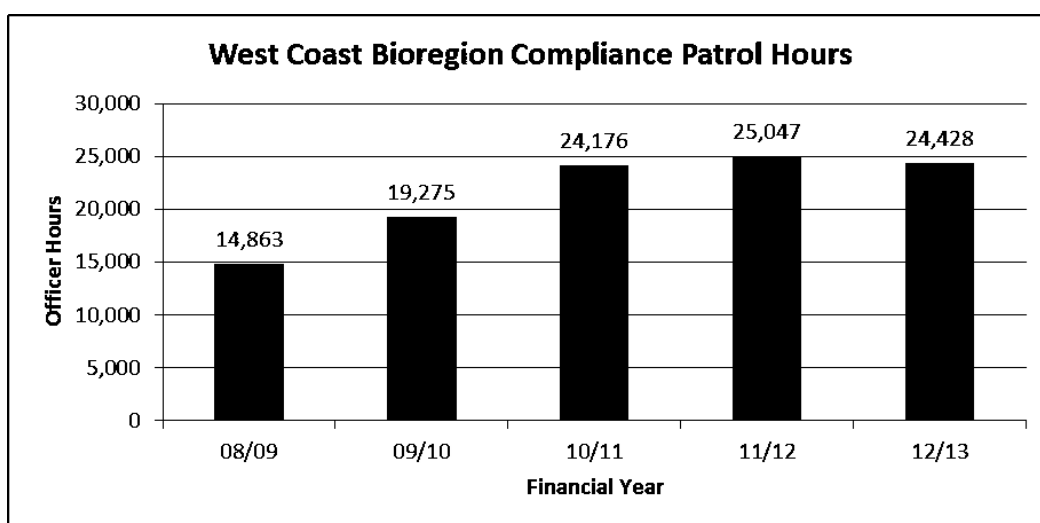
PATROL HOURS DELIVERED TO THE BIOREGION	24,428 Officer Hours
CONTACT WITH THE COMMERCIAL FISHING COMMUNITY ¹	
Field Contacts by Fisheries & Marine Officers	1,970
Letters of warning	91
Infringement warnings	90
Infringement notices	41
Prosecutions	70
Fishwatch reports ²	33
VMS (Vessel Days) ³	18,048
CONTACT WITH THE RECREATIONAL FISHING COMMUNITY	
Field Contacts by Fisheries & Marine Officers	82,531
Infringement warnings	1,227
Infringement notices	841
Prosecutions	227
Fishwatch reports	680
OTHER FISHING-RELATED CONTACTS WITH THE COMMUNITY	
Field Contacts by Fisheries & Marine Officers	6,232
Fishwatch reports	24

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 and PV Walcott while they were operating in the Bioregion.

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 COMPLIANCE FIGURE 1**

"On Patrol" Officer Hours showing the level of compliance patrol activity delivered to the West Coast Bioregion over the previous 5 years. The 12/13 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. and any services delivered by the Department's large Patrol Vessels: *PV Walcott*, *PV Houtman* and *PV Hamelin*).