

GASCOYNE COAST BIOREGION

ABOUT THE BIOREGION

The marine environment of the Gascoyne Coast Bioregion (Gascoyne Overview Figure 1) represents a transition between the fully tropical waters of the North West Shelf of the North Coast Bioregion and the temperate waters of the West Coast Bioregion. Offshore ocean temperatures range from about 22°C to 28°C, while the inner areas of Shark Bay regularly fall to 15°C in winter. The major fish stocks are generally tropical in nature, with the exceptions of the temperate species, pink snapper, whiting and tailor, which are at the northern end of their range in Shark Bay.

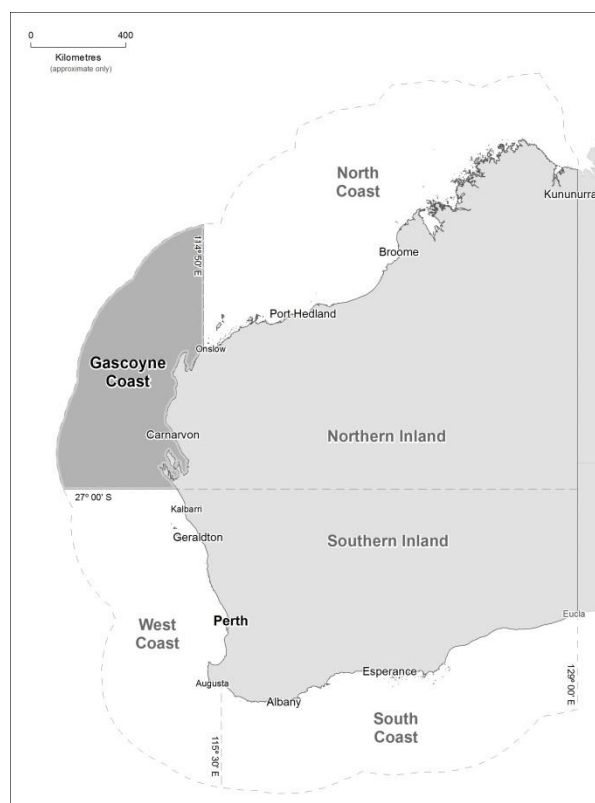
The coastline is characterised by high cliffs in the southern half changing to fringing coral reefs in the north. Coastal waters are generally high-energy in terms of wave action due to the strong trade wind system. The Exmouth Gulf section of the Gascoyne Coast Bioregion is seasonally influenced by extreme tropical summer cyclones, while the Shark Bay end of the Bioregion receives infrequent cyclones, but is affected at times by river outflows from inland cyclone-based summer rainfall. The limited local rainfall comes mostly from the northern edge of winter storm fronts.

The waters off the Gascoyne Coast are also strongly influenced by the unusual southward-flowing Leeuwin Current, generated by flow from the Pacific through the Indonesian archipelago. This tropical current becomes evident in the North West Cape area and flows along the edge of the narrow continental shelf where, coupled with low rainfall and run-off plus the north flowing Ningaloo current, it supports the highly diverse Ningaloo Reef marine ecosystem.

The outer area of the large marine embayment of the World Heritage-listed Shark Bay is also influenced by the warm winter current. The inner waters of the embayment are hypersaline, owing to the high evaporation and low rainfall of the adjacent terrestrial desert areas. The sea floor of both Shark Bay and the continental shelf is typically sandy compared to Exmouth Gulf, which has more mud areas and greater turbidity.

The Gascoyne Coast Bioregion has been identified as one of 18 world ‘hotspots’ in terms of tropical reef endemism and the second most diverse marine environment in the world in terms of tropical reef species.

The Ningaloo reef in the north of the Bioregion is the largest continuous reef in WA and is one of the most significant fringing reefs in Australia. The Bioregion also has some areas of mangroves, mostly in Exmouth Gulf, while seagrass beds are located in a number of areas.



GASCOYNE OVERVIEW FIGURE 1

Map showing the Gascoyne Coast Bioregion.

SUMMARY OF ACTIVITIES POTENTIALLY IMPACTING THE BIOREGION

Climate Change

Some of the key environmental trends that may be affecting ecosystems in WA include:

- Increasing frequency of El Niño/Southern Oscillation (ENSO) events;
- More years with a weaker Leeuwin Current;
- Increase in water temperature off the lower west coast of WA;
- Increase in salinity, which includes some large annual fluctuations;
- Change in the frequency and location of storms (and rainfall) affecting the lower west coast; and
- Change in the frequency of cyclones (and summer rainfall) affecting the north-west coast.

The Gascoyne Coast Bioregion is predicted to be at enhanced risk from the effects of climate given that it spans a transitional zone between tropical and temperate regions. The variables expected to drive climate change impacts include changes in water temperature, ocean currents, winds, rainfall, sea level, ocean chemistry and extreme weather conditions.

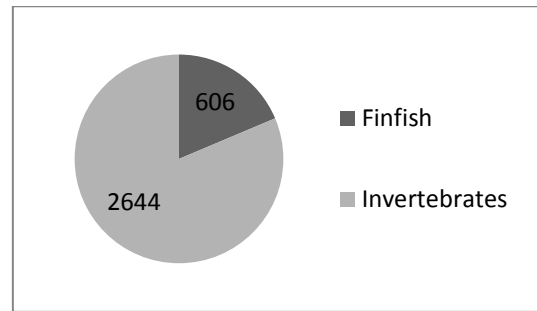
It is apparent that climate change will impact the biological, economic, and social aspects of many fisheries, and both positive and negative impacts are expected. Climate change can influence biological systems by modifying the timing of spawning, range and distribution, composition and interactions within communities, exotic species invasions and impacts, and the structure and dynamics of communities, including changes in productivity. Species distribution shifts are the most commonly reported changes and are often the easiest to recognise and measure, and are being monitored in a national citizen-science program (www.redmap.org.au) that the Department is collaborating in.

Commercial fishing

Commercial fishing is a significant industry in the region, with three of the State’s more valuable fisheries – the Shark Bay Prawn, Exmouth Gulf Prawn and Shark Bay Scallop fisheries – landing combined catches valued in the range of \$40 – \$50 million annually. These trawl based fisheries have operated sustainably in the region since the mid-1960s and are internationally recognised as ‘best practice’ in terms of both management and research. Only a relatively small number of the approximately 1,400 species of fish inhabiting this bioregion are targeted by commercial fishing activity.

The Gascoyne Demersal Scalefish Fishery (GDSF) and Shark Bay Beach Seine and Mesh Net Fishery have operated in the bioregion since the 1960s, and provide a significant proportion of the snapper and whiting catch for the State. The GDSF originally only targeted pink snapper but has developed over the past decade into a broader fishing sector taking other demersal finfish species including emperors, cods and deeper water species such as goldband snapper. The Gascoyne includes part of the Mackerel Managed Fishery (which extends the NT border and is reported on in the North Coast Bioregion chapter) with this area having lower annual catches compared to more northern areas. The region also includes some other small commercial fishing activities for finfish including the marine aquarium fishery which collects small numbers of a wide variety of species but is not permitted within the Ningaloo Marine Park or any waters closed to fishing. There is also a small beach seining fishery within Exmouth Gulf.

The main invertebrate species captured by fisheries in the Gascoyne Bioregion include a number of penaeid prawns, scallops, blue swimmer crabs within the two main embayments of Shark Bay and Exmouth Gulf plus deep sea crabs in the offshore region. The fishery for blue swimmer crabs which operates throughout the waters of Shark Bay had grown in the last decade to be the largest Australian crab fishery until recently affected by environmental issues. Other minor commercial fishing activities for invertebrates operating in the bioregion include collecting silver lipped pearl oyster which is used in pearl culture, though most effort is focused in the North Coast Bioregion.



GASCOYNE COAST OVERVIEW FIGURE 2

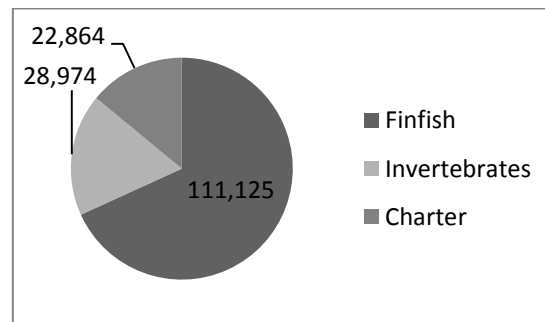
Relative contribution of finfish and invertebrates to the total commercial wild fishery catch originating from the Gascoyne Bioregion. Numbers represent total catch (in tonnes).

Recreational Fishing

The special features of the Gascoyne Coast Bioregion, coupled with the warm, dry winter climate and accessible fish stocks, have made it a focal point for winter recreation by the Western Australian community. Fishing during this season is a key component of many tourist visits. A full range of angling activities is available, including beach and cliff fishing (e.g. Steep Point and Quobba), embayment and shallow-water boat angling (e.g. Shark Bay, Exmouth Gulf and Ningaloo lagoons), and offshore boat angling for demersal and larger pelagic species (e.g. off Ningaloo).

Recreational fishing is predominantly for tropical species such as emperors, tropical snappers, groupers, mackerels, cods, trevallies and other game fish and blue swimmer crab and squid. Some temperate species at the northern end of their ranges, such as (pink) snapper, tailor and whiting, provide significant catches, particularly in Shark Bay. (Gascoyne Coast Overview Figure 3)

Improved infrastructure (e.g. sealed roads) has led to increasing levels of domestic and international tourism to the Gascoyne. Enhanced access to coastal waters via new boat ramps (e.g. Bundegi, Coral Bay, Tantabiddi) and camping sites/facilities and the sustained popularity of recreational fishing also contribute to pressure on local fish stocks. This trend of increasing levels of recreational fishing effort and catches is also related in part to the recently increased levels of regulation and constraint on recreational fishing in the West Coast Bioregion south of the Gascoyne Coast Bioregion.



GASCOYNE COAST OVERVIEW FIGURE 3

The Gascoyne Coast Bioregion finfish and invertebrate catch numbers as assessed in the integrated survey of boat-based recreational fishing in WA 2011/12, and the charter boat catch numbers for the 2013 period.

Aquaculture

Aquaculture development in the Gascoyne Coast Bioregion is largely restricted to the production of pearls and pearl oysters in the major embayments. Hatchery production of oysters is of critical importance in this region, driven by the irregular and therefore unreliable recruitment of both large species of pearl oysters in the wild. Hatcheries in Carnarvon and Exmouth supply significant quantities of *Pinctada maxima* spat to pearl farms in Exmouth Gulf and the Montebello Islands, while several hatcheries supply juveniles of the blacklip pearl oyster *Pinctada margaritifera* to the bioregion’s developing black pearl farms.

Tourism

The Gascoyne Coast Bioregion is a focal point for winter recreation by the Western Australian community. Apart from its scenic beauty, the main attraction of the coastline for tourists is the quality of marine life. The region supports extensive scuba diving and snorkelling activities, particularly inside the coral lagoons of Ningaloo. Specialised eco-tourism activities include whale shark and manta ray observation at Ningaloo and dolphin and dugong viewing in Shark Bay. Fishing is a key component of many tourist visits, and a full range of angling activities is available.

Oil and Gas Activity

Exploration and appraisal drilling has occurred mainly in the northern part of the Gascoyne Coast Bioregion (Gascoyne Overview Figure 4). There is significant oil and gas mining activity offshore of North West Cape in the Exmouth Sub-basin, and the Australian Government has also recently released two areas offshore of Carnarvon in the Southern Carnarvon Basin for further exploration.

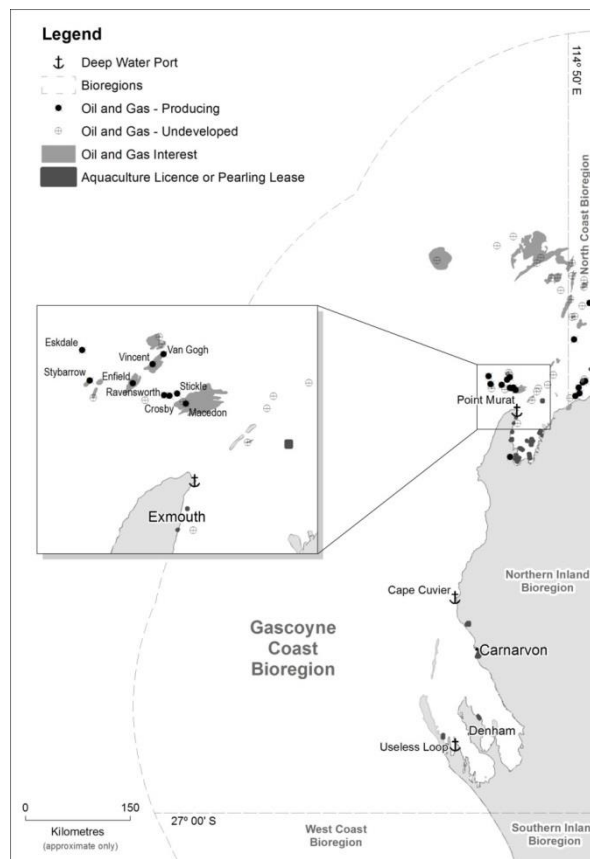
The main disturbances associated with oil and gas exploration and production include noise pollution from seismic surveys, potential for fish movement/impact arising from seismic surveys, disturbance to the marine habitat through drilling and/or dredging activities, release of produced formation water, shipping and transport activities and oil spill accidents.

Shipping and Maritime Activity

There are three deepwater port facilities currently operating in the Gascoyne Coast Bioregion: Useless Loop, Cape Cuvier (both private facilities servicing salt fields) and Point Murat, a naval port facility at Exmouth. The majority of shipping movements involve coastal cargo vessels, shipping associated with the two salt fields in the region and fishing vessels operating out of the numerous small ports along the coast.

Other harbours and maritime facilities of the Gascoyne Coast Bioregion include Denham, Carnarvon, Coral Bay and Exmouth, all of which largely service local fishing and charter vessels, as well as the private vessels of local residents and tourists. The expansion of oil and gas, along with increased recreational, charter and eco-tourism activities, in the area has led to the expansion of many of these facilities.

The impacts from vessels and ships tend to be concentrated around ports and favoured anchorage areas. Impacts include physical damage to the habitat and the potential to introduce and spread marine pest species.



GASCOYNE OVERVIEW FIGURE 4

Exmouth Sub-basin offshore oil and gas production sites and Aquaculture Licences and Pearly Leases.

ECOSYSTEM MANAGEMENT

A variety of measures have been implemented to manage the potential impact of activities on the ecosystem within the Gascoyne Coast Bioregion. These include:

Climate Change

Work is being finalized as part of a three-year FRDC-funded project (2010/535) that aimed to assess the effects of climate change on the marine environment and key fisheries, as well as management implications. The first phase of the project was to understand how environmental factors, such as water temperature and salinity, affect fish stocks in Western Australia based on available historical data. The second phase was to look at historical trends and possible future scenarios of WA marine environments using climate model projections. Lastly, existing management arrangements will be reviewed to examine their robustness to climate change effects and new management policies will be developed in consultation with stakeholders to deal with climate change effects on fish stocks. The Department is also a key collaborator in the National RedMap (Range Extension Database & Mapping

project) project (www.redmap.org.au) which uses a citizen-science approach to document range extensions of a number of key identified climate-change affected species. Understanding shifts in populations is likely to be increasingly important to adaptive fisheries management.

Spatial Closures

The Department of Fisheries has established a comprehensive set of spatial management closures within the Gascoyne region that are equivalent to a number of IUCN categories for marine protected areas. Extensive trawl closures inside the 200 m depth zone in the Shark Bay and Exmouth region provide protection to sensitive benthic habitat, including coral reef, sand flats and seagrass beds of the continental shelf. These areas provide significant fish nursery, breeding and feeding habitat (Gascoyne Overview Figure 5). 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 (Gascoyne Ecosystem Management Table 1; as per Dudley, 2008¹). There are also a number of other 'formal' marine protected areas in this Bioregion that have been established under both the Conservation and Land Management Act 1984 and the Fish Resources Management Act 1994 (see Gascoyne Overview Figure 6). These include the Ningaloo and Shark Bay marine parks, the Murion Islands Marine Management Area, and the Quobba and Miaboolya Beach Fish Habitat Protection Areas. Commercial and recreational fishing activities are restricted in these regions.

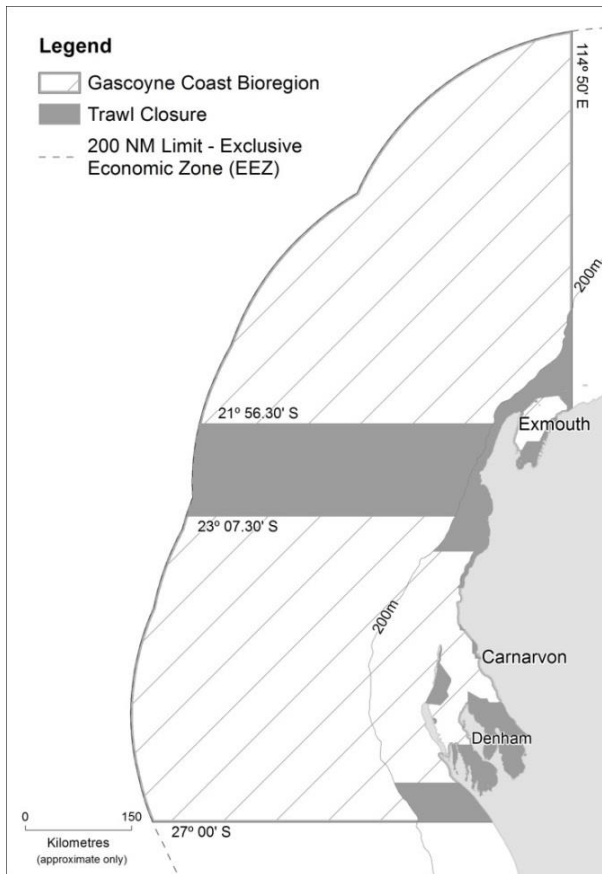
The Commonwealth Government is also undertaking a process of identifying additional protected areas for Commonwealth waters between Shark Bay and the Northern Territory border.

GASCOYNE ECOSYSTEM MANAGEMENT TABLE 1

The areas and proportions of the Gascoyne 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.

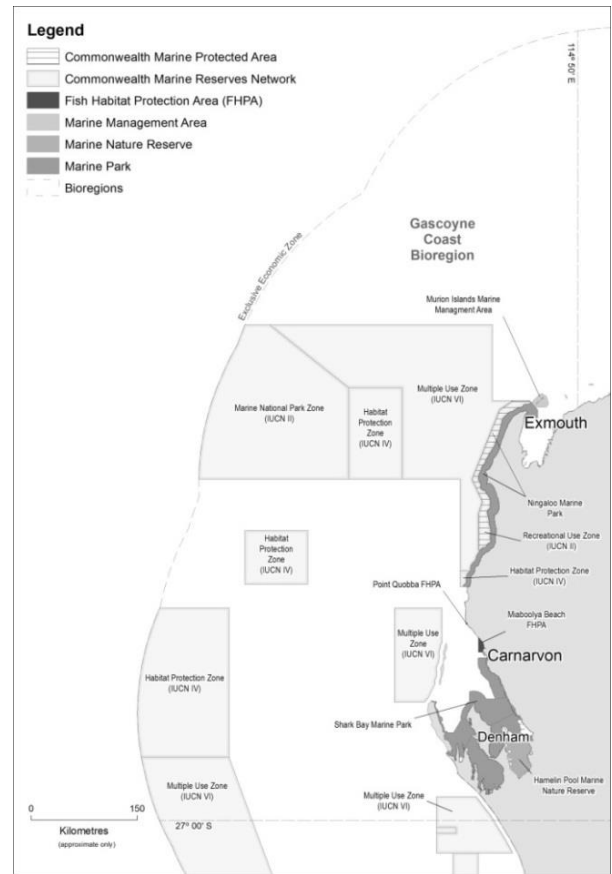
IUCN category or equivalent	State Waters only (24,100 km ²)				All Waters (416,300 km ² (including State waters))			
	Fisheries		Existing MPA		Fisheries		Existing MPA	
	km ²	%	km ²	%	km ²	%	km ²	%
I	0	0	0	0	0	0	0	0
II	0	0	2,500	10	0	0	5,000	1
III	0	0	0	0	0	0	0	0
IV	3,100	13	6,400	27	13,200	3	6,400	2
V	0	0	0	0	0	0	0	0
VI	9,500	39	2,600	11	389,100	93	2,600	1

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



GASCOYNE OVERVIEW FIGURE 5

Map showing the Gascoyne Coast Bioregion and areas closed to trawling. The areas permanently closed to trawling are consistent with IUCN marine protected area category IV.



GASCOYNE OVERVIEW FIGURE 6

Map showing the Gascoyne Coast Bioregion and current and proposed state and commonwealth marine parks and reserves along the northern WA coast.

Management of Commercial Fisheries

There is a high degree of ecosystem management and protection for the ecological assets that are located within the Gascoyne Coast Bioregion. Each of these fisheries operates under a specific management plan, the arrangements of which are implemented through the legislative framework provided by the Fish Resources Management Act 1994 (FRMA). The FRMA and the management plan for each Fishery adhere to arrangements established under relevant Australian laws, with reference to international agreements that require conservation of all ‘fish’ and fisheries resources (which through the definition of fish includes nearly all aquatic organisms).

In WA, comprehensive controls on fishing were first introduced in the 1960s and now apply to all commercial fisheries. These controls are designed to ensure that all catches are kept at sustainable levels, which in turn requires that the annual catch is a relatively small proportion of the overall stock biomass. This approach maintains relatively high biomass levels for all harvested species compared to their unfished situation and therefore ensures that all trophic levels are being kept at relatively high levels of abundance.

These management requirements have significantly reduced the risk of such trophic flow-on effects from occurring, and none are evident in the long-term trends in fish catches.

Strict limits on the use of fishing gear that can result in unwanted interactions with non-targeted species provide similar protection for bycatch and listed species and thus, biodiversity generally.

Examples of controls that operate in at least one fishery within the bioregion include:

- Limited entry;
- Variable spawning/size season closures (areas closed or opened depending upon catch rates and sizes);
- Permanent and seasonal area closures to preserve sensitive habitats that are essential nursery areas;
- Specific regulation to preclude use of gear types with high bycatch potential (eg large, mesh gillnets and long-lines)
- Temporal general closures;
- Primary and secondary bycatch reduction devices (BRDs);
- Total Allowable Catch limits;
- Target catch ranges;

- Minimum commercial size limits;
- Protection of berried females; and
- Monitoring of fishing activities using the Vessel Monitoring System (VMS)

The State is currently employing a bioregional approach to the pre-assessment of all its fisheries for potential third party certification according to the sustainability criteria developed by the Marine Stewardship Council (<http://www.msc.org/>). The progression of a number of fisheries to full certification is underway. This process will ensure independent assessment of the sustainability and effective management of assessed fisheries to an internationally recognised standard.

Management of Recreational fisheries

Recreational fishing in the Gascoyne has been managed via a bioregional-specific management strategy since 2003. This strategy consists of a set of bag, possession and size limits, permitted gear types and seasonal and area closures implemented under the Fish Resources Management Act 1994. For inner Shark Bay (pink) snapper stocks, more complex arrangements are used within the Eastern Gulf, Denham Sound and Freycinet Estuary, where these stocks are managed separately and have explicit Total Allowable Catches (TACs). All recreational fishing activities, including those of the charter sector, are subject to the closures associated with the Ningaloo and Shark Bay Marine Sanctuary Areas, Nature Reserves and Conservation areas. In 2010, a statewide recreational 'fishing from boat' license was also introduced.

A number of recreational fishing surveys have been undertaken in the region, including a recent statewide recreational fishing from boat survey in 2011. The results of such surveys are used to estimate recreational catch and effort of targeted finfish and crustaceans. The results of such surveys are used to maintain a sustainable bioregional-specific management strategy.

Compliance and Community Education

Significant effort is put into ensuring adequate compliance with commercial and recreational fishing regulations. This includes at sea and aerial patrols to ensure closed seasons, closed areas, and operational rules are being adhered to. The use of VMS on commercial vessels also helps the Department monitor vessel location and speed, thus increasing compliance with closures while decreasing the need for untargeted patrol activities.

Biosecurity Risk Management

The International Maritime Organisation has identified the introduction of invasive marine species into new environments by ship's ballast water and biofouling as one of the four greatest threats to the world's oceans. Introduced marine pests can predate on native and farmed species, out-compete natives for space and food, alter nutrient cycle, lead to a loss of diversity in local species, cause human health

impacts, negatively affect commercial fish and seafood species, negatively affect amenity and recreational activities and reduce the fuel efficiency for all vessel types. With increasing human population and associated travel, transport and trade, the risk of introducing new species is likely to grow.

Biosecurity risks associated with commercial vessel movements are managed through the routine monitoring of ports for marine pest species and management of risk associated with biofouling on commercial vessels utilizing state waters. Oil and gas related developments in the region have their own ministerial guidelines to ensure marine and coastal resources are protected. These developments undertake 'proof of freedom' pest monitoring to ascertain they have no pests present.

Management of Aquaculture Activities

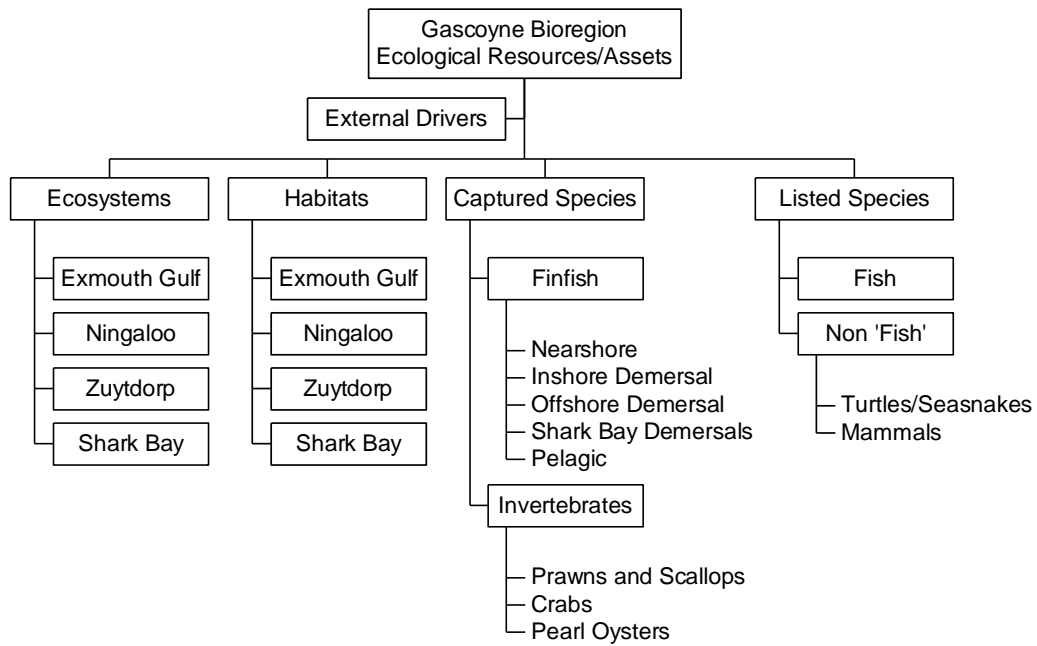
The main focus of the Department of Fisheries in the Gascoyne continues to be on the regulation of the regional pearling industry, including the blacklip oyster *Pinctada margaritifera*, which now complements the major State industry sector built on the silver lip pearl oyster (*Pinctada maxima*). A local aquaculture sector is emerging, focusing on the production of aquarium species, including coral and live rock. This developing sector is regulated according to the policy entitled *The Aquaculture of Coral, Live Rocks and Associated Products*.

ECOSYSTEM MONITORING AND STATUS

In order to assess the adequacy of management arrangements aimed at ensuring sustainability of the ecological assets within the Gascoyne Coast Bioregion, the Department must identify and monitor trends in the condition of these resources. This is achieved through application of an Ecosystem Based Fisheries Management (EBFM) framework (Fletcher, *et al.*, 2010) (see How to Use section for more details) to identify, in a hierarchical manner, the key ecological resources that require ongoing monitoring and assessment.

These key ecological assets identified for the Gascoyne Bioregion are identified in Gascoyne Overview Figure 7 and their current risk status reported on in the following sections.

1 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



GASCOYNE OVERVIEW FIGURE 7

Component tree showing the ecological assets identified and separately assessed for the Gascoyne Coast Bioregion. Under the integrated marine and coastal regionalisation for Australia scheme, the bioregion has been divided into 4 meso-scale regions (See Introduction Fig. 1): Zuytdorp, Shark Bay, Ningaloo, and Exmouth Gulf (imcra, v 4.0, 2006) which have been adopted for sub-regional management within an EBFM framework.

External Drivers

External factors include factors impacting at the bioregional-level that are likely to affect the ecosystem as whole and may not fall within the direct control of Fishery legislation (e.g. climate change). An understanding of these factors, which are typically environmental (cyclones, ocean currents) is necessary to fully assess the performance of the ecological resource. The main external drivers identified with potential to affect the Gascoyne Coast Bioregion include climate and introduced pests and diseases.

Climate

External Driver	Current Risk Status
Climate	MODERATE in short term HIGH in medium term

Being a transitional zone between tropical and temperate regions, the biota of the Gascoyne Bioregion is at enhanced risk of being affected by climate change. Climate change can influence fisheries and biological systems by affecting the timing of spawning, range and distribution, composition and interactions within communities, exotic species invasions and impacts, community structure and productivity. Waters off the Gascoyne coast are strongly influenced by the Leuwin current which brings warm low salinity water southward. After experiencing a weakening trend from the 1960’s to the early 1990’s, the strength of the Leeuwin Current has rebounded in the past two decades which has been driven by changes in frequency of El Niño/La Niña Southern Oscillation (ENSO) patterns. During the summer of 2010/11, a significant warming event took place off the coast of

Western Australia, with widespread reports of fish kills and of tropical species being found further south than their normal range.

Sea-surface temperatures were > 3 °C above the normal summer averages in some regions. The “marine heat-wave” was associated with extremely strong La Niña conditions, leading to a record strength Leeuwin Current for that time of year, which resulted in record high summer sea levels along the mid-west and Gascoyne coast. The heat wave resulted in what is considered to be the first WA regional-scale coral bleaching event, affecting corals south to Rottnest Island and north to the Montebello and Barrow Islands .This warming event may also have contributed to a significant decline in blue swimmer crab and scallop stocks in Shark Bay and a subsequent recruitment failure for both of these species in 2011.

A preliminary assessment of fisheries-dependent indicators of climate change in WA was undertaken in 2010. This work is being completed as part of a three-year FRDC-funded project (2010/535) that will assess the effects of climate change on the marine environment and key fisheries, as well as management implications. The first phase of the project was to understand how environmental factors, such as water temperature and salinity, affect fish stocks in Western Australia based on available historical data. The second phase was to look at historical trends and possible future scenarios of Western Australian marine environments using climate model projections. Lastly, existing management arrangements will be reviewed to examine their robustness to climate change effects and new management policies will be developed in consultation with stakeholders to deal with climate change effects of fish stocks.

Introduced Pests and Diseases

External Driver	Current Risk Status
Introduced Pests and Diseases	LOW

The Department is the lead agency with responsibility for managing the threat posed by introduced marine species to our marine environment. As such it implements a range of risk-based policy, research, monitoring and compliance measures aimed at preventing introduction and establishment of marine pests in State waters.

The Gascoyne represents a transition between tropical and temperate regions and is an increasing focus of oil and gas exploratory activity. As such, there is an increasing risk of introduction and establishment of numerous nationally listed pest species to inhabit this region. Currently, recreational vessel movements, practices and the fouling present on these vessels represents one of our biggest gaps in marine biosecurity knowledge. The Department recently completed an assessment of the likelihood of a marine pest being introduced into ports and quantification of the risk associated with recreational vessels for the introduction and translocation of marine pests into this Bioregion. Further detail may be found in the Appendix section entitled “Activities of the Marine Biosecurity Research Unit during 2013/14”.

Ecosystems and Habitats

A high level of protection of the ecosystems and habitats within the Gascoyne Coast Bioregion is ensured based on the limited area of the Bioregion that is available to commercial fishing activity.

If the areas that are not trawled is taken into account, more than 90 % of statewide benthic habitats out to the 200 m depth contour are, in practical terms, fully protected and may never have been trawled (Ecosystem Management Table 1). There are extensive trawl closures inside the 200 m depth zone in both Shark Bay and Exmouth Gulf that provide protection to sensitive benthic habitats including coral reef, seagrass and sand flats. These areas also provide significant nursery, breeding and feeding habitats for many retained and listed species. There is also a large area from Point Maud to Tantabiddi Well off the Ningaloo Coast (23° 07.30' S to 21° 56.30' S) that is closed to all commercial fishing activities (Gascoyne Overview Figure 5).

The Department identifies and monitors trends in the condition of ecosystems and their associated habitats to ensure the long term sustainability of both these key ecological assets and the fisheries that depend on them. Utilising the Integrated Marine and Coastal Regionalisation for Australia (IMCRA) scheme, the bioregion has been divided into four meso-scale ecosystems; the Ningaloo Coast, Shark Bay and Zuytdorp and Exmouth Gulf ecosystem (Introduction Figure 2).

The key habitats occurring in depths of less than 40 m (where the vast majority of relevant fisheries resources are located and fishing activities are undertaken in this bioregion) include:

- Coral reefs: the Ningaloo ecosystem has the only major

coral reef system in the bioregion. The Ningaloo Reef the largest continuous reef area in Western Australia and is considered one of Australia’s most significant fringing coral reef systems.

- Mangroves: The eastern coast of Exmouth Gulf supports one of the largest areas of mangroves in the region. These areas are thought to be significant sources of nutrients that contribute to the prawn fishery of the Gulf and provide nursery areas for juvenile fish and invertebrates.
- Seagrasses: The central Gascoyne coast and Shark Bay support major seagrass communities, which play important roles in sedimentary processes, food chains and nutrient cycling. Smaller seagrass beds also occur in the eastern and southern sections of Exmouth Gulf. Seagrass beds provide important nursery habitats for many finfish and invertebrate species, such as spangled emperor.
- Sand banks: Extensive sand areas support seagrasses and provide substrate for microalgae in all areas, particularly Ningaloo Reef. In both Exmouth Gulf and Shark Bay, shallow sand banks provide productive habitat and nursery areas for local prawn and finfish stocks. Within the deeper central areas of Shark Bay and Exmouth Gulf, bare sandy/muddy bottom habitats provide the main habitat for juvenile and adult prawns within the trawl areas.
- Other habitats that are located in the ecosystems within the Gascoyne Coast Bioregion include algal communities, rocky shore communities, hard- and soft-bottom benthic communities, and pelagic mid-water communities.

In depths beyond 40 m, ecosystems include hard- and soft-bottom benthic communities, sand banks and pelagic communities. Given the low levels of activities in these depths, there is little detailed information on these environments.

Exmouth Gulf

Ecosystem/habitat	Aquatic zone/category	Current Risk Status
Exmouth Gulf ecosystem	Marine	LOW
Exmouth Gulf benthic habitat	Sand, Mud, Sponge	LOW

Ecosystem

There is significant protection in place for all sensitive habitats and restrictions on the level of impacts that can occur in less sensitive habitats. Approximately 29 % (335 nm²) of Exmouth Gulf is trawled. Trawling is prohibited in a designated nursery area in the southern and eastern section of the Gulf. The nursery area covers 344 nm² and represents 28 % of Exmouth Gulf. A major project surveying biodiversity on and off the trawl grounds in Exmouth indicated that trawled areas have similar diversity to the larger adjacent untrawled areas, indicating that the current level of trawling activity does not affect overall biodiversity and cannot be distinguished from other sources of variation in community structure. The ecosystem in this region could be at increased risk if a number of proposed developments are

implemented.

Habitat

There is a large permanent closure to trawling on the eastern and southern sides of the Gulf which protect sensitive habitats that operate as nursery areas. In the area open, trawling effort is focused in the deeper central and north-western sectors of Exmouth Gulf. Owing to the predominantly mud and sand habitats of the trawl grounds, the trawl gear has relatively little physical impact. The total area trawled each year has to remain below 40%. The area trawled each year is monitored.

Trawling effort is focused in the deeper central and north-western sections of the Gulf which is primarily mud. The mud substrate in Exmouth Gulf is generally comprised of coarse and heavy sediments, which are more resistant to disturbance by trawling. Seagrass beds are spatially separated from trawling activities and are protected within the permanent nursery area closure along the southern and eastern sections of the Gulf. Current estimates of the amount of soft coral and sponge habitat within Exmouth Gulf suggest that there are only relatively small amounts and that trawling, given that the target prawn species prefer mud substrate, does not impact these areas. Macroalgal beds are predominantly located in the southern reaches and on the periphery of Exmouth Gulf in the shallow subtidal and low intertidal limestone pavement regions. The majority of these areas are permanent nursery closures therefore trawling does not impact these habitats.

Ningaloo

Ecosystem/habitat	Aquatic zone/category	Current Risk Status
Ningaloo ecosystem	Marine	LOW
Ningaloo benthic habitat	Sand, Coral	LOW

Ecosystem

The Ningaloo ecosystem is protected via establishment of the Ningaloo Marine Park (NMP) which was established in 1987 and expanded in 2004 to cover and protect the entire Ningaloo Reef. The NMP covers a total area of 4,566 km² from the shoreline to continental slope. No commercial fisheries operate in the waters of the NMP and 34% of the park is zoned as no-take sanctuary areas. A significant level of research and monitoring is being undertaken in the Ningaloo marine park region by DPaW, CSIRO, AIMS and universities. This reflects the main pressures on the ecosystem which are largely not fishing-related. An assessment of the community structure and trophic level of all commercially caught fish species in the Gascoyne Bioregion over the past 30 years through an FRDC project found no evidence of systematic changes that could be evidence of an unacceptable impact on this ecosystem (Hall

and Wise, 2011)¹. The Department is a contributor and supporter of the extensive ecological research and monitoring that has been undertaken in the NMP, much of which was funded by the recently completed WAMSI Node 3 (see www.WAMSI.org.au for full details).

Habitat

Protection of habitats within Ningaloo occurs mainly through the use of spatial zoning throughout the Ningaloo Marine Park. There are no trawl activities conducted in this area. Corals are the most important reef building organisms within the NMP and provide food, shelter and settlement substrate for a variety of other marine flora and fauna. The main risk is to coral habitat results from tourism and other boating related activities. No major pressure on seagrass communities, which are general small, patchily distributed in this region have been identified (CALM 2005).

Zuytdorp

Ecosystem/habitat	Aquatic zone/category	Current Risk Status
Zuytdorp ecosystem	Marine	LOW
Zuytdorp benthic habitat	Sand, Reef	NEGLIGIBLE

Ecosystem

The Zuytdorp ecosystem is largely protected due to the lack of trawling that occurs in this area. The effects of the various scalefish fisheries (handline, dropline, longline and gillnet) on the Gascoyne Coast Bioregion ecosystem have been investigated by Hall and Wise (2011). This study used detailed statistical analyses on over 30 years of commercial catch data to determine if any major changes in community composition have occurred.

Results suggest there is no evidence of a decline in the mean trophic levels or mean maximum lengths of catches taken in the Gascoyne Coast Bioregion. Total catches of the three retained species of deep sea crabs represent a very small biomass, and any impact of crab fishing on the general food chain is expected to be minimal. There is also a large commercial closure between Point Maud and Tantabiddi Well, which limits the spatial extent of commercial fishing activities within the Gascoyne Coast Bioregion.

Habitat

The benthic habitats of the Zuytdorp ecosystem are dominated by mud/sand bottoms, likely to support a relatively sparse invertebrate community. The majority of non-trawl based fishing takes place over sand habitats in depths of 20-250 m, depending on which species is being targeted. Underwater video work, in 20-250m, has shown that the habitat is dominated by sponges, soft corals and

¹ 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.

gorgonians (DoF 2002)¹. The Gascoyne Demersal Scalefish Fishery operates in this ecosystem and is based on using hook and lines, meaning that there is virtually no impact on benthic habitats. Fishing typically occurs over harder patches of hard bottom around the entrance to Shark Bay and the adjacent ocean. Fishing does not normally occur over sensitive seagrass or hard coral habitats. The West Coast Deep Sea Crustacean Fishery operates in this area in depths from 150-1200m. Crab traps in the Zuytdorp are mainly set over mud bottom areas and occasionally bring up solitary corals or sponges that get entangled in the pot. The footprint of the pots and effort levels are both extremely small in relation to the extent of this habitat. There are thus few direct impacts of fishing activity to these habitats.

Shark Bay

Ecosystem/habitat	Aquatic zone/category	Current Risk Status
Shark Bay Gulfs	Marine	LOW
Shark Bay Gulfs	Sand, Sponge	MODERATE
Shark Bay Gulfs	Seagrass	NEGLIGIBLE

Ecosystem

Shark Bay is considered to be a highly productive system with protection for all sensitive habitats and restrictions on the level of impacts that can occur in less sensitive habitats. Benthic habitats and communities of Shark Bay have been described and mapped (CALM 1996). The current level of fishing by all methods does not appear to have noticeably affected the trophic/community structure in Shark Bay. A study of biodiversity in Shark Bay has found that no significant difference in the fish and invertebrate abundance, species richness, evenness or diversity between trawled and untrawled areas (Kangas *et al.* 2007)². Therefore, the closed areas provide protection to those species more vulnerable to trawling (Kangas *et al.* 2007).

Habitats

The extent of various habitat types, such as seagrasses and corals, has been described and mapped (CALM 1996). Seagrass is extensive throughout the eastern and western gulfs, and corals can be found primarily along the eastern coast of the western gulf, and the eastern coasts of Dirk Hartog, Dorre and Bernier Islands. Almost all of these areas are part of the Shark Bay Marine Park and are permanently closed to trawling activities.

The majority of sponge/coral habitats and other sensitive habitats are also contained within specific trawl closures and there are limits to the trawled area to less than 40% of the sand habitats. The few unprotected areas where coral occur (e.g. Egg Island and Bar Flats) are not part of the actively

trawled areas. The main areas where trawling occurs, in the central bay, north Cape Peron and in the northern area of Denham Sound, are sand/shell habitat, which is the preferred substrate of the main targeted species.

There are permanent closures include the Sanctuary and Special Purpose Zones of the Shark Bay Marine Park and the Hamelin Pool Marine Reserve. In addition, specific areas of the Bay are closed to certain fishing methods. Permanent trawl closures protect the majority of seagrass and coral habitats in the eastern and western gulfs.

Captured Species

Finfish

The Gascoyne supports a diverse fish fauna and is noted for its high quality of both commercial and recreational fishing. Approximately 1400 species of fishes could be expected to inhabit this region. Of these only a relatively small number are targeted by commercial fishing activities with demersal finfish species (e.g. Pink Snapper) captured in the Zuytdorp region and nearshore finfish species (e.g. Whiting) within the Shark Bay region. The Department manages commercial and recreational fishing in the State coastal waters (generally 3 nm). By way of the *Offshore Constitutional Settlement 1995* (OCS) agreement between the State and Commonwealth Governments, control is also given to WA for most fisheries which operate out to 200 nm from the coast (except for trawling where WA’s jurisdiction is limited to the 200 m isobath).

Due to the broad spatial distribution of both species and fisheries, the majority of finfish species in this area are managed at the Bioregional scale within four recognized aquatic zones. Indicator species which reflect the characteristics of the broader exploited stocks are monitored in order to assess ecological risk to the range of species targeted. The major fishery operating at the bioregional level is the Gascoyne Demersal Scalefish Fishery. This is a line fishery that originally targeted pink snapper has been developed over the past decade into a broader fishing sector targeting other demersal finfish species including emperors, cods and deeper water species and is managed as the Gascoyne Demersal Scalefish (Managed) Fishery.

The Gascoyne Coast Bioregion also has the Shark Bay-based beach seine fishery (the Shark Bay Beach Seine and Mesh Net Managed Fishery) since the 1960s, which respectively provide most of the pink snapper and whiting catch for the state.

Nearshore (0-20m depth)

Captured Species	Aquatic zone	Ecological Risk
Finfish	Nearshore (0-20m depth)	MODERATE

The indicator species for this suite (e.g. whiting) are all considered to have adequate breeding stocks, fishing catch and effort has been occurring at the same acceptable levels for over 40 years and there are no additional risks that have been identified. Annual catch and effort monitoring is continuing.

¹ Department of Fisheries, (2002). Fisheries Environmental Management Plan for the Gascoyne Region. Fisheries Management Paper No. 142

² Kangas, M.I., Morrison, S., Unsworth, P., Lai, E., Wright, I. and Thomson A. 2007. Development of biodiversity and habitat monitoring systems for key trawl fisheries in Western Australia. Final FRDC Report 2002/038. Department of Fisheries, Western Australia, Fisheries Research Report No. 160. 333 pp.

Inshore demersal (20-250 m depth)

Captured Species	Aquatic zone	Ecological Risk
Finfish	Inshore demersal (20-250m depth)	MODERATE

The main fishery operating in this region is the Gascoyne Demersal Scalefish Fishery, for which a detailed status report is provided at the end of this chapter. The key indicator species for this suite is pink snapper which is currently in a rebuilding phase and spangled emperor, in northern part of the bioregion, is considered to be suffering overfishing (but the overall stock is at an acceptable level). (Pink) snapper are sampled to provide representative catch-at-age data for used in an integrated stock assessment model which is updated every 3 years (most recently in 2012). Comprehensive research on spangled emperor and goldband snapper has generated ‘weight of evidence’ based assessments. Monitoring of commercial catches and age structure is continuing and further research is planned to refine estimates of the key biological parameters.

Offshore demersal (>250 m depth)

Captured Species	Aquatic zone	Ecological Risk
Finfish	Offshore demersal (>250 m depth)	MODERATE

Concerns around deeper-water species (e.g. ruby snapper, various cods) are largely due to uncertainty in the stock status of these species and their long-lived, slow growing life histories. The main risk to these stocks comes from potential increases in fishing by Commonwealth licensed trawlers who operate outside of 200 m depth and the current discussions about altering this line.

Pelagic

Captured Species	Aquatic zone	Ecological Risk
Finfish	Pelagic	MODERATE

The stock status and fishing levels of these species (e.g. Spanish mackerel) are both at acceptable levels

Shark Bay Gulf Demersal

Captured Species	Ecosystem	Ecological Risk
Finfish	Shark Bay Gulf Demersal	MODERATE

The main fishery operating in this ecosystem is the Inner Shark Bay Scalefish Fishery, for which a detailed status report is included at the end of this chapter.

The spawning biomass of pink snapper has returned above the target level (40%) in both the Eastern Gulf and Denham Sound but remained below the threshold level (30%) in

Freycinet. These inner gulf stocks are monitored using daily egg production method [DEPM] surveys to estimate spawning biomass approximately every 3-5 years and intermittent surveys of recreational catch. It is possible that grass emperor will be added to the set of indicators for this suite.

Invertebrates

Commercial fishing for invertebrates is a very significant industry within the Gascoyne Coast Bioregion; three of the State’s most valuable fisheries (the Exmouth Gulf Prawn, Shark Bay Prawn and Shark Bay Scallop Managed Fisheries) land combined catches valued in the range of \$AUD 40-50 million annually. These trawl-based fisheries have operated in the region since the mid-1960s and are internationally recognised as ‘best practice’ in terms of both management and research (Fletcher and Santoro 2012). A fishery for blue swimmer crabs (the Shark Bay Crab [Interim] Managed Fishery), based primarily in Carnarvon but operating throughout the water of Shark Bay, has grown in the last decade to be the largest Western Australian crab fishery. The Gascoyne also supports the majority of the catch of deep sea crabs off the coast of Western Australia as part of the West Coast Deep Sea Crustacean Managed Fishery.

Nearshore (0-20 m depth)

Captured Species	Aquatic zone	Ecological Risk
Crabs	Nearshore (0-20 m depth)	MODERATE
Pearl Oysters	Nearshore (0-20 m depth)	MODERATE

There are a number of issues related to resource sharing and gear conflicts between the Shark Bay crab trap and Shark Bay prawn and scallop trawl fisheries. A recent (2011 stock assessment) concluded that there was conflicting evidence about the level of impact the current catch levels were having on the stock. Subsequent to this review, the relative abundance of all size classes of crabs in Shark Bay declined significantly. The reasons for this unexpected and substantial decline appear to be linked to several adverse extreme environmental events and this has already had a significant impact on the 2011/12 fishing season.

The recent stock levels of pearl oysters in this region have been low. Recovery management arrangements have already been implemented and minimal catches have been taken in recent years.

Exmouth Gulf

Captured Species	Aquatic zone	Ecological Risk
Prawns	Exmouth Gulf Ecosystem	MODERATE

The only commercial fishery that operates continuously in the Exmouth Gulf ecosystem is the Exmouth Gulf Prawn Managed Fishery (EGPMF). The Exmouth Gulf Beach Seine Fishery, which only has one license holder, is very small scale and does not operate every year. The EGPMF is the

second largest prawn trawl fishery in WA, with a landed value in 2011 of around \$ 11 million. The Fishery is located in the north/northwest waters of Exmouth Gulf . Currently, the two main target species of this fishery are the brown tiger prawn and western king prawn. A status report summarizing the condition of the EGPMF is included at the end of this chapter.

Management of the prawn fisheries is based on input controls which include limited entry, seasonal and area openings and closures, gear controls. Permanently closed nursery areas within the fishery prevent the fishing of small size prawns while spatio-temporal closures serve to maintain tiger prawn breeding stocks above the threshold abundance level. In the Exmouth Gulf Prawn Managed Fishery, of the 4000 km² waters contained within the fishery boundary, 1100 km² is closed to trawling but a further 900 km² is not trawled. All the stocks of prawns are at acceptable levels.

Zuytdorp

In addition to the bioregional fisheries, the Zuytdorp ecosystem is also utilized by the West Coast Deep Sea Crustacean Managed Fishery which has been operating since the late 1990s.

Shark Bay

Captured Species	Aquatic zone	Ecological Risk
Prawns and Scallops	Shark Bay Ecosystem	MODERATE

Four commercial fisheries targeting invertebrates operate within the waters of Shark Bay which include trawl (Shark Bay Prawn Managed Fishery for which a detailed status report is provided at the end of this chapter) and Shark Bay Scallop Managed Fishery (both also target crabs), trap based fisheries (Shark Bay Crab (Interim) Managed Fishery) and beach seine fisheries (Shark Bay Seine and Mesh Net Managed Fishery)

Management of the prawn and scallop fisheries is based on input controls which include limited entry, seasonal and area openings and closures, gear controls. Permanently closed nursery areas within the fishery prevent the fishing of small size prawns while spatio-temporal closures serve to maintain tiger prawn breeding stocks above the threshold abundance level.

For the Shark Bay Prawn and Scallop Managed Fisheries, 41,500 km² waters are legislated within the fisheries’ boundaries. Prawn trawling only occurs in 4,500 km² leaving 37,000 km² untrawled (7,600 km² of which is closed to the Fishery). Scallop trawling occurs over even less of the area (3,400 km²), leaving 38 100 km² untrawled and 9,700 km² closed to the Fishery.

To ensure that sufficient stock remained for spawning, the fishing arrangements provide a threshold catch rate limit for the scallop fleet to cease fishing. All the stocks of prawns are at acceptable levels. The stock of scallops, however, declined significantly after the 2011 season had ended and this is likely to have been generated by the same set of environmental conditions that affected the crab stocks

Listed species

A variety of endangered, threatened and protected¹ (ETP) species can be found within the Gascoyne Coast Bioregion, including cetaceans, dugongs, marine turtles, sea snakes, elasmobranchs, seahorses and pipefish and sea/shore birds. These species are protected by various international agreements and national and state legislation. Primary pieces of legislation include the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*, the *Western Australian Wildlife Conservation Act 1950*, and the *Fish Resources Management Act 1994*.

Specific commercial fishing regulations implemented in the 1970s and 1980s preclude the use of large-mesh gillnets and long-lines throughout the region, to prevent the incidental entanglement of dugongs and turtles. These controls have also provided protection for the large shark species which are a feature of this region. More recently, bycatch reduction devices (‘grids’) installed in all trawl nets in this bioregion have further increased the protection for sharks, rays and any turtles encountered on the trawl grounds. In a further effort to protect sharks and rays, line-fishery vessels are not permitted to use wire snoods.

Fish

Listed species	Risk
Fish	LOW

There are no listed fish species (including syngnathids) at risk in this region.

Non-Fish

Listed species	Ecological Risk
Turtles/seasnakes	LOW
Mammals	LOW

While listed species including dugongs, turtles and sea snakes occur in the Gascoyne region area, only sea snakes and occasionally turtles are encountered in the trawl catches. Both of these species are typically returned to the sea alive. Grids are now compulsory, which has largely eliminated the capture of any turtle or other large animal. The number of turtles captured now is very low and most of these are returned alive. Turtle captures and their status at release are monitored and reported.

There are no recorded captures of mammals by the trawl fisheries in this bioregion.

¹ It must be noted that merely being on the listed species list does not automatically indicate that a species is either threatened or endangered.

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 has undertaken a research project to investigate the likelihood of a marine pest being introduced into the Gascoyne Coast Bioregion by commercial shipping (see Bridgwood & McDonald 2014¹).

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 introduced marine pests (IMP) the greater the risk of IMPs being brought into the recipient port i.e. a positive linear relationship. Based on available commercial vessel data (Useless Loop Port only) from 2011, there were 189 commercial visits to the Gascoyne 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 Gascoyne Coast Bioregion. There was a 68% compatibility rating of potential inbound IMPs with the environment of the Gascoyne Coast Bioregion from 11 international LPOCs (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 Gascoyne Coast Bioregion was from Japan (Introduced Pests Figure 2).

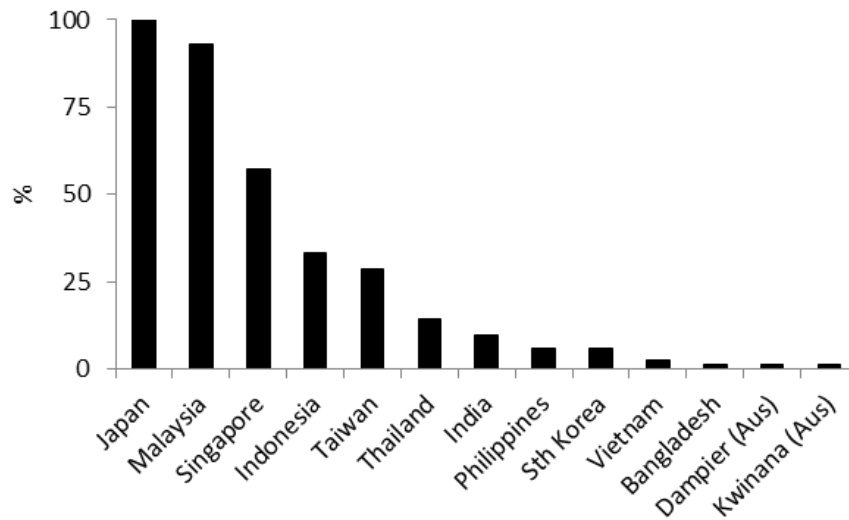
To date the Marine Biosecurity Research and Monitoring have not undertaken any introduced marine pests monitoring in the Gascoyne Coast Bioregion. Given the increase in vessels movements associated with the significant oil and gas mining activity offshore there is a real possibility of the introduction of marine pests into this bioregion.



INTRODUCED PESTS FIGURE 1

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

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 FIGURE 2

Ranking of the infection and establishment risk posed to the Gascoyne 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. Japan 100%)

FISHERIES

Shark Bay Prawn and Scallop Managed Fisheries Status Report

E.Sporer, M. Kangas, I. Koefoed, R. Oliver

Main Features			
Status		Current Landings	
Stock level		King Prawns	1139 t
Prawn	Adequate	Tiger Prawns	660 t
Scallop	Inadequate (non-fishing)	Endeavour Prawns	15 t
Fishing level		Scallops	Nil
Prawn	Acceptable		
Scallop	Acceptable		

Fishery Description

The Shark Bay Prawn Managed Fishery (SBPMF) is the highest producing Western Australian fishery for prawns. It targets the western king prawn (*Penaeus latisulcatus*) and brown tiger prawn (*Penaeus esculentus*), but also takes a variety of smaller prawn species including endeavour prawns (*Metapenaeus* spp.) and coral prawns (various species).

The Shark Bay Scallop Managed Fishery (SBSMF) catches the saucer scallop (*Amusium balloti*), and is usually WA’s most productive scallop fishery. These two fisheries are managed through limited entry, gear controls (both use low opening, otter trawls as the fishing method) and in-season

real time management to ensure sustainability and maximise economic efficiency.

Both the area and timing of operation of the two fisheries overlap and vessels that operate within the prawn fishery are also licensed to retain scallops under the SBSMF.

Governing legislation/fishing authority

Shark Bay Prawn Managed Fishery Management Plan 1993

Shark Bay Prawn Managed Fishery Licence

GASCOYNE COAST BIOREGION

Shark Bay Scallop Managed Fishery Management Plan 1994

Shark Bay Scallop Managed Fishery Licence

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

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

Consultation process

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

Boundaries

The boundaries of the SBPMF and the SBSMF are located in and near the waters of Shark Bay as presented in Shark Bay Prawn and Scallop Figures 1 & 2. These diagrams outline the boundaries of the two fisheries plus show all the area closures (both temporary and permanent) and the specific areas trawled in the 2013 season.

Management arrangements

Management of the prawn and scallop fisheries is based on input controls, which include limited entry, seasonal and area openings and closures, gear controls and limits on crew numbers. Both fleets undertake trawl fishing using otter trawl systems. Each fleet has a separate standard net size and gear configuration. This system has specific effort controls based on maximum headrope length and the maximum fishing days (season duration). These controls have allowed fleet rationalisation to occur in response to improvements in vessel and gear efficiency.

The maximum headrope allocation for the prawn fleet was set at 790 m (or 432 fathoms of headrope). This headrope allocation was originally for use in the twin trawl configuration using nets of maximum size equal to 2 x 14.63 m (8 ftm), but has been reduced by 8.3 % to 724 m (396 ftm), when the change to the more efficient quad gear configuration was approved. Scallop boats are authorised to operate with two 12.8 metre nets (7 fathoms) and the total net headrope capacity for the scallop fleet is 358.4 metres (196 fathoms).

Bycatch reduction devices ('grids') are mandatory for all prawn and scallop trawl nets. In addition, secondary bycatch reduction devices (fish escape devices) are mandatory for nets of prawn boats because they fish with small size mesh codends. Dedicated scallop boats have larger 100 mm mesh codends resulting in only a small amount of bycatch being taken during trawl operations and therefore do not require the secondary devices.

The *Fish Resource Management Act 1994* (FRMA) is the overarching legislation for the SBPMF. The key object of the FRMA is to conserve develop and share the fish resources of the State for the benefit of present and future generations. The delivery of this management outcome is supported by the

use of a sophisticated system of seasonal, spatial and temporal closures (nursery and spawning area). These management controls, in particular, the spatial and temporal closures, are designed to ensure the maintenance of breeding stocks for all prawn species, maximise the size of the prawns at capture and minimize environmental impacts of the fishery.

The key harvest strategy for these fisheries is 'constant escapement' through the use of real time management of spatial and temporal fishing effort. This is supported by the Research Division of the Department of Fisheries who carry out surveys and regular monitoring of the catch by the fleet to provide advice on when to close areas based on the target catch rates. The Vessel Monitoring System (VMS) monitors the location of all activities by licensed fishing boats in these fisheries and adherence to permanent closures.

The Commonwealth Government's Department of the Environment (DoE), has assessed the fisheries under the provisions of the *Environmental Protection and Biodiversity Conservation Act 1999* and accredited both fisheries for a period of five years (re-assessment in 2018), allowing product from the fisheries to be exported from Australia. The comprehensive Ecological Sustainable Development assessment of these fisheries found that the only material risks requiring direct management actions to ensure acceptable performance were the breeding stock levels of the targeted prawn and scallop species, bycatch species impacts, listed species interactions (including loggerhead turtles), habitat effects and provisioning effects. Boxed text in this status report provides the annual assessment of performance measures/indicators for each of these issues.

For the 2013 prawn season, the fishing arrangements included an opening date of 11 March and closing date of 15 October, providing a total of 175 nights fishing. During this season, the fishing strategy involved voluntary rolling area openings, based on assessments of the sizes and abundance of king and tiger prawns obtained through fishery-independent surveys. The tiger prawn spawning area (TPSA) was closed on 29 June.

The 2013 scallop season did not open because of environmentally-induced low scallop abundance and is the second successive year of no scallop fishing.

Research summary

Research and monitoring activities in the Shark Bay region is separated into two regions, Northern Shark Bay and Denham Sound, as they represent separate stocks of prawns and scallops. Research activities continue to focus on stock assessment and annual monitoring of the target stocks, by fishery-independent surveys and commercial catch rates, particularly tiger prawns and scallop stocks.

Prawns

The seasonal operations of the prawn fishery are dynamic because they depend on the strength and timing of recruitment which, in turn, affects the opening and closing dates for the fishing season. These dates vary each year depending on environmental conditions, moon phase and the results of fishery-independent surveys to estimate recruitment strength. The timing and spatial pattern of the fishing season allows the harvesting of the current season's recruits and the large residual prawns not caught in the previous fishing

season. Permanently closed nursery areas within the fishery prevent the fishing of small prawns and provide habitat preservation, while spatio-temporal closures serve to target prawns at optimum sizes for market requirements and maintain tiger prawn breeding stocks above the threshold abundance level.

The fishery uses moon closure periods because king prawns are sensitive to light, which makes them less active around the full moon and hence less catchable. Industry has voluntarily extended these closures to increase economic efficiency by shifting fishing effort away from these times of reduced catch rate. In 2013, the moon closures ranged from four to nine days per month and were set out in the season arrangements.

From early August onwards, the Extended Nursery Area (ENA) is closed to protect smaller prawns (primarily king prawns) and provide protection as a buffer to the remaining tiger prawns during the key spawning period before moving onto the trawl grounds from the nursery area. The closure of the ENA was implemented in 1983 but the tiger prawn spawning stock abundance within this area was never assessed during the key spawning period until 2013. The Denham Sound opening occurs in July/August each year, which gives protection to smaller prawns early in the season allowing a higher spawning biomass in this region.

During October, trawling was permitted in a limited area below the Snapper Trawl Line (STL) in Denham Sound for a maximum period of 10 days. Fishery independent surveys undertaken in these waters prior to fishing indicated that the risk to juvenile pink snapper stock was very low, however access to this area in future years will be subject to prawn catch rate level and pink snapper numbers.

All prawn boats completed detailed daily log books, and these, together with pre-season fishery-independent recruitment surveys and in-season surveys of size composition and spawning stock, provide the information for monitoring the status of the stocks. In-season prawn surveys have proved to be valuable by providing prawn size structure information, which allows industry the opportunity to harvest prawns at market size.

Scallops

The opening date of the scallop fishing season is based on a compromise between maintaining breeding stock levels (measured by a pre-season survey of stock abundance and commercial catch rates during the fishing season) and the seasonal decline in meat condition associated with spawning.

A target estimated scallop catch level for Denham Sound and northern Shark Bay has also been set to determine if commercial fishing can commence in either area each season. The catch prediction from the annual pre-season survey in November 2012 indicated a very low scallop abundance that was well below the target catch level for fishing to commence in either region, therefore, the fishery remained closed for 2013.

Retained Species

Commercial production (season 2013)

Prawns	1815 tonnes
Scallops	Nil

Landings

Prawns

The total landings (whole weight) of major prawn species for this fishery was 1815 tonnes, comprising 1139 tonnes of king prawns, 660 tonnes of tiger prawns and 15 tonnes of endeavour prawns (Shark Bay Prawn and Scallop Figure 3). Both king and tiger prawns were above last year’s catch of 1075 and 494 t, respectively. In addition, 122 t of coral prawns (various species, but mainly *Metapenaeopsis crassissima*) were landed. The total landings of major prawn species were within the new target catch range (set in 2009) of 1350 to 2150 t. The new catch range reflects the change in the expected level of king prawn landings (950 to 1350 t) which has been reviewed to reflect current fishing/harvesting strategies and effort levels under normal environmental conditions.

King prawn landings (1139 t) were within their revised catch range. Tiger prawn landings (660 tonnes) were also within the historical target catch range (400-700 tonnes).

Scallops

No landings of scallops were allowed in 2013 due to low abundance.

Byproduct

Byproduct landings from the prawn fleet included 15.8 t of blue swimmer crab (*Portunus armatus*), 5.8 t of squid, 20.7t of cuttlefish, 3.2 t of bugs (*Thenus australiensis* and *T. parindicus*), < 1 t of octopus and 13 t mixed finfish species.

The total season landings of blue swimmer crabs by the prawn boats were low as there was a maximum retention of only one tonne of crabs per boat on a voluntary basis. The fleet retained crabs from 28 May and ceased on 21 July due to the low stock abundance of crabs in Shark Bay (see Gascoyne Coast Blue Swimmer Crab report for more details). Not all boats achieved their one tonne of crab catch.

Fishing effort/access level

Eighteen prawn boats operated in 2013. All boats fished with quad gear configuration (four, 10.1 m nets). The mean annual total effort recorded historically by 27 prawn boats between 1990 and 2004 inclusive is 44,864 hours, fishing with twin gear (prior to 1990, the fleet consisted of 35 boats). An adjustment was made to the nominal effort for the increased headrope (37.5% per boat) towed by the 18 quad boats with the 2013 adjusted effort being 35,897 hours (twin-gear equivalent). This adjusted effort is approximately 8% higher than 2012 and well below the mean effort between 1990 and 2004. The impact of gear amalgamation means that effective effort has not reduced as much as nominal effort.

The increased cost of fishing (mainly high fuel prices and high value of the Australian dollar) has also reduced effort. The 2013 prawn season arrangements provided 175 nights fishing, however, a maximum of 160 nights were fished.

Recreational component: Nil

Stock Assessment

Assessment complete: Yes

Assessment level and method:

Level 4 - Direct survey/catch rate

Breeding stock levels:

King prawns	Adequate
Tigers prawns	Adequate
Scallops:	Inadequate

Prawns

The catch per unit of effort for the prawn fishery can be used as an indicator to monitor changes in stock levels from year-to-year. Spawning stock and recruitment indices are derived from survey data and commercial catch rate levels of tiger prawn spawning stock from logbook data. Conservative tiger prawn catch rate levels are in place to maintain spawning stock above acceptable levels. Logbooks provide information on the daily catch (kg) of target species and effort (hours trawled) expended in specific fishing areas. Catch per unit effort can then be derived for each fishing area by each boat by species. Fishery-independent surveys are undertaken for king and tiger prawn stocks, which are monitored and assessed for size and catch rates from recruit surveys in March and April, king prawn surveys in Denham Sound in June and July, and tiger prawn breeding stock surveys in July and August.

Fishery-independent recruitment surveys are undertaken as fishery-dependent data on key recruitment grounds are no longer available. Historically, fishing occurred in these grounds from 1 March and commercial catch rate information provided information on recruitment trends, however since late 1990s, no fishing occurs in these areas early in the season. The information is also used to forecast a predicted catch range for tiger and king prawns and to determine the extent of areas to be opened to fishing to meet prevailing market requirements.

The spawning stock surveys are undertaken to verify tiger prawn catch rates after the TPSA is closed to fishing. Some of the king prawn breeding stock is also protected by this closure and their catch rates are also recorded during the surveys. Two standard spawning stock surveys are generally undertaken around the third moon phase in July and August, in the Tiger Prawn Spawning Area (TPSA). For 2013 the surveys were planned for end of June and July (third moon phase) but the surveys were actually undertaken in July and September due to commercial boat availability and therefore the TPSA could not be assessed on the appropriate moon phase directly after closure. In 2013 the survey was also extended to include the Extended Nursery Area (ENA). The ENA survey was implemented to undertake an additional assessment of the spawning stock (spawning condition and abundance) for tiger and king prawns around the same lunar phase as the TPSA is sampled, during the key spawning period. In future it is planned that the surveys be undertaken during August and September when the ENA and the TPSA are both closed. This will require an adjustment of spawning index time series to take into account the sampling months. The TPSA was closed to fishing on 21 June to maintain a level spawning stock of tiger prawns between 20 and 25 kg/hr (the target level is 25 kg/hr based on 22 fathoms net headrope length in quad gear configuration).

Catch rate assessment

The overall king prawn catch rate of 31.7 kg/hr (for adjusted

effort equivalent to twin gear units) was slightly lower than in 2012 (32.4 kg/hr), however, it was relatively high when compared with the previous ten years mean catch rate (24.1 kg/hr). The overall tiger prawn catch rate of 18.4 kg/hr was higher than in 2012 (14.9 kg/hr) and also higher than the previous 10 years mean catch rate (11.3 kg/hr). These catch rates show that the fishing fleet is fishing efficiently and abundance levels are acceptable.

Survey assessment and breeding stock levels

For 2013, the king and tiger prawn mean survey catch rates during the combined recruitment surveys (March and April) were 47.6 kg/hr and 47.5 kg/hr respectively and the catch predictions for king and tiger prawns were 880 t (705 to 1055 tonnes) and 500 t (400 to 600 tonnes) respectively. The actual landed catches of both species were above their predicted ranges. The relationship between survey indices and landings will continue to be reviewed.

To help maintain adequate tiger prawn breeding stock levels, fishing is delayed on the tiger prawn stock by not opening the Carnarvon/Peron line (CPL) at the commencement of the season. The aim for the Tiger Prawn Spawning Area (TPSA) within the CPL is to close this area at a target catch rate level of 25 kg/hr. The target catch rate (kg/hr) level was conservatively adjusted for use of quad gear (four 10.1 m nets) in 2007 (up from 20 kg/hr). The catch rates for tiger prawns in the TPSA were 20.2 kg/hr and 7.9 kg/hr in July and September respectively. The tiger prawn spawning stock level in the TPSA in July was below the target level of 25 kg/hr, which is based on July-August catch rates but considerably higher than that observed in July 2012 (6.6 kg/hr). The lower catch rate in September was expected as the catch rate level generally declines by this time because the prawns migrate through this area. The TPSA is an important area for tiger prawn spawning stock from June, the early stages of the key spawning period, to maintain adequate stock abundance because it is significant for egg production at this time. By September/October the tiger prawn abundance generally declines to a low level, therefore, this time may not provide an appropriate measurement of the entire spawning stock.

Conversely, the ENA becomes an important area for spawning after it closes from August. This area maintains some prawn abundance (both tiger and king prawns) and spawning stock throughout the latter part of the key spawning period. The surveys conducted in July and September 2013 showed tiger prawn catch rates of 21.0 kg/hr and 39.7 kg/hr respectively with a mean catch rate of 30.5 kg/hr. The overall catch rate from the TPSA and ENA combined may better represent the total spawning stock level of tiger prawns but cannot be directly compared to previous spawning stock surveys which were just done in the TPSA. In the future a revised index will be determined for these two areas combined and will be used in stock assessment and harvest strategy. The king prawn catch rates during the spawning stock survey in the TPSA in July and September were 75.8 kg/hr and 23.1 kg/hr respectively with a mean catch rate of 49.4 kg/hr, which is above the historical range for this species (16-29 kg/hr) at this time of year. King prawn spawning stock remains above the level where it significantly affects the recruitment and it is therefore adequate. Fluctuations in the annual king prawn harvest are most likely to have resulted from varying effort levels and environmental effects on recruitment, not from the spawning stock abundance.

Variable quantities of minor penaeids (predominantly coral prawns) are retained, depending on the catch of the target species. Owing to the small size of these species, it is likely that the majority of the stock is able to pass through the trawl mesh, suggesting that the overall exploitation is low and that breeding stock levels will therefore be adequate. Due to the low market prices received for these minor species their retention is low.

Projected prawn catch range next season (2014):
King prawns 725-1085 tonnes
Tiger prawns 430-645 tonnes

The recruitment survey results for March-April 2014 were similar to 2013 and therefore similar predicted catch range for king and tiger prawns are derived.

The main performance measures for the prawn fishery relate to maintenance of breeding stocks for each of the major target prawn species. In 2013, the breeding stock indicator for tiger prawns was slightly below the target level of 25 kg/hr. However, the 2014 tiger prawn recruitment index was average and provided a catch prediction within the target catch range and it appears that overall there was an adequate spawning stock during the key spawning period in 2013. Examination of the 2013 logbook data for the spatial distribution and abundance of tiger prawn spawning stock indicates the stock was concentrated well south of the TPSA. The king and tiger prawn annual landings were within the revised king prawn target range and the historical tiger prawn target range.

Scallops

Scallops mature at about one year of age and spawning typically occurs from April to November. Fishing is therefore controlled to ensure that sufficient scallops remain through the key spawning season (April to July), which is the critical period for generating the forthcoming season's recruits.

The 2013 catch predictions based on the fishery-independent survey in November 2012, were extremely low for both Denham Sound (10 t) and northern Shark bay (20 t). These very low overall catch predictions for the fishery meant that all the available stock needed to be protected as spawning stock and the fishery remained closed. This low recruitment appears due to continued poor environmental conditions (e.g. warm water temperatures) for recruitment and in part the low abundance of spawning stock resulting from the extreme environmental conditions in late 2010 and early 2011 in Shark Bay due to the very strong La Niña, strong Leeuwin Current and record-high water temperatures.

A small area where some recruit scallops were identified in Denham Sound was closed to prawn trawling in 2013 as an additional protective measure for the scallop spawning stock. This will assist in assessing whether recruitment variability is due to environmental factors alone or if it is also impacted by trawling on the spawning stock and/or subsequent recruitment.

The performance measure is to ensure adequate breeding stock levels. This is normally achieved by cessation of fishing at the appropriate catch rate target as the catch predictions were below the minimum abundance level for fishing, the fishery remained closed for the 2013 season to allow all scallops to contribute to the spawning stock. Despite no fishing in 2012 and 2013 the spawning stock is at record-low levels and hence is likely to negatively impact on the recruitment even if environmental conditions improve.

Projected scallop catch next season (2014):

Nil tonnes (whole weight)

The catch projection for the 2014 season is based on the November 2013 annual survey results and were extremely low (3 – 4 t meat weight) for both northern Shark Bay and Denham Sound. As the catch prediction for the fishery is so low all the available stock should again remain for spawning with no scallops to be taken. Three consecutive years of low recruitment means that the spawning stock in 2014 will again be well-below average.

Non-Retained Species

Bycatch species impact:

Low

Prawn trawlers

Bycatch composition for the prawn fishery is dominated by dead wire weed, which breaks off from the extensive shallow Wooramel seagrass bank annually over summer. The bycatch also contains a number of small size fish species mostly not taken by other sectors. Small blue swimmer crabs and other crustacean species are also taken in significant quantities but are generally returned to the sea alive. Overall bycatch taken in trawl nets are moderate relative to other subtropical trawl fisheries at about 4–8 times the prawn catch. Grid and secondary bycatch reduction devices (square mesh panels in cod-ends) are fully implemented and further reduce the quantity of small fish retained in trawls. A comprehensive research survey found no significant difference in invertebrate or finfish abundance or diversity between trawled and untrawled areas.

The two performance measures for the fishery relate to:

(i) its impact on biodiversity through the take of non-target (bycatch) species, and (ii) its impact on associated species, e.g. dolphins, through the discarding of bycatch (provisioning). In the case of biodiversity, a major project surveying bycatch species on and off the trawl grounds has been completed. Data analysis indicates that trawled areas have similar diversity to the larger adjacent untrawled areas, indicating that the performance indicator will be met. For provisioning, the indicator has been met due to the lower and more targeted trawl effort and implementation of BRDs in the fleet. Both actions have reduced the rate of discards relative to the pre-BRD period.

Scallop trawlers

Generally the total bycatch of fish and other fauna is minimal for the scallop fishery owing to the legislated design of the

nets (which use 100 mm mesh) and the relatively short duration of the fishery. No fishing occurred in 2013.

Listed species interaction: Low

Although listed species including whales, dolphins, dugongs, turtles and sea snakes are particularly abundant in Shark Bay generally, only sea snakes are seen regularly in the trawl catches in certain areas, and these are mostly (~90%) returned to the sea alive. There has been a focus on improved reporting of interaction and fate of listed species. The full implementation of bycatch reduction devices (grids) in the fishery since 2002 has generally eliminated the occasional capture of turtles in trawl nets.

For the 2013 prawn fishing season, 36 turtles were recorded as caught in nets in the prawn fishery with 35 being recorded as returned to the sea alive. With improved reporting of listed species interactions, 363 sea snakes were reported as caught with 351 returned to the sea alive.

Ecosystem Effects

Food chain effects: Low

Although the harvest rates of the retained target species are high, such species have very high natural mortality rates and make up a relatively small proportion of the ‘fish’ biomass on the trawl grounds. Thus, most prawn and scallop predators are opportunistic due to these natural variations in prawn and scallop populations. Consequently, it is considered unlikely that the commercial take of prawns and scallops impacts significantly on the upper trophic levels within the Shark Bay ecosystem. The reduced levels of effort now used by the fishery, combined with the modifications to gear to reduce unwanted catch, will have further reduced the potential for indirect food chain impacts to occur.

Habitat effects:

Prawn fishery Moderate

Scallop fishery Low

There are extensive permanent and temporary closures in the Shark Bay trawl fisheries. The total area inside Shark Bay is 4652 nm² and represents 38% of the total fishery area (including closed areas) (Shark Bay Prawn and Scallop Figure 1).

Prawn trawlers

The prawn fleet operates in approximately 7% of the overall fishery boundaries. The permitted trawl area inside Shark Bay is 1768 nm² and represents 38% of inner Shark Bay (excluding the closed areas) but trawling does not occur across this whole region. Trawl fishing is focused in the deeper areas (predominantly sand/shell habitats) of the central bay, north and northeast of Cape Peron and in the northern area of Denham Sound. The majority of sponge/coral habitats are contained within specific trawl closures to protect these areas.

Scallop trawlers Nil

Performance measures for habitat impact relate to the spatial extent of prawn trawling within Shark Bay’s sand/shell and coral/sponge habitats. Both the prawn and scallop fleet permitted trawl areas are below the 40% level of the inner Shark Bay area. Most sponge/coral habitats in Shark Bay are now protected by fishery permanent closures, which will limit the actual trawl area below 40% at any time. In 2013 the performance measure was met as the total area trawled within inner Shark Bay by the prawn fleet was approximately 798 square nautical miles or 17% of inner Shark Bay.

Social Effects

These industries are a major contributor to regional employment. During 2013, approximately 100 skippers and other crew were employed in the prawn fishery. There are also approximately 55 processing and support staff directly employed at Carnarvon. Nor West Seafood is based in Carnarvon with administration, wharf and engineering staff based at the small boat harbour and a processing factory at Babbage Island. Approximately 70% of their work force is permanent. The prawn sector also utilises, wherever possible, Western Australian service companies providing engineering supplies, packaging, transport logistics, ship stores and fuel.

Economic Effects

Estimated annual value of major prawn and scallop for 2013:

Prawns Level 5 - > \$20 million (\$22.9 million)

Scallops Level 0 - Nil

The value of the fishery including blue swimmer crabs, coral prawns, cuttlefish, squid and bugs to the prawn fleet is \$23.3 million.

Ex-vessel prices for prawns vary, depending on the type of product and the market forces operating at any one time, and average ex-boat prices were as follows:

King prawns	\$12.33/kg
Tiger prawns	\$13.33/kg
Coral prawns	\$3.33/kg
Endeavour prawns	\$7.27
Crabs	\$9.23/kg

Fishery Governance

Target catch range:

Prawns (New range) 1350 – 2150 tonnes

Scallop 1250 – 3000 tonnes whole weight

Under previous effort levels, normal environmental conditions and based on catches in the 1990s following the restructuring of the fishery to 27 licences, the target catch range had been set for major penaeids at 1501 – 2330 t. Similarly, the target catch ranges for individual species were king prawns 1100 – 1600 t, tiger prawns 400 – 700 t and endeavour prawns 1 – 30 t.

The current focus of industry is to target larger size prawns

resulting in a shift in effort which has reduced the expected range of total landings (under normal environmental conditions) for king prawns to 950 -1450 t compared to historical catch ranges with tiger prawns 400 – 700 t and endeavour prawns 1 – 30 t, remaining at the same level. Because of the change to the king prawn catch range, a revised overall range has been calculated as 1350 -2150 tonnes. This range will be adopted in 2014 with a new target catch range developed for the combined prawn catch and individual target species.

The scallop target catch range, under normal environmental conditions, remains at approximately 1250 – 3000 t whole weight, based on catches over the five-year period 1995 – 1999. This period exclude the high catches of the early 1990s (Shark Bay Scallop Figure 4), apparently created by an unprecedented four years of El Niño conditions. The projected scallop catch for 2014 (<10t whole weight), based on a pre-season survey, is below the target catch range and the fishery remains closed.

New management initiatives (2014)

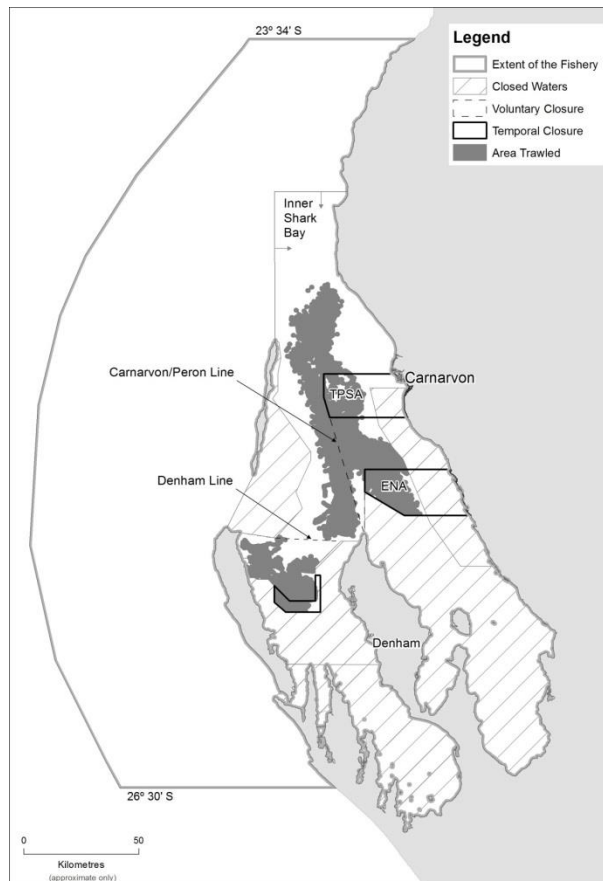
The pre-assessment phase for the Marine Stewardship Council approval system has been completed for both fisheries, with the Shark Bay Prawn Managed Fishery undergoing full assessment during 2014-15.

External Factors

Increasing costs of fishing and lower returns due to the global economic climate and competition from imported and locally aquacultured small prawns, has focussed harvesting practices on targeting larger prawns during efficient catch rate periods and shifting the emphasis to domestic markets rather than export markets. This has also provided the prawn industry the opportunity to maximise the return from all species taken in the fishery where possible, particularly scallops and blue swimmer crabs. Fishing in the early part of the season and short moon closure periods at this time tends to increase the take of smaller size and soft prawns (particularly king prawns) and to some extent, reduces the value of the fishery.

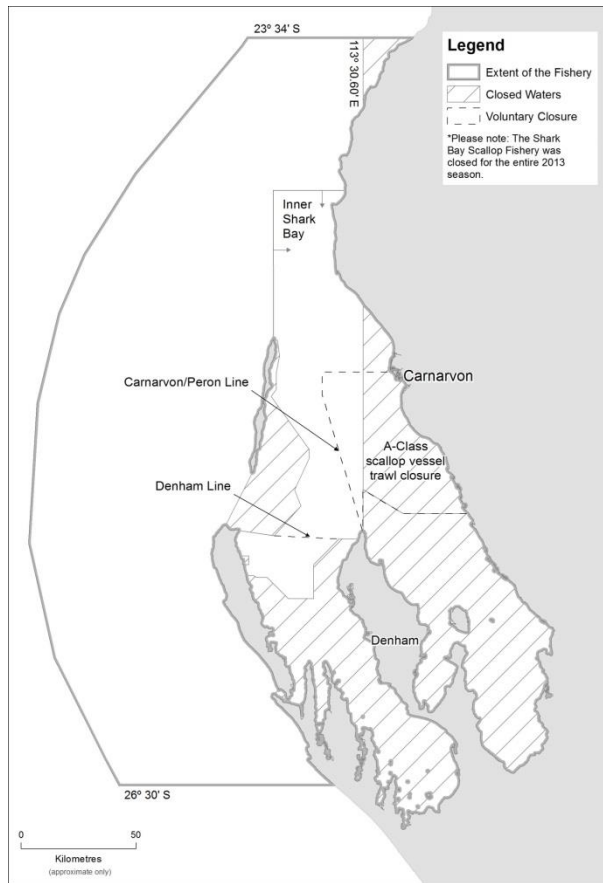
The major environmental factor influencing these stocks appears to be the flow of the Leeuwin Current along the outside of the embayment. A relationship between current strength (as measured by Fremantle sea level) and king prawn catches has been identified and may be used to indicate broad catch trends. The higher current flows increase water temperatures, which may increase the growth and catchability of the prawns. A relationship exists between sea level (at Fremantle) and the recruitment of scallops in Shark Bay, particularly in the Red Cliff area. Generally, high sea levels corresponding to strong Leeuwin Current (and warmer water temperatures) correlate with poor recruitment.

The Department of Fisheries is currently examining the mechanisms that control recruitment success in greater detail, in order to explain more of the inter-annual variation that occurs.



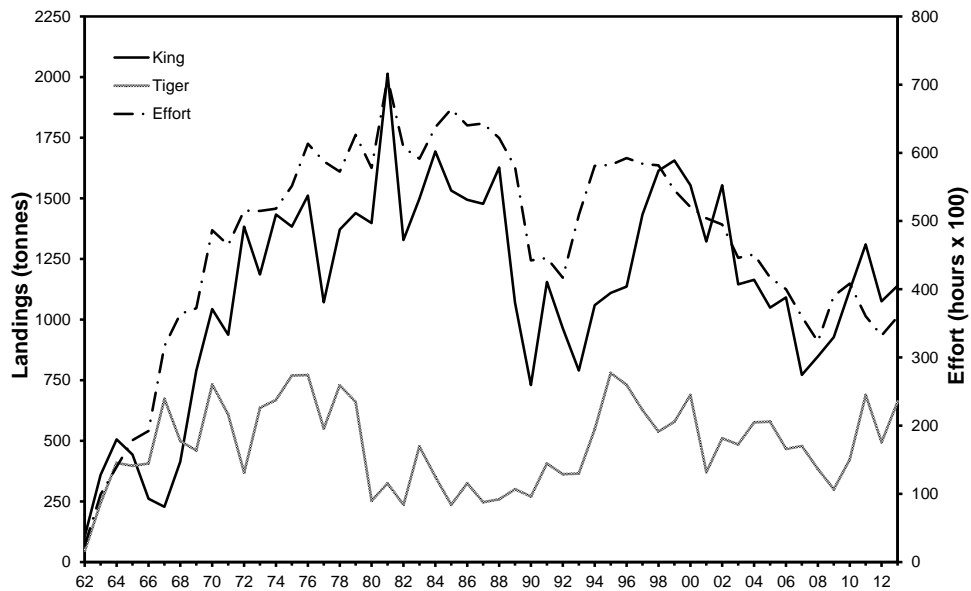
SHARK BAY PRAWN AND SCALLOP FIGURE 1

The main boundaries of the Shark Bay Prawn Managed Fishery, Inner Shark Bay, TPSA, ENA, trawl closures, permitted trawl area (extends out to the 200m isobath) and area trawled in 2013.



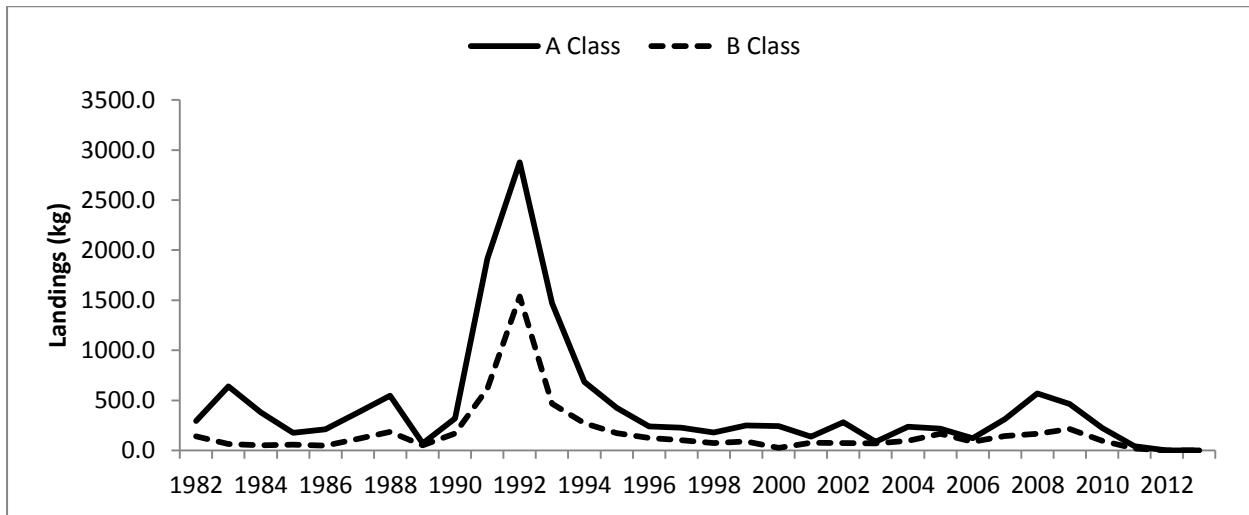
SHARK BAY PRAWN AND SCALLOP FIGURE 2

The main boundaries of the Shark Bay Scallop Managed Fishery, permitted trawl area (extends out to the 200m isobath).



SHARK BAY PRAWN AND SCALLOP FIGURE 3

Shark Bay Prawn Managed Fishery annual landings and effort (adjusted to quad gear units) 1962 – 2013.



SHARK BAY PRAWN AND SCALLOP FIGURE 4
 Shark Bay Scallop Managed Fishery annual landings 1983 – 2013.

Exmouth Gulf Prawn Managed Fishery Status Report

E. Sporer, M. Kangas, I. Koefoed, R. Oliver

Main Features			
Status		Current prawn Landings	
Stock level	Adequate	Tiger	95 t
Fishing level	Acceptable	Kings	331 t
		Endeavours	85 t
		Banana	74 t

Fishery Description

The Exmouth Gulf Prawn Managed Fishery uses low opening, otter prawn trawl systems within the sheltered waters of Exmouth Gulf to target western king prawns (*Penaeus latisulcatus*), brown tiger prawns (*Penaeus esculentus*), endeavour prawns (*Metapenaeus* spp.) and banana prawns (*Penaeus merguensis*).

Governing legislation/fishing authority

Exmouth Gulf Prawn Managed Fishery Management Plan 1989
 Exmouth Gulf Prawn Managed Fishery Licence
 Commonwealth Government *Environment Protection and Biodiversity Conservation Act 1999* (Export Exemption)

Consultation process

The Department undertakes consultation directly with licensees on operational issues.

Boundaries

The main boundaries for the Exmouth Gulf Prawn Managed Fishery are shown in Exmouth Gulf Figure 1. This diagram outlines the boundaries of the fishery, the areas where trawling is permitted, the areas actually trawled in 2013, the Tiger Prawn Spawning Area (TPSA) which is closed for part of the season, and the areas permanently closed to trawling.

Management arrangements

Management of this fishery is based on input controls, including limited entry, seasonal and area openings and closures, moon closures and gear controls. Management arrangements are designed to keep fishing effort at levels that will maintain a sufficient spawning biomass of prawns (particularly tiger prawns). The process for in-season fishing area opening/closing is dynamic and involves real-time management between the Department’s Research Division and the industry. Opening and closing dates vary each year, depending on environmental conditions, moon phases and the results of fishery-independent pre-season surveys that

provide a catch prediction. The Department's Vessel Monitoring System (VMS) monitors the activities of all boats during the season.

Within this fishery, effort is primarily controlled through the maximum headrope units (capacity of the fishery) and the duration of the season. The maximum headrope allocation for the fleet is set at 394.8 m (216 fathoms), which is a 10% reduction of the original headrope since the change to the more efficient quad gear configuration was approved. This has resulted in a reduction in the number of boats with the headrope allocation being redistributed among the remaining boats. The reduction of boat numbers and overall net allocation has allowed industry to maximise economic efficiency, whilst maintaining overall and stock sustainability.

In recent seasons, management arrangements have provided for a fishing period of about 200 nights with a minimum of 28 non-fishing nights for moon closures during the period. For the 2013 season, official opening and closing dates were set at 8 April and 14 November, providing a maximum of 185 nights fishing. This is a flexible arrangement and the season actually commenced on 15 May based on results from pre-season surveys and fishing ceased 10 November (144 days fished). There were spatio-temporal closures during the early part of the season (May to 26 July) to avoid fishing on small prawns to maximise the value of the limited tiger prawn stock available in 2013.

Stringent measures are in place to ensure that spawning stock levels for tiger prawns are maintained at adequate levels and the prospects of both recruitment and growth over-fishing are avoided. These measures will continue to be applied, while incorporating a flexible fishing regime to optimise size and value of prawns.

Bycatch reduction devices (BRDs) are mandatory in this fishery, with all boats required, by a condition on the managed fishery licences, to fish with a 'grid' and a secondary fish escapement device (FED) fitted in each net. Industry, in association with the Department, successfully gained certification from the US Department of State in 2008 and was re-certified in 2012. This certification allows licensees to export product to the US market. A review of the conditions, of its BRD-compliance, for reducing the potential for turtle captures by the US Department of State will be undertaken in 2014. Because of the increase in the size of the net headrope and the body of the net to accommodate the reduction of boat numbers (from 9 to 6) the actual size of the grids and the grid escape opening were required to be increased in line with the U.S standards. Since 2002 industry has also used 'hopper' in-water sorting systems which provide an improved quality of prawns and reduced mortality for some bycatch species.

The Commonwealth Government's Department of the Environment (DotE), assessed the fishery in 2013 under the provisions of the *Environmental Protection and Biodiversity Act 1999* (EPBC Act), and has accredited the fishery for a period of five years (re-assessment in 2018), allowing product from the fishery to be exported from Australia. The comprehensive ESD assessment of this fishery made a number of recommendations that required management action to ensure adequate performance, including status of the target stock, listed species interaction and bycatch monitoring. Boxed text in this status report provides the

annual assessment of performance measures/indicators related to these issues.

Research summary

Research activities continue to focus on stock assessment and surveys to monitor annual recruitment of tiger prawns, spawning stock levels and a pre-season surveys of king prawns (established in 2002). These surveys also provide prawn size structure information to assist with harvesting strategies (these are detailed above in the management arrangements) and understanding of prawn movement in this fishery. An annual catch prediction for both tiger and king prawns is also provided using an index derived from the recruitment surveys. In 2013 two pre-season recruitment surveys were undertaken for both tiger and king prawns.

Monitoring of fishing activity is undertaken in real time and using target catch rates to determine the specific timing of the closure of the tiger prawn spawning area. All boats complete detailed daily logbooks, which, together with survey data and catch unload records, provide a major source of information for managing the fishery. The joint evaluation and implementation of gear modifications to reduce bycatch and improve product quality is ongoing.

King prawn breeding stock levels in the fishery are maintained at adequate levels during normal environmental conditions through controls on fishing effort, their extended breeding period and lower catchability of the species compared to tiger prawns. Research into the cause of the low tiger prawn recruitment in 2012 and 2013 is currently underway.

Retained Species

Commercial production (season 2013):

585 tonnes

Landings

The total landings of major penaeids for the 2013 season were 585 t, comprising 95 t of tiger prawns, 331 t of king prawns, 85 t of endeavour prawns and 74 t of banana prawns. The tiger prawn landings were well below the normal catch range (250-550 t) but an improvement on the 2012 catch of 46 t. The king prawn landings were slightly below the target catch range (350-500 t). The king prawn landings increasing trend has continued since the low recorded landings of 97 t in 2011. Endeavour prawn landings were below the normal catch range of 120-300 t but an improvement on last year's catch of 51 t. Banana prawn landings were the highest on record in 2013.

Recorded landings of byproduct were; 2 t of blue swimmer crab (*Portunus armatus*), 3 t of squid, 1 t of bugs (*Thenus australiensis*), 2 t of coral prawns, 3 t of cuttlefish and <1 t of octopus. Landings of blue swimmer crabs were slightly below the historical range (8 to 58 t). The low effort in locations where crabs are abundant, were reflected in the low catches which were similar to the 2012 season. Crabs and other byproduct are taken incidentally and are variable depending on abundance available on the trawl grounds each year. Fishers retain crabs at a minimum size of approximately 137 mm spine to spine measurement (compared to the recreational minimum size of 127 mm).

Fishing effort/access level

In 2013 six boats operated towing a total of 292.6 m (160 fathoms) of net headrope, well below the maximum allocation of 395 metres (216 fathoms). There were two different net headrope sizes towed, four boats towing 10.97 m (6 fathom nets) and two boats towing 14.63 m (8 fathom nets), because four boats cannot tow the larger nets.

Total nominal effort for the 2013 season was 9503 hours, a slight increase compared to the extremely low nominal effort recorded in 2012 (7042 hours). The adjusted effort (to twin gear) in 2013 was 17,124 hours. Fishing effort (in hours) in 2013 was the second lowest in 40 years but also reflects the low prawn abundance. Generally the effort on king prawns is targeted at the latter part of the season when their abundance peaks during late August to end September. Fishing effort normally continues into November, and also did in 2013 year mainly because of the low effort during the early part of the season (a combination of banana and tiger prawn fishing in the Central area) and shifting effort to the latter part of the season. The season ceased on 10 November with 144 days actually fished, only 27 more fishing nights compared to 2012.

Stock Assessment

Assessment complete: Yes

Assessment level and method:

Level 4 - Direct survey/catch rate

Breeding stock levels: Adequate

Projected catch next season (2014):

275 (220-330) tonnes tiger prawns

125 (100-150) tonnes king prawns

The standardised catch per unit effort (CPUE) data from the fishery is an indicator of abundance, and can be used to monitor changes in stock levels from year to year. The average catch and catch rate is compared to a ten-year reference point (1989 to 1998) for each species. Because of the reduced number of boats in the fleet and the focus on size and quality of prawns the reference catch ranges need to be reviewed in the future and possibly adjusted for the current fishing harvesting strategy. The tiger and king prawns stocks are also assessed each year using standardised recruitment and breeding stock surveys.

Catch assessment

The preliminary adjusted annual catch rate of 5.6 kg/hr for tiger prawn was lower than the reference catch rate of 10 kg/hr. As in 2012, the low catch rate of tiger prawns reflect their low abundance. The likely cause of the continued low abundance (low recruitment levels) may be a result of three years of very high water temperatures since 2010/2011 (highest observed in 2013) and its possible continued impact on the spawning stock and/or inshore structured habitats. During 2013 fishing on the tiger prawn stock was again conservative and only parts of the Central area was open to fishing. Fishing for tiger prawns was undertaken from 15 May to 26 July after which the TPSA closed. There were six subsidiary openings in the Central area whilst the Eastern area remained closed for the entire season. When fishing ceased according to the target catch rate level for tiger prawns on 26 July the TPSA was not re-opened to fishing for

the remainder of the season.

The adjusted catch rate 19.3 kg/hr for king prawns is above reference catch rate level of 11.7 kg/hr. There is still, however, some concern for the king prawn stock as total landings were below the acceptable catch range even though there was an increase in the total landings compared to 2011 and 2012 seasons. Fishing effort does not appear to be the main cause of the decline in annual landings at current effort levels, however, there may need to be a consideration of implementing a small area closure during the spawning season to provide protection to some of the spawning stock. Fishery-independent surveys are undertaken to measure the recruitment strength and spatial distribution and catch and effort information from logbooks is used during the spawning phase to assess the stock status and to understand the distribution of king prawns in the northern gulf. The season commenced on 15 May, almost 1 month earlier than in 2012, as a result of improved king prawn recruitment. King prawns were fished conservatively during the early part of the season and effort in the northern area (the main king prawn fishing grounds) was focused mainly in the latter part of the season. Also in the early part of the season, areas where small size king prawns were located, were closed to fishing to ensure that size and quality were maintained.

All prawn fishing ceased in 2013 following the fishing protocol set out in the season arrangements related to king prawn size composition.

Survey assessment

The tiger and king prawn stocks are assessed each year using standardised surveys, which permits variations to the management plan using flexible real-time arrangements within the season to optimise catch and size grades and ensure sustainability.

For tiger prawns, this process involves analysis of survey-based indices of recruitment and spawning stock, which are assessed against the spawning stock recruitment relationship. The catch prediction for tiger prawns is based on the relationship between recruitment survey indices (early and late March and early April) and the season's landings (April–November of the same year). The recruitment survey recorded an improved abundance level compared to 2012 and predicted tiger prawn catch range for 2013 was 170 to 250 tonnes. For the 2013 season the annual total landings were below the prediction range, probably as a result of conservative levels of fishing. The tiger prawn breeding stock levels are maintained at adequate levels by monitoring the tiger prawn catch rates to determine when fishing should cease in the main tiger prawn fish grounds. This strategy maintains the spawning biomass of tiger prawns above the historically determined biological reference point. The present target catch rate is 25 kg/hr based on 6-fathom nets in quad gear configuration (which is reduced to 19 kg/hr after 1 November).

For the 2013 season it was difficult (as it was in 2012) to monitor the tiger prawn catch rates because of the intermittent nature of fishing between the tiger prawn area and the northern king prawn area and, the presence of banana prawns in the Central area which fishers sometimes targeted instead of tiger prawns. When boats shift effort between areas, monitoring tiger prawn catch rates on a daily basis is problematic. Also, the low number of boats (6) in the fishery does not provide a full coverage of all the fishing areas with

only hot spots being primarily fished. For this reason a survey was undertaken on 3 July to obtain standardised fishery-independent tiger prawn catch rate information east of the spawning area. The Central area was closed between 2 and 15 July and re-opened for a limited fishing time within a restricted area between 16 and 25 July. When fishing ceased on 26 July the TPSA was not re-opened to fishing for the remainder of the season.

Three standardised tiger prawn breeding stock surveys are carried out in August, September and October each year. The 2013 survey results showed an average quad gear CPUE for all three surveys of 14.7 kg/hr and 30.4 kg/hr in the spawning areas (Q1 and Q2 respectively) with an overall mean catch rate of 22.6 kg/hr compared to 17.3 kg/hr in 2012. This level is an increase on the spawning stock abundance observed in 2012 and is above the limit (15 kg/hr) and threshold reference points (20 kg/hr) but is slightly below the target level (25 kg/hr). King prawn breeding stock levels in the fishery are maintained at adequate levels during normal environmental conditions through controls on fishing effort, their extended breeding period and lower catchability of the species compared to tiger prawns.

Recruitment surveys were also undertaken for king prawns in the northern part of the fishery that provided prawn size structure and abundance information. The combined pre-season surveys (March and April) provided a catch prediction of 315 t with a range between 250 and 380 t. The annual landing of 331 t was within the catch prediction range.

There is no formal stock assessment for endeavour prawns, a secondary target species whose distribution overlaps that of tiger prawns, and they are fished to varying levels depending on the abundance of (and hence the fishing effort applied to) the more valuable tiger prawns. The breeding stocks of endeavour prawns are considered to be at adequate levels because their distribution overlaps that of the tiger prawns and the tiger prawn closures also protect a significant portion of the endeavour prawn breeding stock each year. In addition, endeavour prawns are also considered to be more resilient to fishing pressure due to their smaller size and lower catchability and less targeting than the tiger and king prawns.

The main performance measures for the fishery relate to maintenance of breeding stocks for each of the major target prawn species. The strategy for tiger prawns is to maintain the spawning biomass above the historically determined biological reference points with the present target of 25 kg/hr with a limit of 15 kg/hr. The mean tiger prawn spawning stock catch rate of 22.6 kg/hr was slightly below the target level. Stocks of king prawns are monitored using catch levels which were slightly below the target catch range but within the predicted catch range. However, there is a conservative harvesting strategy in place for this species. The higher banana prawn annual landings corresponded to the relatively higher rainfall experienced by this region over the summer months.

Non-Retained Species

Bycatch species impact: **Low**

Bycatch levels for Exmouth Gulf are relatively low by tropical trawl fisheries standards, with few species of

significance to other fishing sectors being taken. All boats used hoppers (in-water catch sorting systems), which add another level of improvement for bycatch survival and product quality. Fishing adjusted effort in 2013 was a slight increase compared to the 2012 season (the lowest since 1970) the second lowest seen since 1970.

The two performance measures for the fishery relate to (i) its impact on biodiversity through the take of non-target (bycatch) species, and (ii) its impact on associated species, e.g. dolphins, through the discarding of bycatch (provisioning). Analysis indicates that trawled areas have similar diversity to the larger adjacent untrawled areas (even though abundances may vary), indicating that the performance indicator will be met. For provisioning, the indicator has been met due to the lower and more targeted trawl effort (with only six boats now operating) and implementation of BRDS in the fleet. Both actions have reduced the rate of discards relative to the pre-BRD period.

Listed species interaction: **Low**

While listed species including dugongs, turtles and sea snakes, occur in the general area, only sea snakes and occasionally turtles are encountered in the trawl catches. Both species are typically returned to the sea alive. Grids are now compulsory, which has largely eliminated the capture of any turtles or other large animals. In addition, secondary bycatch reduction devices (square mesh panels) were implemented in all nets in 2005. There has been a focus on correct reporting of interactions with listed species by fishers. In 2013 ten turtles (2 green, 1 loggerhead and 7 unidentified) were reported as captured in nets and returned to the sea alive. One hundred and eleven sea snakes (unidentified) were reported as captured and were reported as returned to the sea alive. Fourteen sawfish were reported as captured but their status was unknown and 1 seahorse was reported.

Ecosystem Effects

Food chain effects: **Low**

Although the prawn species are managed to relatively high levels of annual harvest, the impact of the catch on local food chains is unlikely to be significant in view of the high natural mortality, extent of non-trawled nursery areas and variable biomass levels of prawns resulting from variable environmental conditions, such as cyclone events.

Habitat effects: **Low**

Historically, the fishery has impacted on some shallow water areas (less than 12 m in depth) containing sponge habitats, but the refocusing of the fishery into deeper waters to take larger prawns since the early 1980s has reduced this interaction. The trawling effort is now focused in the deeper central and north-western sectors of Exmouth Gulf. Owing to the predominantly mud and sand habitats of the trawl grounds, the trawl gear has relatively little physical impact. Overall, the nature of this particular trawl fishery and the very tight controls on effort indicate that its environmental effect is now likely to be low. The spatial extent of area fished in the last two years has also been reduced with the

area trawled below 25% of the fishery compared to around 30% in past years.

Performance measures for habitat impact relate to the spatial extent of trawling within the licensed area of the Exmouth Gulf fishery. In 2013 the performance measure was met as the total area trawled, at approximately 247 square nautical miles (21.7%) per cent of Exmouth Gulf, was below the 40% level.

Social Effects

The estimated employment in the fishery for the year 2013 was 18 including skippers and other crew. Twenty three additional support staff are also based in Exmouth Gulf and additional support staff in Fremantle for refit of boats. Within the Exmouth area, the fishery is one of the major regional employers contributing to the economic viability of the Exmouth township.

Economic Effects

Estimated annual value of major prawns for

2013: Level 3 - \$5 - 10 million
(\$6.8 million including byproduct)

Ex-vessel prices for prawns vary, depending on the type and quality of product and the market forces operating at any one time. In this fishery there is a high degree of vertical integration, with the fishing company, which own the boats undertaking direct marketing of the product into overseas markets. For this reason, the prices quoted for prawns and byproduct are provided by the company based on an overall average price taking into account each grade abundance landed. The total estimated value of the fishery includes byproduct (\$6.8 million). This reflects an increased value of the fishery compared to the low 2012 season value, however, below the expected value of the fishery between 8 and 11 million dollars. Estimated prices for prawns were as follows:

King prawns	\$12.33/kg
Tiger prawns	\$13.33/kg
Banana prawns	\$ 9.33/kg
Endeavour prawns	\$7.27/kg
Coral prawns	\$3.33/kg

Fishery Governance

Target catch range: 721 – 1,410 tonnes

Current fishing level: Acceptable

Under current fishing effort levels, the target catch range for major penaeids is 721–1,410 t so the total catch of 585 t is below the range. The long-term target catch ranges for individual species are king prawns 350–500 t, tiger prawns 250–550 t, endeavour prawns 120–300 t and banana prawns 1–60 t (noting that maximum or minimum catches do not occur for all species simultaneously). The catch ranges for individual species and a total for all major penaeids were

developed (circa 1999) as a means of providing governance for the target ranges for prawns in the prawn managed fisheries. For Exmouth the initial individual species ranges were changed in 2000, but has not been reflected in the total for major penaeids. This has been amended for 2012, including banana prawns (1–60 tonnes)

These overall and individual figures are generally based on a 10-year average (1989-1998). Tiger prawns annual landings (95 t) while below the catch prediction (170-250 t) was not unexpected due to the low effort that triggered the early cessation of fishing on tiger prawns. The king prawn survey catch rates indicated an abundance (315 t) slightly below the long term catch range. The annual landings (331 t) were below the catch range but within the predicted range (250 to 380 t).

New management initiatives (2014)

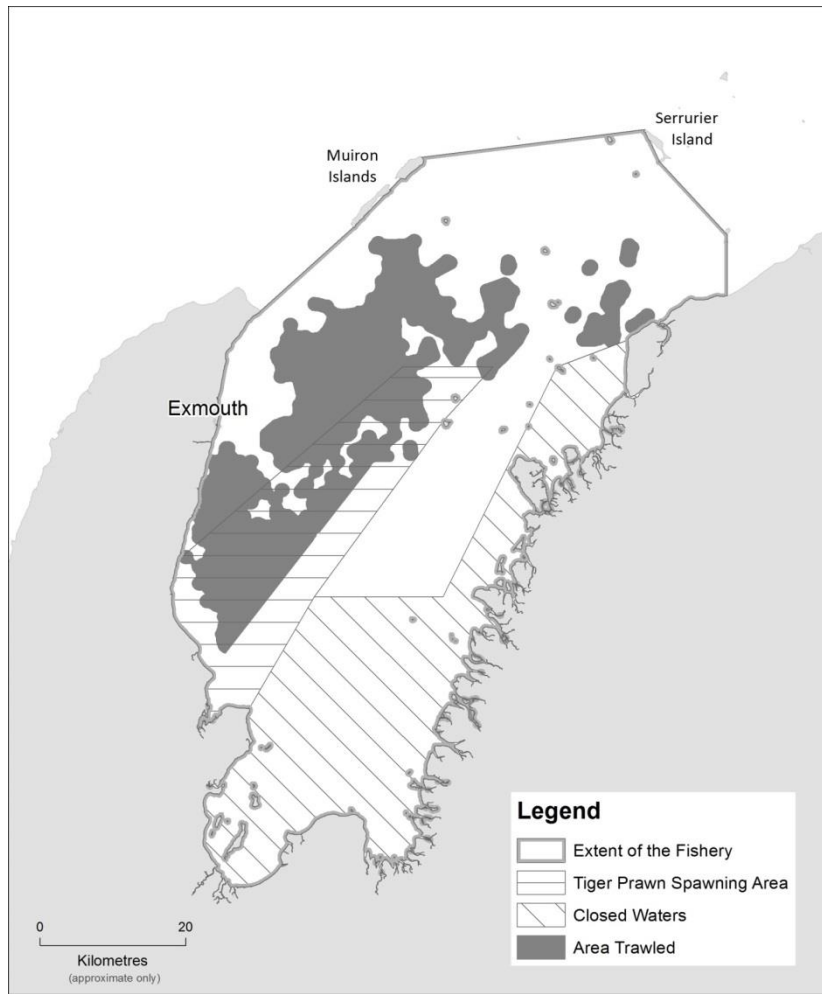
The Department is still progressing an amendment to the management plan in consultation with licensees to incorporate changes to gear arrangements in this fishery. The fishery completed the Marine Stewardship Council pre-assessment during mid-2013 and is undergoing full assessment in 2014/15.

External Factors

Increasing costs of fishing and lower returns due to the global economic climate, high value of the Australian dollar and competition from imported and Australian aquacultured small prawns, has focussed fishing harvesting strategies about targeting larger prawns during efficient catch rate periods and shifting the emphasis to domestic markets, however, product to the export markets are maintained but at lower profit margins.

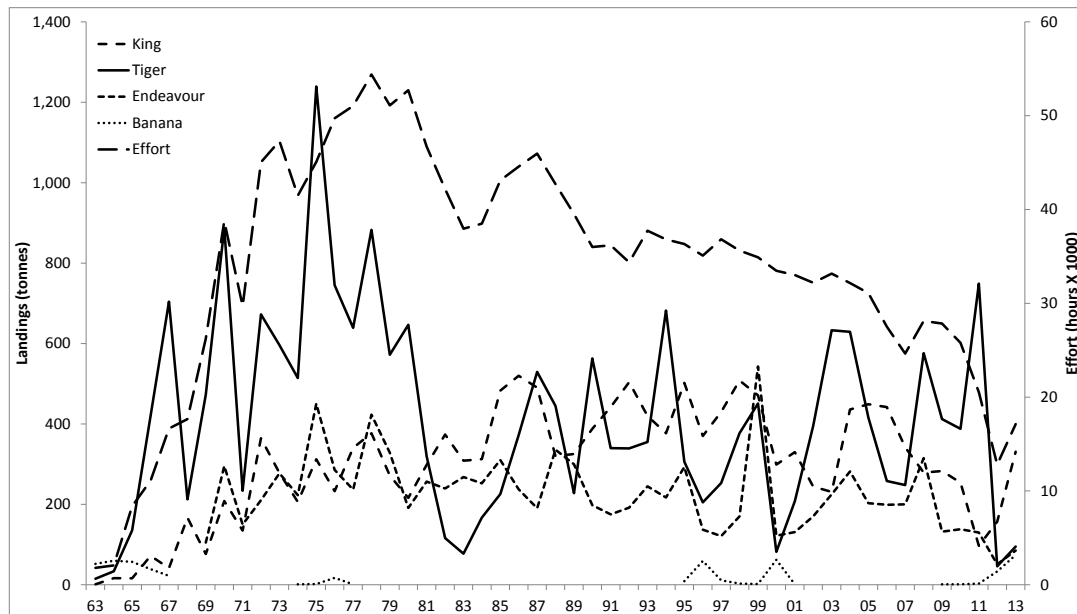
Cyclones appear to have a significant effect on the productivity of Exmouth Gulf. Cyclone impacts can be either positive or negative. Early (December to January) cyclones can have a negative impact (high mortality) on small size prawns in the shallow nursery areas. The positive effect is that the water becomes turbid and prawn mortality reduces and prawns are triggered to move out into the trawl grounds. It is considered likely that there will be other environmental effects of cyclones, related to the destruction of shallow seagrass nursery areas. Other environmental factors, may also impact on recruit survival, but have yet to be fully investigated.

The heat wave event may have contributed to the recent extremes in abundance of brown tiger prawns in Exmouth Gulf. In 2011, the brown tiger prawn recruitment and landings were one of the highest recorded which led to a very high spawning stock abundance. However in 2012, the lowest recruitment was observed resulting in the lowest catch. This in turn has resulted in low spawning stock in 2012 although it is at levels that has historically resulted in moderate recruitment. In 2013 there was some improvement in recruitment. The cause of the low recruitment is being investigated in regard to sea temperatures and funding is being sought to further investigate impacts on inshore habitats.



EXMOUTH GULF PRAWN FIGURE 1

The main boundaries of the Exmouth Gulf Prawn Fishery, extent of fishery closed waters, TPSA (Q1 and Q2), and area trawled in 2013.



EXMOUTH GULF PRAWN FIGURE 2

Exmouth Gulf Prawn Managed Fishery annual landings and adjusted effort (twin-gear), 1963 – 2013.

West Coast¹ Deep Sea Crustacean Managed Fishery Status Report

J. How and K. Nardi

Main Features

Status	Current Landings
Stock level	Adequate
Fishing Level	Acceptable
	Crystal Crabs
	140 t

Fishery Description

The West Coast Deep Sea Crustacean Managed Fishery targets Crystal (Snow) crabs (*Chaceon albus*), Giant (King) crabs (*Pseudocarcinus gigas*) and Champagne (Spiny) crabs (*Hypothalassia acerba*) using baited pots operated in a long-line formation in the shelf edge waters (>150m) of the West Coast and Gascoyne Bioregions.

Governing legislation/fishing authority

West Coast Deep Sea Crustacean Managed Fishery Management Plan 2012

West Coast Deep Sea Crustacean Managed Fishery Licence

Commonwealth Government *Environment Protection and Biodiversity Conservation Act 1999* (Wildlife Trade Operation).

Consultation process

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

Boundaries

The boundaries of this fishery include all the waters lying north of latitude 34° 24' S (Cape Leeuwin) and west of the Northern Territory border on the seaward side of the 150m isobath out to the extent of the Australian Fishing Zone.

Management arrangements

The West Coast Deep Sea Crustacean Managed Fishery is a quota-based 'pot' fishery. The fishery mostly operates in depths of 500-800 metres, with the only allowable method for capture being baited pots ('traps'). These are operated in 'long-lines', which have between 80 and 180 pots attached to a main line marked by a float at each end.

The Department of Fisheries has minimum size limit and specific regulations to protect breeding females (berried

females must not be retained). A minimum carapace length of 120 mm applies for the principal target species Crystal Crab, and 92 and 140 mm carapace minimum lengths applying respectively for the lesser targeted species-Champagne and Giant crabs.

The fishery transitioned from an interim managed fishery to a managed fishery on 1 January 2013. Within the new management plan, there was unitisation of the licenses (which replaced permits in the previous interim management plan). Unitisation allowed greater transfer of units between license holders. Catch of Giant and Champagne crabs were previously retained as 'byproduct' of a permit. They are now unitised as "B" class units which allowed these to be transferred onto a single license to permit these species to be specifically targeted while still retaining a "B" class quota of 14 t.

Research summary

Research for this fishery has involved assessing the current status of the west coast deep sea crab stocks based on commercial catch returns, log book information and at-sea research monitoring of the catch. The annual total Crystal crab catch from 2000 to 2008 have been historically used to monitor this fishery for ecologically sustainable development assessment. However, since the quota system has come into operation in 2008, performance measures are now based on whether the quota is achieved and the standardised catch rate required to achieve quota.

A recent pre-assessment of the fishery for Marine Stewardship Certification has been the focus of the research for this fishery. It has resulted in the development of a proposed harvest strategy and control rules framework, and a re-assessment of the model for standardisation of the catch rates. There has also been considerable work undertaken to gain a better understanding of the catches, particularly undersize and berried females which are currently only estimates by fishers recorded through the volunteer logbook program. This assessment includes remote video / on-board monitoring and industry catch sampling. All methods are currently being assessed for future monitoring protocols.

¹ Note: This is the official name of the fishery. Boundaries include Gascoyne, see above.

Retained Species

Commercial landings (season 2013):

Crystal crab	139.5 tonnes
Giant crab	0.0 tonnes
Champagne crab	0.0 tonnes

The catch of 139.5 tonnes of Crystal crab in 2013 was similar to all years since the introduction of 140 t. quota in 2008 (Deep Sea Crab Figure 1). There was no catch of ‘B’ class quota (Champagne or Giant crab). The lack of Champagne crab catch is likely due to low market demand, and there being no targeted fishing for Giant crabs. The catch records are based on mandatory monthly catch and effort returns prior to 2008, with the more accurate trip catch disposal records from 2008 onwards.

Recreational catch estimate (season 2013) Nil

Fishing effort/access level

Nominal commercial effort decreased by 1 % from an estimated 54,028 pot lifts in the 2012 season to 53,414 pot lifts in the 2013 season. The standardised commercial effort similarly decreased from 68,483 pot lifts in the 2012 season to 62, 807 pot lifts for the 2013 season, a 8% reduction. The catch of the fishery (see above) is divided by the average logbook catch rates to provide an estimate of nominal effort for the fishery and the standardised catch rate for the standardised effort.

Stock Assessment

Assessment complete Yes

Assessment level and method:

Level 2 - Catch rate

Breeding stock levels Adequate

The fishery effectively achieved the quota for crystal crabs with landings of 139.5 t, which is within the target catch range (100-140 t). The standardised catch rate of legal crabs increased by 9% in 2013 to 2.22 kg/pot compared with 2.03 kg/pot in 2012 (Deep Sea Crab Figure 2). The 2013 standardised catch rate represents the highest in a decade (Deep Sea Crab Figure 2), and is above the current notional upper target reference point .

Crystal crabs are known to be very slow growing as are most other deep-water species. Preliminary estimates suggest that the males attain maturity at around 12 years and reach legal minimum size at about 14 years. Ageing estimates are not available for females, but size at maturity information shows that they mature well below the legal size limit and probably moult once after reaching maturity, which means that their contribution to the fished biomass is small and that egg production in the fishery is well protected by the legal size limit provided that there are sufficient males. After a drop in the standardised catch rate of ovigerous females in 2008, presumably due to a shift in effort with the removal of zone restrictions, it has remained steady from 2008 to 2012 and remains above the current notional threshold reference point

(Deep Sea Crab Figure 3a). There was a progressive decline in the standardised catch rate of undersized crabs with the catch rate reaching a low in 2010. Since then the standardised catch rate has increased and in 2013, the level is above the notional threshold level and is similar to the level in 2012 (Deep Sea Crab Figure 3b)

The standardized catch rate takes into account the soak period, location and depth of fishing, however does not take into account increases in fishing efficiency.

The performance measures for the fishery were revised after the move to quota to:

- a) whether the quota has been achieved, and*
- b) the standardised catch rate to achieve the quota is acceptable (above an ‘informal’ threshold value with a degree of certainty).*

Both of the measures were met.

Non-Retained Species

The fishery just completed a Marine Stewardship Certification pre-assessment, and all aspects associated with non-retained species were scored such that they pose little-no effect on the bycatch or listed species.

Bycatch species impact Low

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

Listed species interaction Negligible

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

Ecosystem Effects

The fishery just completed a Marine Stewardship Certification pre-assessment, and all aspects associated with ecosystem effects were scored such that they pose little-no effect on the ecosystem.

Food chain effects Negligible

Total landings of the 3 species of deep sea crabs represent a very small biomass, and any impact of fishing on the general food chain is expected to be minimal. Most of the commercial Crystal crab catch is taken in depths between 500 to 800 metres. An estimate of the amount of ground between 500–1,000 m over the distributional range of Crystal crabs is about 50,600 km². Assuming that all the ground is equally productive, at catch levels experienced in the past seasons about 3 kilograms of crabs are being removed each year per square kilometre of ground.

Habitat effects Low

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

Social Effects

This fishery is based on mobile vessels that employ a skipper and two or three crew. The product is landed live at ports between Carnarvon and Fremantle, generating some additional economic activity and benefits. There were three vessels operating in 2013.

Economic Effects

Estimated annual value (to fishers) for 2013

Level 2 - \$1 - 5 million (\$2.3 million)

The beach value of the fishery was about \$2.3 million in 2013 with the majority of the catch sold live to Asian markets both locally and internationally.

Fishery Governance

Target catch range	100-140 tonnes
Effort range	50-80,000 pot lifts
Current fishing (or effort) level	Acceptable

The TAC for the fishery has been set well below landings of which occurred in the early and mid 2000's and is at the lower end of the target catch range for the WTO assessments.

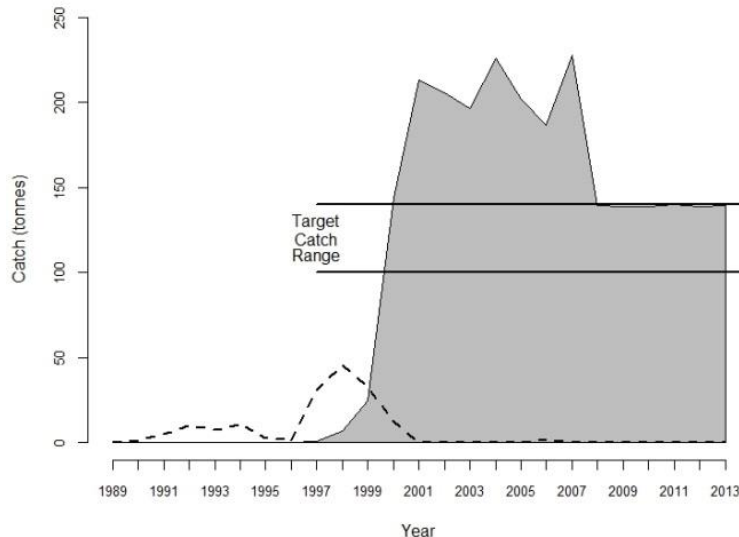
A preliminary effort range to achieve the TAC had been generated as 70,000–100,000 pot lifts but with the current nominal effort (2009-13) of 76,370- 53,414 pot lifts all below this level. The effort range was subsequently revised to 50,000-80,000 pot lifts. A proposed harvest strategy is currently being considered by industry which will formalise future effort levels under quota in line with the proposed target range for standardised catch rates.

New management initiatives (2014)

It is planned that the proposed harvest strategy currently before industry will be formally incorporated into the management plan of the fishery. It should be noted that the management plan for the fishery was introduced on 1 January 2013.

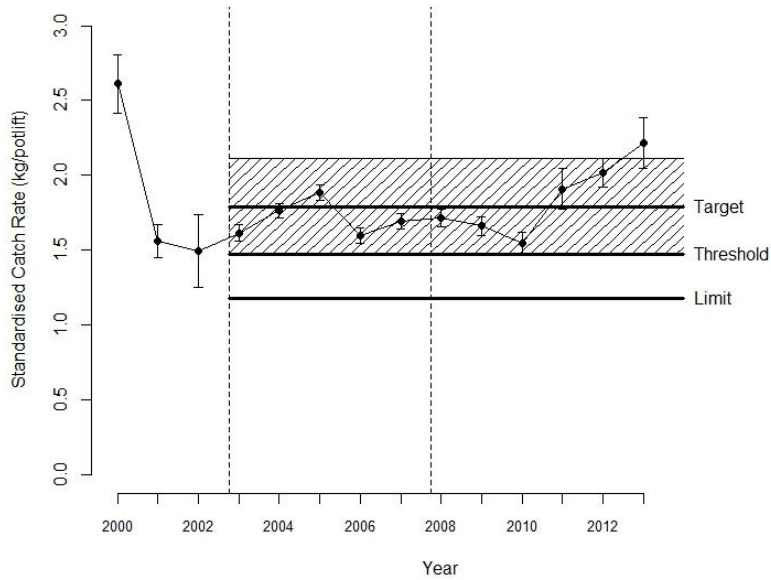
External Factors

Given a large export market, fluctuation in the Australian dollar can have impacts on the economic performance of the fishery.



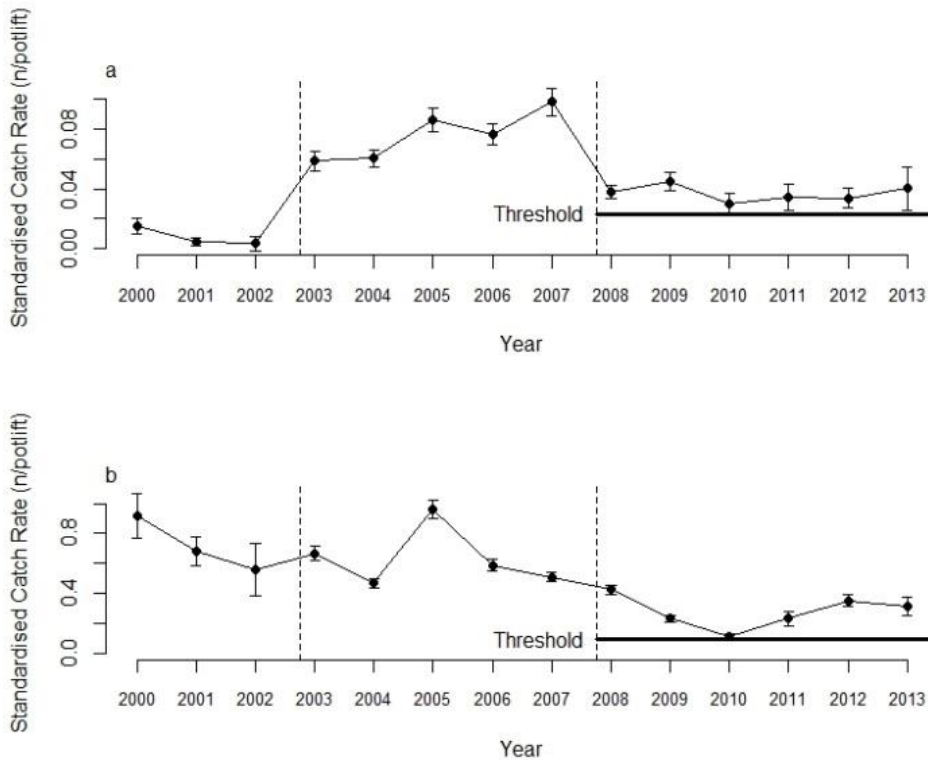
WEST COAST DEEP SEA CRUSTACEAN FIGURE 1

Annual catches of Crystal (grey) and Champagne (dotted line) crabs since 1989. Annual giant crab catches have always been small, and they have therefore been excluded. Heavy lines represents the target catch region for crystal crabs (100-140t).



WEST COAST DEEP SEA CRUSTACEAN FIGURE 2

Standardised catch per unit effort (± 95 CI) since 2000 for crystal crabs. Area between vertical dashed lines indicate period when management required fishing in all zones. Horizontal lines represents the current notional target (solid line) and target range (hashed region), threshold and limit reference points for crystal crabs in the fishery. The method of standardizing catch rates was revised this year which has resulted in minor changes to the annual values.



WEST COAST DEEP SEA CRUSTACEAN FIGURE 3

Standardised catch per unit effort (± 95 CI) since 2000 for a) berried and b) undersized crystal crabs relative to their respective notional threshold reference point

Gascoyne Demersal Scalefish Fishery Status Report

G. Jackson, R. Marriott, E. Lai and H. Zilles

Main Features			
Status	Current Landings (2013)		
Stock level	Pink snapper:		
Pink snapper	Adequate	Commercial	233 t
Goldband snapper	Adequate	Recreational	30 t
Spangled emperor	Adequate	Charter	11 t
Fishing Level	Goldband snapper:		
Pink snapper	Acceptable	Commercial	73 t
Goldband snapper	Acceptable	Recreational	7 t
Spangled emperor		Charter	8 t
North Gascoyne	Unacceptable	Spangled emperor:	
South Gascoyne	Acceptable	Commercial	2 t
		Recreational	35 t
		Charter	4 t

Fishery Description

The Gascoyne Demersal Scalefish Fishery encompasses commercial and recreational (line) fishing for demersal scalefish in the continental shelf waters of the Gascoyne Coast Bioregion (Gascoyne Demersal Scalefish Fishery Figure 1).

Since 1 November 2010, the Gascoyne Demersal Scalefish Managed Fishery (GDSF) has incorporated the pre-existing pink snapper quota system from the Shark Bay Snapper Managed Fishery (SBSF) plus the previously open access area south of Coral Bay.

Commercial vessels in these waters historically focussed on the oceanic stock of pink snapper (*Chrysophrys auratus*) during the winter months. The GDSF licensed vessels fish throughout the year with mechanised handlines and, in addition to pink snapper, catch a range of other demersal species including goldband snapper (*Pristipomoides multidentis*), rosy snapper (*P. filamentosus*), ruby snapper (*Etelis carbunculus*), red emperor (*Lutjanus sebae*), emperors (Lethrinidae, including spangled emperor, *Lethrinus nebulosus*, and redthroat emperor, *L. miniatus*), cods (Epinephelidae including Rankin cod, *Epinephelus multinotatus* and goldspotted rockcod, *E. coioides*), pearl perch (*Glaucosoma burgeri*), mulloway (*Argyrosomus japonicus*), amberjack (*Seriola dumerili*) and trevallies (Carangidae).

A limited number of licensed charter vessels and a large number of recreational vessels fish out of Denham, Carnarvon and around the Ningaloo area (Gnaraloo Bay, Coral Bay, Tantabiddi and Exmouth) and catch a similar range of demersal species.

Governing legislation/fishing authority

Commercial

Gascoyne Demersal Scalefish Management Plan 2010

Gascoyne Demersal Scalefish Managed Fishery Licence

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

Recreational

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

Consultation process

Commercial

The Department undertakes consultation directly with licensees on operational issues. Industry Annual General Meetings are convened by the Western 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 facilitated by Recfishwest under a Service Level Agreement although the Department undertakes direct consultation with the community on specific issues.

Boundaries

Commercial

The GDSF operates in the waters of the Indian Ocean and Shark Bay between latitudes 23°07'30"S and 26°30'S

(Gascoyne Demersal Scalefish Fishery Figure 1). GDSF vessels are not permitted to fish in inner Shark Bay. No state-licensed commercial vessels are permitted to fish between 21°56' and 23°07'30"S ('Point Maud-Tantabiddi Well' closure). Management arrangements for the West Coast Demersal Scalefish Fishery (WCDSF) permit a limited number of commercial vessels to operate in Gascoyne waters up to the southern boundary of the GDSF (26°30'S).

Recreational (including Charter)

The recreational fishery (which includes activities by licensed charter vessels) operates in all Gascoyne waters with the exception of Sanctuary Zones, Marine Nature Reserves and Conservation Areas within the Ningaloo and Shark Bay Marine Parks.

Management arrangements

Commercial

The *Gascoyne Demersal Scalefish Management Plan 2010* (the Plan) was implemented on 1 November 2010. The Plan superseded the *Shark Bay Snapper Management Plan 1994* and provides a more effective management framework for the sustainable use of all demersal scalefish stocks in the Gascoyne Coast Bioregion. The 'open-access' wetline fishing operations that were previously undertaken in waters between 23°34'S and 23°07'30"S (Gascoyne Demersal Scalefish Fishery Figure 1) are also incorporated within the Plan (see Fisheries Management Paper No. 224 for further details).

Pink snapper within the GDSF are managed through the use of output controls based on an Individual Transferable Quota system. The 'quota-year' for pink snapper runs from 1 September to 31 August, with a total of 5,142 units in the fishery. There is a requirement to hold a minimum of 100 units of pink snapper entitlement to be able to operate within the fishery. This requirement was carried over from the *Shark Bay Snapper Management Plan 1994*.

Demersal scalefish other than pink snapper are currently managed using an interim effort cap of 30 days per 100 units of pink snapper quota which restricts total fishing effort and is applied as a non-transferable licence condition. A dedicated non pink snapper demersal scalefish entitlement system is being developed by the Department in consultation with WAFIC and licensees.

An Environmental Protection and Biodiversity Conservation Act (EPBC Act) assessment for the SBSF was first completed in 2003, and the fishery was re-accredited in 2009 for a further 5 years (next scheduled review will be in 2015). This fishery along with all other commercial fisheries in the Gascoyne underwent Marine Stewardship Council (MSC) pre-assessment in 2013.

Minimum legal lengths apply to many of the commercial target species (e.g. pink snapper, red emperor and emperors).

Recreational (including Charter)

The recreational fishery (including charter vessels) is managed using maximum and minimum legal lengths, daily bag and possession limits, and limitations on the use of certain fishing gears. Daily bag limits in the Gascoyne were revised in 2013 as a result of a statewide recreational fishing review which was designed to simplify recreational fishing

rules across the state. Key changes included the introduction of a mix species bag limit of five demersal finfish as well as limits for individual species that include: three pink snapper; three cods; three emperors and one coral trout. Recreational fishers can no longer transport fish by unaccompanied means (e.g. courier).

All persons fishing from a powered boat anywhere in the state are required to hold a Recreational Fishing from Boat Licence or fish in the company of a licence holder (since March 2010).

Research summary

Catch and effort monitoring for this fishery includes analyses of commercial 'daily/trip' returns for GDSF licensed vessels, catch-disposal records (only for pink snapper, to monitor individual quotas), 'monthly' catch and effort returns for charter vessels, and various recreational survey data.

The commercial catch and effort data reported here are for GDSF licensed vessels fishing between 23°07'30"S and 26°30'S. The reporting period used for commercial catches is the 2012-13 licensing period for the GDSF, i.e. 1 September 2012 – 31 August 2013 (referred to as 'season 2013'). Charter catches are reported for the calendar year. For recreational fishing, the most recent catch estimates for goldband snapper and spangled emperor were derived from data obtained from the first statewide integrated survey of recreational boat-based fishing undertaken between 1 March 2011 and 29 February 2012 (Ryan *et al.* 2013)¹. Because the integrated survey only provides Bioregional-level catch estimates, the catch estimates for pink snapper are also informed based on the second Gascoyne wide boat-fishing survey (based on boat ramp interviews) that was undertaken between April 2007 and March 2008 (Marriott *et al.* 2012)².

Research undertaken by the Department of Fisheries on the retained species in each Bioregion is now focussed on selected indicator species.

In the Gascoyne Coast Bioregion, pink snapper, goldband snapper and spangled emperor are the indicator species for the inshore demersal suite with ruby snapper and eightbar grouper (*Epinephelus octofasciatus*) the indicator species for the offshore demersal suite (DoF 2011³).

Pink snapper: Detailed research on the oceanic snapper stock and the associated SBSF was undertaken throughout the 1980s and early 1990s. Commercial catches are sampled throughout the year to provide representative catch-at-age data. An integrated stock assessment model has been used to determine stock status since 2003 and is updated every 3 years (most recently in 2014).

Goldband snapper: Comprehensive research on goldband snapper commenced in 2007 as part of a Gascoyne Integrated Fisheries Management (IFM) project. Goldband snapper in

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 162 pp.

2 Marriott et al. (2012). Biology and stock status of demersal indicator species in the Gascoyne Coast Bioregion. Fisheries Research Report No. 228, Department of Fisheries, Western Australia, Perth.

3 DOF (2011). Resource Assessment Framework (RAF) for Finfish Resources in Western Australia. Fisheries Occasional Publication No. 85, Department of Fisheries, Perth.

the Gascoyne Coast Bioregion are managed as a single stock. The risk-based ‘weight of evidence’ assessment has been externally reviewed and published (Marriott *et al.* 2012). Monitoring of catches from the commercial, recreational and charter sectors and population age structure is on-going and further research is planned to refine estimates of the key biological parameters.

Spangled emperor: Comprehensive research on spangled emperor commenced in 2007 also as part of the Gascoyne IFM project. Spangled emperor in the Gascoyne Coast Bioregion are managed as a single stock. The risk-based ‘weight of evidence’ assessment has been externally reviewed and published (Marriott *et al.* 2012). In addition to the monitoring of commercial, recreational and charter catches, limited biological monitoring of recreational catches landed at fishing tournaments and public fish cleaning stations for this species is on-going.

Retained Species

Commercial landings (season 2013):

Total	366 tonnes
Pink snapper	233 tonnes
Goldband snapper	73 tonnes
Spangled emperor	2 tonnes
Other species	58 tonnes

The total commercial catch taken by the GDSF in the 2013 season was 366 t which is similar to the catch level in 2012 (Gascoyne Demersal Scalefish Fishery Figure 2). The catch comprised 233 t of pink snapper (oceanic stock, TACC = 277 t), plus 133 t of other species including 73 t of goldband snapper, 2 t of spangled emperor and 58 t of other scalefish species (Gascoyne Demersal Scalefish Table 1).

Recreational catch estimate (includes charter sector):

Pink snapper	ca. 40 tonnes
Goldband snapper	ca. 15 tonnes
Spangled emperor	ca. 40 tonnes

In 2013 the recreational catch of pink snapper (oceanic stock) reported by licensed charter boats was 11 t (same as in 2012). In 2007/08, an estimated 31 t of pink snapper (oceanic stock) was taken by recreational vessels fishing in Gascoyne waters (excluding inner gulfs of Shark Bay). The total catch of this stock of pink snapper taken by recreational and charter vessels in the Gascoyne is therefore assumed to be approximately 40 tonnes.

The recreational catch of goldband snapper reported by charter boats in 2013 decreased to 8 t (11 t in 2012). The recreational catch of goldband snapper in 2007/08 is estimated to have been approximately 7 t. The total catch of goldband snapper taken by recreational and charter vessels in the Gascoyne is therefore assumed to be approximately 15 tonnes.

The recreational catch of spangled emperor reported by charter boats in 2013 was 4 t (5 t in 2012). In 2011/12, an

estimated 35 t of spangled emperor was taken by boat-based recreational fishers in Gascoyne waters, which is slightly higher than the recreational catch estimate for 2007/08 (30 t). The total catch of spangled emperor taken by recreational and charter vessels in the Gascoyne is therefore assumed to be approximately 40 tonnes.

Fishing effort/access level

Commercial

There were 55 licences with pink snapper quota in the 2013 season with 16 vessels actively fishing (18 in 2012). These vessels (all are required to hold a minimum of 100 units of pink snapper quota to be able to operate in the waters of the GDSF) fished for a total of 748 days. The level of overall effort in this fishery is approximately 50% of that in the early 2000s (Gascoyne Demersal Scalefish Fishery Figure 2). The level of effort targeted at pink snapper varies on a seasonal basis, historically peaking in June–July, when the oceanic stock aggregates to spawn. Pink snapper catch rates are assessed annually using ‘standard boat days’, i.e. days fished by quota-holding vessels that caught more than 4 t each of pink snapper by line during the period June–July. GDSF vessels fished for 181 boat days during June–July in 2013 (223 in 2012).

Recreational

Total recreational boat fishing effort across the entire Gascoyne between 1 March 2011 and 29 February 2012 was estimated at approximately 60,000 fisher days (Ryan *et al.*, 2013).

Stock Assessment

Assessment complete:

Pink snapper	Yes
Goldband snapper	Yes
Spangled emperor	Yes

Assessment level and method:

Pink snapper	Level 2 - Catch Rates (annual) Level 5 - Composite Assessment (2013)
Goldband snapper	Level 1 - Catch (annual) Level 3 - Fishing Mortality (2007/08)
Spangled emperor	Level 1 - Catch (annual) Level 3 - Fishing Mortality (2007/08)

Breeding stock levels:

Pink snapper	Adequate
Goldband snapper	Adequate
Spangled emperor	Adequate

Pink snapper: An integrated stock assessment model was developed for this stock in 2003 and indicated that the spawning biomass of the oceanic stock was at a depleted level (< target level in 2002–2003). The most recent assessment using this method (completed in 2014) indicated that the spawning biomass in 2013 was above the threshold

level (30% of the unexploited spawning biomass) and just below the target level (40% of the unexploited spawning biomass).

Prior to the development of the integrated assessment model, the breeding stock was assessed using a pink snapper annual threshold catch rate based on catch and effort information from the peak of the spawning season (June–July). It is recognised that the use of catch rate as an index of pink snapper abundance must be treated with caution, due to the aggregating behaviour of the stock during the winter spawning period.

This indicator was used in the original EPBC Act assessment of the SBSF with an inaugural threshold level set at a minimum of 500 kg pink snapper/standard boat day. Since the reductions in quota were implemented in the mid-2000s, the pink snapper catch rate (GDSF vessels fishing in June–July only) has fluctuated around 550 kg/day. In the 2013 season, the pink snapper catch rate reached 710 kg pink snapper/standard boat day, the highest level since the mid-1990s (Gascoyne Demersal Scalefish Fishery Figure 3) (see also box below).

The current performance measure for the Gascoyne Demersal Scalefish Fishery is that the pink snapper catch rate for the peak months (June–July) should not fall below a minimum threshold level of 500 kg pink snapper/standard boat day.

The catch rates in the early 2000s declined to a low of 450 kg pink snapper/standard boat day. After the TACC was reduced significantly in 2004 and again in 2007, catch rates have increased to an average value of about 550 kg/day. In 2013, the catch rate was 710 kg pink snapper/standard boat day well above the threshold and the highest level since 1995.

Goldband snapper: Historical monthly catch rate data from the SBSF were found to be uninformative for use as an index of relative abundance for this species. Several more years of daily trip logbook data (implemented in January 2008) will provide the minimum basis of a time series of catch rates for examining trends in relative stock biomass. A research project is underway to evaluate daily catch rate data for pink snapper and goldband snapper. A risk-based ‘weight of evidence’ approach, based on an assessment of fishing mortality (F), has been used to assess the stock. Sufficient data from sampling the commercial fishing catches in both the 2006 and 2008 quota years were available for this analysis. Estimates of F for both years were within the target range, indicating that fishing was not having an unacceptable impact on the age structure of the population at that time. As the commercial targeting of goldband snapper has only occurred since ca. 2000, the flow through effects of these catches to its sampled population age structures used for 2008 stock assessments many not have been detectable. Therefore, ongoing monitoring was advised to confirm this low risk profile.

The total goldband snapper catch in 2013 remained below the preliminary maximum commercial catch limit recommended for this species in the Gascoyne Coast Bioregion (100–120 t, see Marriott *et al.* (2012) for details). Breeding stock levels and fishing level are currently assessed as adequate.

Spangled emperor: Historical monthly commercial catch rate data for spangled emperor were found to be uninformative as an index of abundance. A risk-based ‘weight of evidence’ approach, based on an assessment of fishing mortality, was used to assess stock status based on data collected primarily in 2007. Estimates of fishing mortality (F) indicated that in the South Gascoyne, F was close to the target level while in the North Gascoyne, F was above the limit level, suggesting that localised over-fishing was occurring north of Point Maud. Relatively few individual spangled emperor older than 10 years old were sampled from the North Gascoyne in 2007, indicating that older fish had been removed by fishing, at least from areas outside of sanctuary zones of the Ningaloo Marine Park. That F exceeded the limit level indicated that the current level of fishing on the spangled emperor population in the North Gascoyne exceeded sustainable levels and were higher than from a previous assessment done in 1989–91 (Moran *et al.* 1993¹). The spangled emperor breeding stock was estimated to be at an acceptable level for the Bioregion overall noting significant reductions in the relative numbers of older (breeding age) spangled emperor in the North Gascoyne due to localised depletions (see Marriott *et al.* (2012) for further details). A slightly higher estimate of Bioregion-wide catch for this species in 2011/12 indicates that estimates of F for spangled emperor may be at similar levels, or slightly higher, than those estimated for 2007.

Non-Retained Species

Bycatch species impact

Negligible

The commercial catch consists of a large number of demersal species of medium to high market value; therefore there are few species captured by the fishery that are not retained.

Commercial operators must return any sharks caught and are not permitted to use wire trace, in order to minimise interactions with sharks.

Listed species interaction

Negligible

As line fishing is highly selective, interactions with listed species by commercial, charter and recreational fishers in the GDSF are low. Commercial GDSF and charter fishers are required to record all listed species interactions in their logbooks. During 2013, commercial fishers in the GDSF reported no interactions with listed species. No interactions were reported in 2013 by the charter fishery in the Gascoyne Coast Bioregion.

Ecosystem Effects

Food chain effects

Low

Pink snapper and other species in this suite are generalist feeders and are just some of a number of such species inhabiting the continental shelf waters in this Bioregion. Food chain effects due to fishing for species within this suite are considered to be low because the quota system restricts overall GDSF catches to a relatively small percentage of the

¹ Moran, M. Edmonds, J., Jenke, J., Cassels, G. & Burton, C. (1993). Fisheries biology of emperors (Lethrinidae) in North-West Australian coastal waters. FRDC Project 89/20 Final Report. Department of Fisheries, Western Australia.

total biomass. The juvenile components of these stocks are likely subject to large, mostly-environmentally driven fluctuations in abundance even in the absence of fishing, resulting in significant variability in annual recruitment strength. A recent study (Hall and Wise, 2011)¹ of finfish community structure in this Bioregion found no evidence of material changes.

Habitat effects

Negligible

The nature of the fishery, targeting aggregations of adult pink snapper and other demersal scalefish using hooks and lines, means that the commercial fishery has virtually no direct impact on benthic habitats.

Social Effects

The pattern of fishing by GDSF vessels in 2013 was similar to previous years and reflects the focus on pink snapper during the peak season and fishing in deeper waters offshore for other species at other times of the year.

In 2013, 16 vessels fished during the entire season, 6 of which fished for more than 10 days during the peak season, typically with a crew of 2-3. Commercial fishing and associated fish processing are important sources of local employment in Denham and Carnarvon.

Shark Bay and Ningaloo are popular recreational fishing destinations and both locations are major tourist attractions especially during the winter months and school holidays.

Economic Effects

Estimated annual value (commercial sector) for

2012: Level 2 - \$1 - 5 million

The gross value of production (GVP) of the commercial component of the Gascoyne Demersal Scalefish Fishery was in the range \$1-5 million in 2012. While a dollar value is difficult to assign to recreational and charter catches at this stage, the availability of demersal target species underpins the local recreational fishing-based tourism industry and generates significant income for the regional economy.

Fishery Governance

Commercial:

Current effort level Pink snapper (season 2013):

Acceptable

Current catch level Goldband (season 2013):

Acceptable

Target catch (and effort) range:

Pink snapper 277 tonnes/380-540 days

Goldband snapper 100-120 tonnes (preliminary maximum catch limit)

In 2013, GDSF vessels with pink snapper quota required 328 boat days to catch 233 t of pink snapper (oceanic stock, TACC = 277 t). The available TACC was not entirely taken due to quota being left in the water for a range of operational factors affecting a small number of vessels.

The average catch rate at 710 kg pink snapper/boat day during the peak season for the 2013 was well above the threshold level (500 kg/standard boat day). This catch rate-based performance measure will be re-assessed when results from analyses of higher resolution (daily/trip catch and effort returns) data become available. The catch of goldband snapper in 2013 was below the preliminary maximum commercial catch limit.

Recreational:

Current effort level (2007/08):

Pink snapper

Acceptable

Goldband snapper

Acceptable

Spangled emperor

Unacceptable (North Gascoyne)

Acceptable (South Gascoyne)

Estimates of fishing mortality (based on data from 2007/08) indicate localised depletion of spangled emperor was occurring north of Point Maud outside of the sanctuary zones.

New management initiatives (2014/15)

The *Gascoyne Demersal Scalefish Management Plan 2010* (the Plan) was implemented on 1 November 2010, superseding the *Shark Bay Snapper Management Plan 1994*. The Plan provides the Department with the ability to manage all demersal scalefish stocks in the Gascoyne Coast Bioregion.

Phase one of the Plan has been implemented, and includes a formal entitlement system, in the form of individual transferable quota, for pink snapper. A second form of formal entitlement is required to be introduced into the Plan to explicitly regulate the take of all other demersal scalefish species. The development of an entitlement framework with the capacity to regulate catches of these other ‘non-pink snapper’ scalefish species that can work in combination with the existing ITQ system for pink snapper is scheduled for implementation in 2015.

All commercial fisheries in the Gascoyne Coast Bioregion, including the GDSF, underwent Marine Stewardship Council (MSC) pre-assessment in 2013.

External Factors

Under the Offshore Constitutional Settlement, commercial vessels licensed by the Commonwealth may operate in state waters off the Gascoyne coast, outside the 200 m isobath, as part of the Western Deepwater Trawl Fishery (WDWTF). In the 2012/13 season, total effort in this fishery was less than 70 hours trawled with no reported catches of pink snapper taken by WDWTF vessels fishing off the Gascoyne coast (AFMA unpublished data).

Climate change has the potential to impact fish stocks in range of ways. The effects of climate change may include

¹ Hall, N.G. & Wise, B.S. (2011). Development of an ecosystem approach to the monitoring and management of Western Australian fisheries FRDC Report 2005/063. Fisheries Research Report 215 Department of Fisheries, Western Australia. 112 pp.

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increasing sea surface temperatures, changes in major ocean currents (e.g. Leeuwin Current), sea level rise and ocean acidification. A review of the impacts and responses to marine climate change in Australia was undertaken by CSIRO in 2009. More recently, a 3-year FRDC-funded project to assess the effects of climate change on key fisheries in Western Australia has now been completed

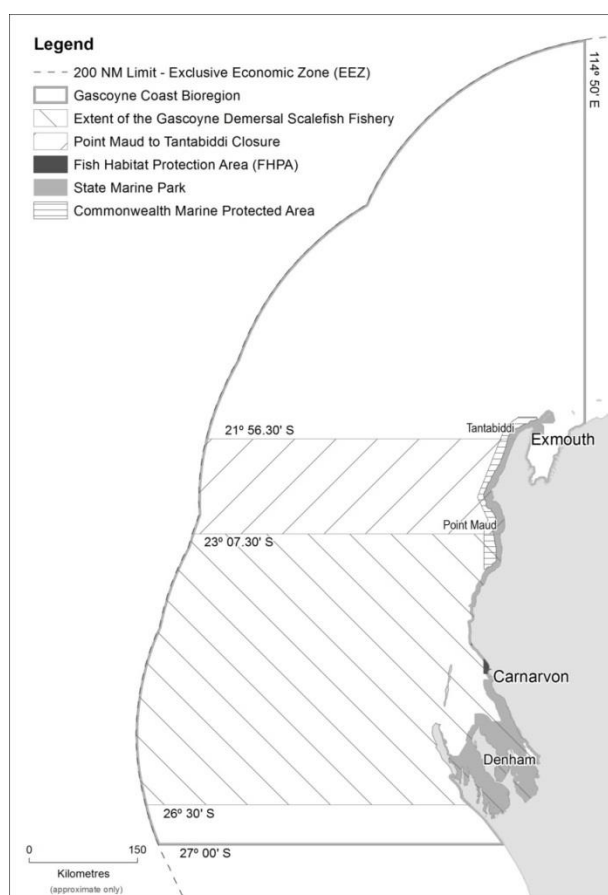
(Caputi *et al.* 2014). Pink snapper was considered as a case study species within this project with potential impacts of climate change likely to include a southward shift in the centre of geographic distribution; changes to spawning patterns; changes in individual growth and stock productivity, and through projected impacts on the Leeuwin Current, changes in larval dispersal.

GASCOYNE DEMERSAL SCALEFISH FISHERY TABLE 1

Total commercial catch of demersal scalefish species other than pink snapper taken in Gascoyne waters between

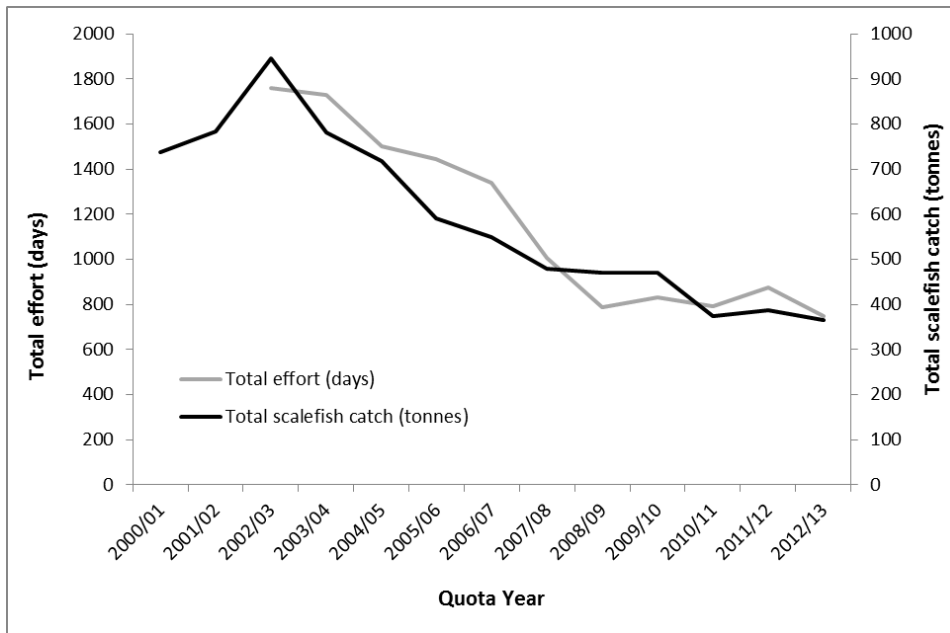
Species	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13
Goldband snapper	239.8	105.8	107.2	121.1	143.8	104.6	53.2	64.2	73.2
Red emperor	18.5	19.4	17.0	12.8	11.7	9.8	8.2	13.1	7.9
Spangled emperor	13.5	18.1	7.0	7.0	3.3	3.8	3.7	4.3	2.3
other emperors	31.8	29.2	34.3	26.8	13.8	9.2	10.4	11.6	5.1
Cods	27.9	21.9	21.5	15.0	9.5	13.4	11.4	21.1	14.0
Other	82.0	78.1	77.1	65.8	64.8	72.9	50.7	38.9	30.8
Total	413.5	272.5	264.1	248.5	246.9	213.7	137.5	153.0	133.4

2003/04 and 2012/13 (excludes mackerels, sharks and tunas). Units are tonnes.



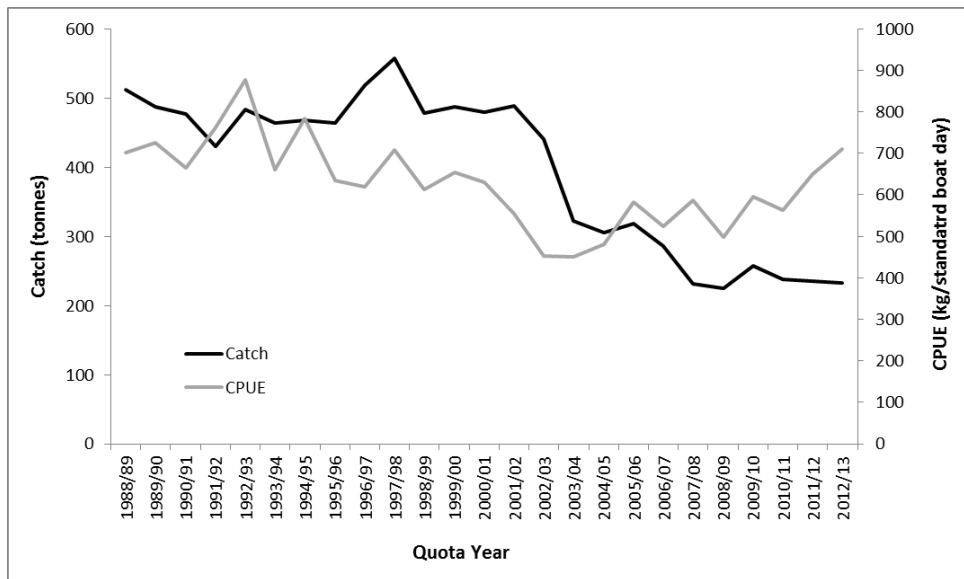
GASCOYNE DEMERSAL SCALEFISH FISHERY FIGURE 1

Waters of Gascoyne Coast Bioregion including Gascoyne Demersal Scalefish Fishery and 'Point Maud to Tantabiddi Well' fishing closure.



GASCOYNE DEMERSAL SCALEFISH FISHERY FIGURE 2

Gascoyne demersal scalefish catch (all species including pink snapper, tonnes) and total fishing effort (days) from 2000/01 to 2012/13



GASCOYNE DEMERSAL SCALEFISH FISHERY FIGURE 3

Gascoyne pink snapper catch and catch per unit effort by quota year from 1988/89 to 2012/13. Units are kg whole weight of pink snapper per standard boat day. The CPUE for vessels line fishing for snapper in June-July (peak season) is incorporated in the stock assessment model used to assess the oceanic pink snapper stock.

Inner Shark Bay Scalefish Fishery Status Report

G. Jackson, J Brown, J. Norriss and H. Zilles

Main Features			
Status		Current Landings	
Stock level:		Commercial (2013)	
Whiting	Adequate	Whiting	142 t
Sea mullet	Adequate	Sea mullet	32 t
Tailor	Adequate	Tailor	15 t
Western yellowfin bream	Adequate	Western yellowfin bream	18 t
Pink snapper	Eastern Gulf - Adequate	Pink snapper	0.4 t
	Denham Sound – Adequate	Recreational (Pink snapper only)	
	Freycinet Estuary – Recovering	Eastern Gulf	4 t (2010)
Fishing Level:		Charter	1 t (2013)
Whiting	Acceptable	Denham Sound	6 t (2010)
Sea mullet	Acceptable	Charter	1.5 t (2013)
Tailor	Acceptable	Freycinet	1.5 t (2010)
Western yellowfin bream	Acceptable	Charter	0 t (2013)
Pink snapper	Eastern Gulf – Acceptable		
	Denham Sound – Acceptable		
	Freycinet Estuary – Acceptable		

Fishery Description

The Inner Shark Bay Scalefish Fishery encompasses commercial and recreational fishing for scalefish species within the waters of the Eastern Gulf, Denham Sound and Freycinet Estuary in inner Shark Bay (Inner Shark Bay Fishery Figure 1). This includes the activities of the Shark Bay Beach Seine and Mesh Net Managed Fishery (SBBSMNF) and the Inner Shark Bay Recreational Fishery.

The SBBSMNF operates from Denham and uses a combination of beach seine and mesh net gears to mainly take four species/groups: whiting (mostly yellowfin, *Sillago schomburgki*, with some goldenline, *S. analis*), sea mullet (*Mugil cephalus*), tailor (*Pomatomus saltatrix*) and western yellowfin bream (*Acanthopagrus morrisoni*).

Most recreational fishing in Shark Bay is boat-based using rod & line or handline with some netting for bait and sea mullet. The key recreationally caught species are pink snapper (*Chrysophrys auratus*), grass emperor (black snapper or blue-lined emperor, *Lethrinus laticaudis*), western butterfish (*Pentapodus vitta*), whiting (*Sillago* spp.), Queensland school mackerel (*Scomberomorus queenslandicus*), tailor, blackspot tuskfish (bluebone, *Choerodon schoenleinii*) and goldspotted rockcod (estuary or slimy cod, *Epinephelus coioides*). A limited number of licensed charter vessels operate out of Denham and Monkey Mia.

Governing legislation/fishing authority

Commercial

Shark Bay Beach Seine and Mesh Net Limited Entry Fishery Notice 1992

Shark Bay Beach Seine and Mesh Net Managed Fishery Licence

Recreational

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

Consultation process

Commercial

The Department undertakes consultation directly with licensees on operational issues. Industry Annual General Meetings are convened by the Western 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 (e.g. Shark Bay Inner Gulf Pink Snapper Working Group that convenes every 3 years).

Boundaries

The areas covered by this report are shown in Inner Shark Bay Fishery Figure 1. Fishing is not permitted in the Hamelin Pool Nature Reserve or in sanctuary zones, recreational zones or special purpose zones within the Shark Bay Marine Park.

Management arrangements

Commercial

The SBBSMNF is managed through input controls in the form of limited entry, gear restrictions (e.g. vessel size, net length and mesh size) and permanently closed waters (e.g. Hamelin Pool, Big Lagoon, Denham foreshore). A unit in the fishery comprises one primary vessel, a maximum of three netting dinghies and a maximum fishing team of three individual fishers. Commercial line fishing for snapper has not been permitted in these waters since 1996 (see 'Gascoyne Demersal Scalefish Fishery').

Recreational

The recreational fishery in Shark Bay is managed using a combination of daily bag, possession, size and gear limits. Boat-based fishers also require a statewide recreational boat fishing licence while net fishers require a statewide recreational net fishing licence. For pink snapper more complex arrangements apply, including seasonal closures, within the Eastern Gulf, Denham Sound and Freycinet Estuary where a quota tag system also applies (Inner Shark Bay Fishery Figure 1). These stocks are managed separately with explicit Total Allowable Catch (TAC) targets. In 2013, the TACs for pink snapper were as follows:

Eastern Gulf	15 tonnes (approx. 12 tonnes recreational, 3 tonnes commercial)
Denham Sound	15 tonnes (approx. 12 tonnes recreational, 3 tonnes commercial)
Freycinet Estuary	5 tonnes (approx. 1,400 fish, i.e. 1,050 recreational and 350 commercial)

Research summary

The Department of Fisheries uses an indicator species approach to monitor and assess the status of the finfish resources throughout the State (DoF 2011¹). These indicators were selected to represent the nearshore/estuarine (waters of 0-20 m depth), inshore (waters of 20-250 m depth) and offshore (waters greater than 250 m depth) demersal, and pelagic finfish suites using a risk-based approach based on the relative vulnerability of the species/stock to fishing activities.

In the Gascoyne Coast Bioregion, tailor and yellowfin whiting are indicators for the nearshore suite while pink snapper is one of three indicators for the inshore demersal suite. While not indicators, the status of sea mullet, western yellowfin bream and grass emperor is also reported here because these species are significant components of the

commercial and recreational catch in the inner Shark Bay.

The stocks of pink snapper within the inner gulfs have been the focus of a comprehensive research program since 1996/97. Since 2002, integrated stock assessment models (Level 5) have been used to separately assess the status of the Eastern Gulf, Denham Sound and Freycinet Estuary stocks, and to determine appropriate levels of TAC. These assessments are updated every 3 years (next assessment scheduled for late 2014).

Estimates of recreational catch and effort in the inner gulfs were derived annually between 1998 and 2010 (no surveys in 1999 and 2009) using 'on-site' recreational fishing surveys involving interviews with boat crews returning to the Monkey Mia, Denham, and Nanga boat ramps (Wise *et al.* 2012)². The first integrated survey of boat-based recreational fishing in WA was conducted during 2011/12 (Ryan *et al.* 2013)³. This survey was developed to provide statewide and bioregional level catch estimates; estimates at the finer scale required for the management of inner gulf snapper stocks are not available from these survey data.

Catches of pink snapper taken by licensed commercial and charter vessels are derived from compulsory monthly catch returns. The status of the four SBBSMNF target species (whiting, sea mullet, tailor, western yellowfin bream) are monitored each year using data from commercial catch returns coupled with the extensive scientific knowledge gained from research dating back to the 1960s. Performance indicators for the SBBSMNF in the form of target catch ranges and threshold catch rates were determined as part of an ESD risk-based assessment that was undertaken in 2002-03 for Departmental purposes. This fishery along with all other commercial fisheries in the Gascoyne Coast Bioregion underwent Marine Stewardship Council (MSC) pre-assessment in 2013.

Research on pink snapper in the inner gulfs is now limited to a monitoring level that involves trawl surveys to monitor juvenile recruitment each year and daily egg production method (DEPM) surveys to estimate spawning biomass every 3 years. Most recently, DEPM surveys were undertaken in the Eastern Gulf in 2012 and in Denham Sound and the Freycinet Estuary in 2013. Stock assessments for these three pink snapper stocks will be updated prior to the next scheduled Inner Gulf Pink Snapper Working Group meeting (scheduled for October 2014).

Level 2 assessments based on trends in commercial catch and catch rates (CPUE) obtained from compulsory monthly fisher returns are conducted for the main target species of the SBBSMNF (i.e. yellowfin whiting, sea mullet, tailor and western yellowfin bream). For yellowfin whiting only, a level 3 (F-based) assessment has also recently been undertaken following the MSC pre-assessment of the SBBSMNF. A level 3 assessment was conducted for grass emperor based on data collected in 2005.

² Wise *et al.* (2012) Long-term monitoring of boat-based recreational fishing in Shark Bay, Western Australia; providing advice for sustainable fisheries management in a World Heritage Area. *Marine and Freshwater Research* 63: 1129-1142

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. 162 pp.

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

Retained Species

Commercial landings (season 2013):

Whiting	142 tonnes
Sea mullet	32 tonnes
Tailor	15 tonnes
Western yellowfin bream	18 tonnes
Pink snapper	0.4 tonnes

The total catch taken by SBBSMNF licensed vessels in 2013 was 219 t which represents an approximate 13% increase on the total catch taken in 2012. This total catch comprised 142 t of whiting, 32 t of sea mullet, 15 t of tailor, 18 t of western yellowfin bream and 12 t of other mixed scalefish species that included 0.4 t of pink snapper (taken as bycatch in net fishing gears).

Recreational catch estimates

(including charter, 2013)

Pink snapper	Eastern Gulf ca. 4-5 tonnes
	Denham Sound ca. 6-7 tonnes
	Freycinet Estuary ca. 1-2 tonnes
Grass emperor	ca. 10 tonnes

As a direct result of management intervention for pink snapper in Shark Bay, including the introduction of TAC-based management in 2003, contemporary recreational catches of pink snapper are much lower than were taken in the 1980s and 1990s.

Based on results of the most recent 'on-site' recreational fishing survey in 2010, the estimated recreational catch of pink snapper was approximately 4-5 tonnes in the Eastern Gulf, approximately 6-7 tonnes in Denham Sound and approximately 1-2 tonnes in the Freycinet Estuary. The estimated recreational catch of grass emperor in 2010 was approximately 10 tonnes (all areas combined).

In 2013, licensed charter vessels landed approximately 1.5 t of pink snapper in Denham Sound and approximately 1 t in the Eastern Gulf; no charter boat catches were reported from the Freycinet Estuary. A total catch of approximately 1 t of grass emperor (all three areas combined) was reported by charter vessels in 2013.

Fishing effort/access level

Commercial

In 2013, of the 10 SBBSMNF licenses, seven vessels were routinely involved in fishing. Following the sharp declines in recent years, total fishing effort in 2013 (646 boat days) was at a similar level to that in 2012 (692 boat days).

Recreational

In 2010, boat-based recreational fishing effort in the inner gulfs was estimated at approximately 37,000 boat fisher hours (compared to an estimated 33,000 fisher hours in 2007). More recent estimates of recreational fishing effort in Shark Bay are currently not available from the first statewide integrated survey of recreational boat-based fishing.

Stock Assessment

Assessment complete

Whiting	Yes
Sea mullet	Yes
Tailor	Yes
Western yellowfin bream	Yes
Pink snapper	Yes
Grass emperor	Yes

Assessment level and method:

Whiting/Sea mullet/Tailor/Western yellowfin bream	Level 2 - Catch, Catch Rate (2013)
Pink snapper	Level 5 - Composite Assessment (2011)
Grass emperor	Level 3 - Fishing Mortality (2005)
	Level 1 - Catch (2010)

Breeding stock levels

Whiting	Adequate
Sea mullet	Adequate
Tailor	Adequate
Western yellowfin bream	Adequate
Pink snapper	Eastern Gulf - Adequate
	Denham Sound - Adequate
	Freycinet Estuary - Recovery
Grass emperor	Adequate

Whiting, Sea mullet, Tailor, Western yellowfin bream:

Assessment of the four main SBBSMNF target species is based on annual analysis of the commercial catch and effort data. Target catch ranges and threshold catch rates (CPUE) have been determined for the total catch overall (not shown) and for each target species (Inner Shark Bay Fishery Table 1).

In 2013, the total commercial catch (all species) taken by the SBBSMNF was 219 tonnes, an increase of 31 tonnes from 2012, whilst fishing effort (boat days) declined slightly from 664 days to 646, to the lowest reported level for the fishery (Inner Shark Bay Scalefish Fishery Figure 2).

In 2013, the catch of whiting (142 tonnes) was just above the target catch range and the CPUE (220 kg/boat day) well above the threshold catch rate at the highest level observed since 1990 (Inner Shark Bay Scalefish Fishery Figure 3). This increase in both catch and catch rate can be attributed to an increase in availability of whiting and greater time spent targeting this species rather than other lower-value species such as sea mullet. A research study is currently investigating the species and age-composition of the whiting catch.

The catch of sea mullet (32 tonnes) and the CPUE (50 kg/boat day) in 2013 were at historically low levels and below their respective target and threshold levels (Inner Shark Bay Scalefish Fishery Figure 4). The decrease in the sea mullet catch is partly explained by the fleet targeting the higher-value whiting species, but may also be attributable to

a change in the distribution ('latitudinal shift') of sea mullet due to warming waters; lower catches have been observed in the northern fisheries (i.e. SBBSMNF and Exmouth Gulf Beach Seine Fishery) and increased catch rates in the southern fisheries (i.e. West Coast Nearshore Net Fishery, Peel-Harvey Estuarine Fishery, South West Beach Seine Fishery and the South Coast Estuarine Fishery – See reports in the West Coast and South Coast Bioregions sections).

In 2013, the tailor catch (15 tonnes) was again below the target range and the CPUE (23 kg/boat day) was around the threshold level (Inner Shark Bay Scalefish Fishery Figure 5). The low landings of tailor that have become a feature of the fishery in recent years are mostly attributed to local processing restrictions.

The catch (18 tonnes) and CPUE (28 kg/boat day) of western yellowfin bream in 2013 had doubled from 2012 levels and were above the target catch range and the threshold catch rate, respectively (Inner Shark Bay Scalefish Fishery Figure 6). These increases can likely be attributed to another strong year class entering the fishery, as has previously occurred during the period 2002-2007.

Pink snapper: DEPM surveys that directly estimate snapper spawning biomass were conducted annually in the Eastern Gulf, Denham Sound and Freycinet Estuary during the period 1997-2004 and periodically since. Most recently, DEPM surveys were conducted in the Eastern Gulf in 2012 and in Denham Sound and Freycinet Estuary in 2013. Research trawl surveys, to monitor variation in juvenile recruitment, have been conducted each year since 1996. Integrated assessment models have been used to assess the status of the three stocks in relation to the management target (40% of the unexploited spawning biomass) since 2002. The most recent assessments (2011) estimated the spawning biomass of snapper was above the target level (40%) in both the Eastern Gulf and Denham Sound but while improving was still below the threshold level (30%) in the Freycinet Estuary.

Grass emperor: Based on age-structure data collected in 2005, fishing mortality (F) was estimated to be around the threshold level (F=M, natural mortality). More recent information on F for this species is not available but there is no trends in recent catch data that would suggest the situation has significantly changed.

Non-Retained Species

Bycatch species impact **Low**

Bycatch is minimal in the SBBSMNF because netting operations selectively target specific schools of fish. Based on experience, fishers can determine the species and size of the school, and the size of individual fish within the school, before deploying the net. Fish are readily observed in the very shallow near-shore waters of Shark Bay. Non-target species and under-sized fish are avoided in most cases.

Listed species interaction **Negligible**

As nets are actively set and hauled, if any listed species such as dugongs, dolphins or marine turtles are caught (rare events) they are immediately released. Commercial fishers are required to report any interactions with endangered,

threatened and protected (ETP) species. In 2013, no interactions with ETP species were reported.

Ecosystem Effects

Food chain effects **Low**

The overall catch levels in the fishery have been relatively stable over several decades, despite a long-term reduction in effort, suggesting that recruitment of the main target species has not been significantly affected by fishing mortality. The total biomass of the key target species appears sufficient to maintain trophic function in these waters.

Habitat effects **Negligible**

Seine nets are set and hauled over shallow sand banks, including intertidal areas. Sand habitats are naturally dynamic environments with resident infauna adapted to cope with regular physical disturbances. Combined with the low frequency of fishing in any one location, this indicates that the fishery is unlikely to have a lasting effect on the habitat.

Social Effects

Commercial

Currently around 14 commercial fishers are employed in the SBBSMNF based on seven fishery licenses actually operating. Fishing and associated fish processing is an important source of local employment - the fishery, although relatively small-scale, makes a significant contribution to the Denham economy and community.

Recreational

Shark Bay is a popular tourist destination, especially during the winter months and school holidays: data indicate that approximately 30% of all visitors participate in recreational fishing during their stay.

Economic Effects

Estimated annual value (commercial sector) for 2012 **Level 2 - \$1 - 5 million**

Commercial

The gross value of production (GVP) of the SBBSMNF in 2013 was estimated in the range \$1-5 million.

Recreational

While a dollar value is difficult to assign to recreational and charter catches, the availability of quality fishing underpins the tourism industry and generates significant income for the regional economy.

Fishery Governance

Commercial

Current effort level (2013): **Acceptable**

Target catch range (2013):

All species (ex pink snapper) **235–335 tonnes**

Pink snapper **Eastern Gulf 3 tonnes**

Denham Sound 3 tonnes**Freycinet 1.2 tonnes**

Total fishing effort in the SBBSMNF was 646 boat days in 2013. The total commercial catch (ex. pink snapper) in 2013 at 219 t was below the lower limit of the target catch range (235–335 tonnes), however, this needs to be viewed against the background of the historically low levels of effort and increasing trend in catch of whiting. At this time, this fishery is considered to present a low risk to the sustainability of the finfish and other ecological resources of inner Shark Bay, and as a consequence is a low research/management priority.

Commercial catches of pink snapper taken as bycatch by SBBSMNF vessels in 2013 were either nil or significantly below their allocation within the respective pink snapper TACs (0.4 tonnes in Denham Sound, nil catch in Eastern Gulf and Freycinet Estuary).

Recreational**Target catch range (2013):****Pink snapper****Eastern Gulf 12 tonnes****Denham Sound 12 tonnes****Freycinet Estuary 3.8 tonnes**

Recreational catches of pink snapper were assumed to be similar to those estimated in 2010 (no 'on-site' survey undertaken in 2011-2013) and therefore within the respective TACs in each area.

In 2013, a total of 565 applications (first and second rounds) were received for Freycinet Estuary pink snapper quota tags with all the tags available (total 1,050) allocated to recreational fishers.

New management initiatives (2014/15)

As an outcome of the 'Wetline Review' (see Fisheries Management Paper No. 224 for details), a management plan is proposed for a Gascoyne Inshore Net Fishery. The Plan will incorporate the existing SBBSMNF, the Exmouth Gulf Beach Seine Fishery and commercial net fishing in the Carnarvon area as separate zones under a single management plan.

All commercial fisheries in the Gascoyne Coast Bioregion, including the SBBSMNF, have been through a Marine Stewardship Council (MSC) pre-assessment in 2013.

External Factors

While the inner Shark Bay system has been considered relatively stable as a result of its typically low-rainfall and arid environment, the region is occasionally affected by cyclone-related flood events such as occurred in the Gascoyne and Wooramel Rivers in late 2010 and again in early 2011. Combined with this, the marine heatwave in the summer of 2010/11 had significant impacts on some marine habitats (e.g. temperate seagrasses) and invertebrate species (e.g. blue crabs and scallops) (see Fisheries Research Reports 222¹ & 250²). The impact of these events on key scalefish species in inner Shark Bay remains to be fully determined.

Climate change has the potential to impact fish stocks in range of ways. The effects of climate change may include increasing sea surface temperatures, changes in major ocean currents (e.g. Leeuwin Current), sea level rise and ocean acidification. A review of the impacts and responses to marine climate change in Australia was undertaken by CSIRO in 2009. More recently, a 3-year FRDC-funded project to assess the effects of climate change on key fisheries in Western Australia has now been completed (Caputi *et al.* 2014³). Pink snapper and tailor were both considered as case study species within this project.

1 Pearce *et al.* (2011). The "marine heatwave" off Western Australia during the summer of 2010/11. Fisheries Research Report No 222. Department of Fisheries, Western Australia, Perth.

2 Caputi *et al.* (2014). The marine heatwave off Western Australia during the summer of 2010/11 - 2 years on. Fisheries Research Report No 250. Department of Fisheries, Western Australia, Perth.

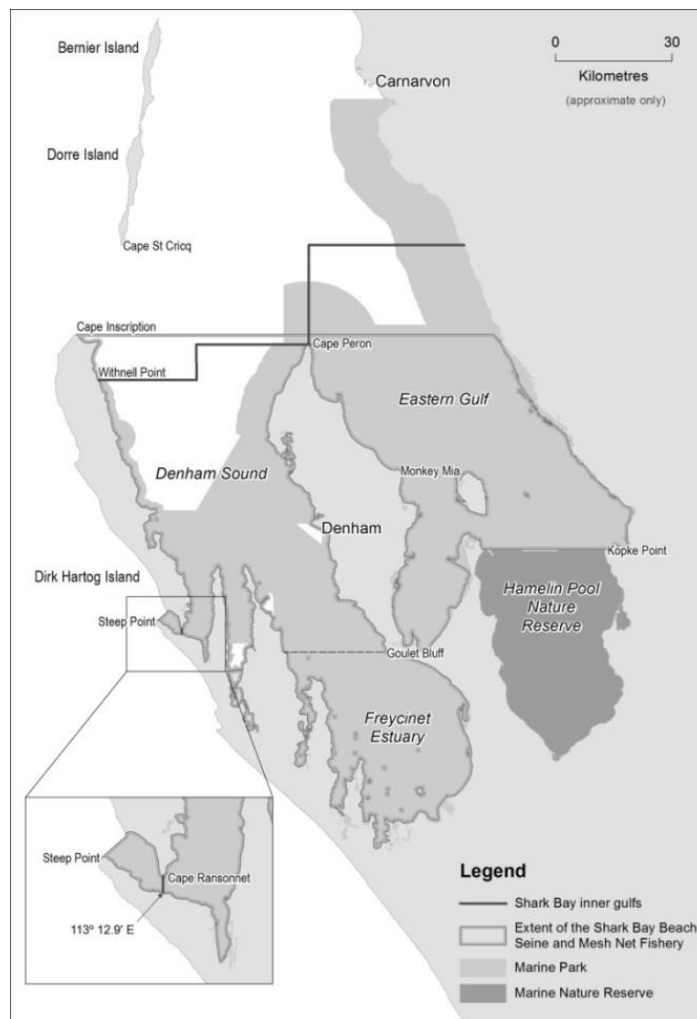
3 Caputi *et al.* (2014). Management implications of climate change effect on fisheries in Western Australia: Parts 1 & 2. FRDC Project 2010/535 Final Report. Department of Fisheries, Western Australia, Perth.

INNER SHARK BAY SCALEFISH FISHERY TABLE 1

Annual catch and target catch range (tonnes) (upper), and annual CPUE and threshold level (kg/boat day) (lower) for key species taken by Shark Bay Beach Seine and Mesh Net Managed Fishery vessels for the period 2004-201

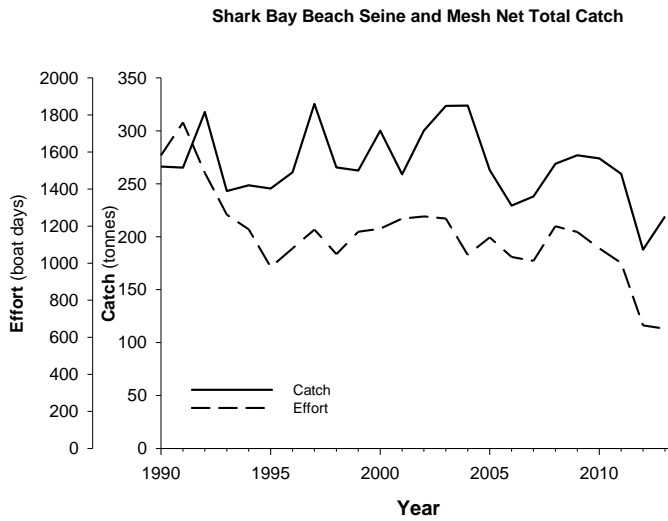
Species	Acceptable catch range	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Whiting	93-127	119	116	113	102	117	115	118	105	116	142
Mullet	77-144	143	85	62	91	107	124	117	116	40	32
Tailor	25-40	24	19	21	23	23	19	19	17	16	15
Bream	7-15	27	27	23	14	8	8	10	9	9	18

Species	Trigger level	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Whiting	75	114	102	110	100	98	100	112	105	175	220
Mullet	62	137	74	60	90	89	106	107	116	61	50
Tailor	21	23	17	20	22	19	16	17	17	25	23
Bream	5	26	23	22	14	6	7	10	9	14	28



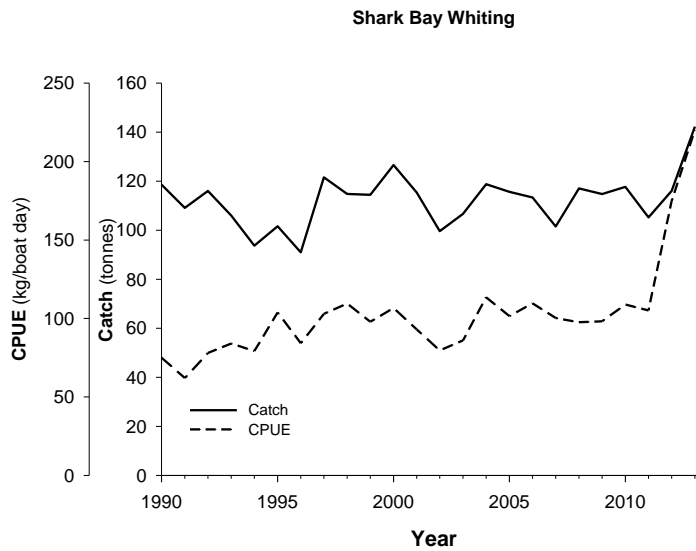
INNER SHARK BAY SCALEFISH FISHERY FIGURE 1

The commercial (scalefish) and recreational fishing areas of inner Shark Bay.



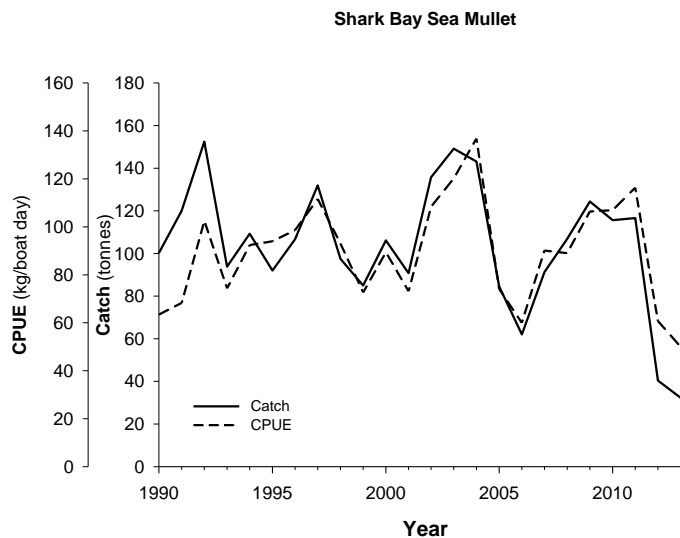
INNER SHARK BAY SCALEFISH FISHERY FIGURE 2

The total annual catch and effort for the Shark Bay Beach Seine and Mesh Net Managed Fishery over the period 1990–2013.



INNER SHARK BAY SCALEFISH FISHERY FIGURE 3

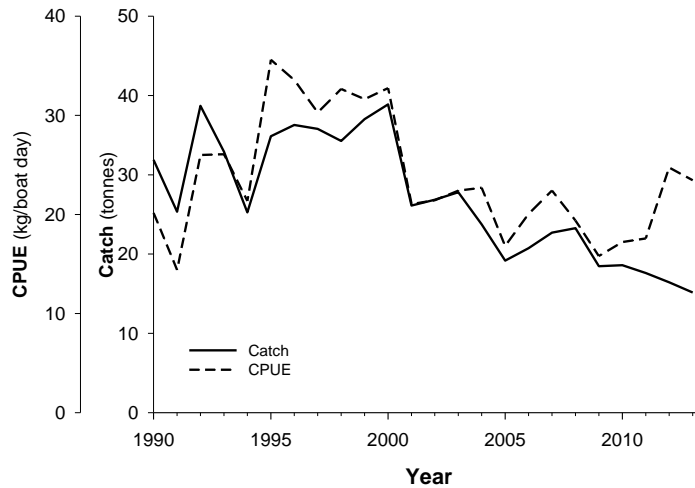
The annual whiting catch and catch per unit effort (CPUE) for the Shark Bay Beach Seine and Mesh Net Managed Fishery over the period 1990–2013.



INNER SHARK BAY SCALEFISH FISHERY FIGURE 4

The annual sea mullet catch and catch per unit effort (CPUE) for the Shark Bay Beach Seine and Mesh Net Managed Fishery over the period 1990–2013.

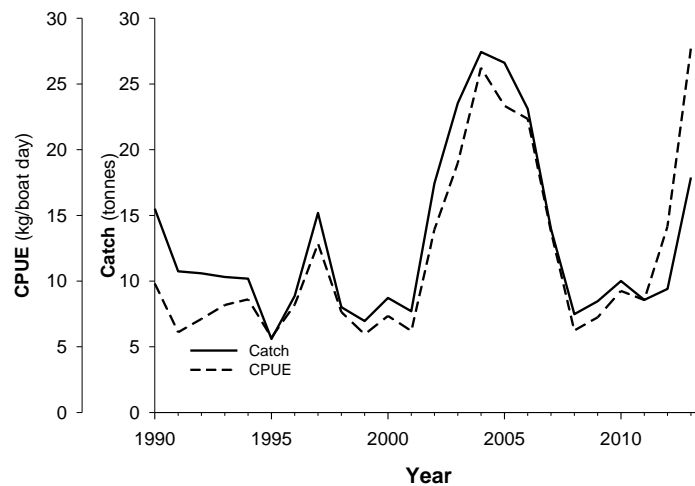
Shark Bay Tailor



INNER SHARK BAY SCALEFISH FISHERY FIGURE 5

The annual tailor catch and catch per unit effort (CPUE) for the Shark Bay Beach Seine and Mesh Net Managed Fishery over the period 1990–2013.

Shark Bay Western Yellowfin Bream



INNER SHARK BAY SCALEFISH FISHERY FIGURE 6

The annual western yellowfin bream catch and catch per unit effort (CPUE) for the Shark Bay Beach Seine and Mesh Net Managed Fishery over the period 1990–2013.

Shark Bay Blue Swimmer Crab Fishery Status Report

A. Chandrapavan, E. Sporer, S. O'Donoghue and S. Blazeski.

Main Features			
Status	Current Landings		
Stock level	Environmentally limited	Commercial catch (experimental fishing trial)	36 t
Fishing level:	Shark Bay trap fleet		20 t
Voluntary commercial closure since April 2012 (experimental fishing only)	Shark Bay trawl fleet		16 t
	Recreational catch		~ 1t

Fishery Description

The blue swimmer crab (*Portunus armatus*) resource in Shark Bay is harvested commercially by the Shark Bay crab trap and Shark Bay prawn trawl fisheries, with small amounts retained by the Shark Bay scallop fishery. This crab stock also supports a small (~1 t) but important recreational fishery. Prior to 2012, this was Australia's highest producing blue swimmer crab fishery. However, between July and December 2011, commercial catch rates declined rapidly due to significantly low stock abundance across the region that appeared to be caused by environmental conditions generated by an unprecedented marine heatwave, combined with multiple flooding events during the summer of 2010/11. Commercial fishing for blue swimmer crabs in Shark Bay ceased in April 2012 on a voluntary industry-agreed basis to facilitate stock rebuilding. Given the extremely small recreational catch levels in this region, restrictions on the recreational sector were considered unnecessary. Since the closure, intensive monitoring of the resource and its recovery has been undertaken using a combination of trawl and trap based surveys.

Governing legislation/fishing authority

Commercial

Shark Bay Crab Fishery (Interim) Management Plan 2005

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

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

Shark Bay Prawn Management Plan 1993

Shark Bay Scallop Management Plan 1994

Commonwealth Government *Environment Protection and Biodiversity Conservation Act 1999* (Wildlife Trade Order – Shark Bay Interim Managed Fishery only)

Recreational

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

Consultation process

Commercial

The Department of Fisheries undertakes consultation directly with licensees on operational issues. Industry Annual Management Meetings are now 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

Recreational consultation processes are now facilitated by Recfishwest under a Service Level Agreement although the Department continues to undertake direct consultation with the community on specific issues

Boundaries

The Shark Bay Crab Interim Managed Fishery covers the waters of Shark Bay north of Cape Inscription, to Bernier and Dorre Islands and Quobba Point (Shark Bay Blue Swimmer

Crab Figure 1). In addition, two fishers with long-standing histories of trapping crabs in Shark Bay are permitted to fish in the waters of Shark Bay south of Cape Inscription.

The boundaries of the Shark Bay Prawn and Scallop Managed Fisheries, which also retain blue swimmer crabs, are described in the relevant status reports specific to the trawl fisheries elsewhere within this document.

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 currently managed under an input control system, primarily through the regulation of licence and trap (hourglass) numbers or length of headrope of trawl net. Supplementary controls cover what species can be retained, associated minimum size limits, gear specifications, and area, seasonal and daily time restrictions. The principal management tool employed to ensure adequate breeding stock involves having minimum size limits well above the size at sexual maturity. Male blue swimmer crabs in Shark Bay become sexually mature at 97 mm carapace width, while females become sexually mature below 92 mm carapace width. Setting the commercial minimum size at 135 mm carapace width (as per a voluntary industry agreement) is designed to ensure adequate egg production for associated blue swimmer crab stocks under typical environmental conditions.

There are five crab trap permits with combined total of 1,500 units of entitlement (currently valued at 1 trap each) in Shark Bay under the *Shark Bay Crab Fishery (Interim) Management Plan 2005* which sets the number of traps that can be fished, fishery specific spatial closures, gear specifications and other controls. These permits are consolidated onto three active vessels. Two permit holders who have a long standing history of crab fishing south of Cape Peron (south of the existing waters of the Shark Bay Crab Interim Managed Fishery [SBCIMF]), have a Fishing Boat Licence (FBL) condition that allows them to fish in these waters but with no more than 200 traps. At no time, however, may they each use more than 300 traps in total across all of the waters of Shark Bay.

There are currently 28 trawl (18 prawn and 10 scallop) licences authorised to take blue swimmer crabs in Shark Bay. Management controls for the trawl fisheries that retain blue swimmer crabs in the Gascoyne Coast Bioregion, namely the Shark Bay Prawn Managed Fishery and the Shark Bay Scallop Managed Fishery, are based on limited entry, seasonal and area closures, and gear controls including bycatch reduction devices (grids) and these are fully described in the relevant status reports within this document. The Department of Fisheries' vessel monitoring system (VMS) continues to monitor the activities of all trawlers in these fleets.

A third comprehensive ESD assessment of the Shark Bay fishery was completed in June 2011. The Federal Department of the Environment (DotE) approved the fishery to export product for a further five years until September 2016, subject to several conditions and recommendations - for details refer to: <http://www.environment.gov.au/coasts/fisheries/wa/shark->

bay/index.html.

Recreational fishing for blue swimmer crabs in WA 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 is a minimum size limit well above the size at sexual maturity. A minimum legal size limit of 127 mm carapace width applies in the waters of the Gascoyne Coast Bioregion, along with a bag limit of 20 crabs per person or 40 crabs per boat. Recreational crab fishers mainly use drop nets or scoop nets.

Research summary

Historically data for the assessment of blue swimmer crab stocks in the Gascoyne bioregion are obtained from trap fishers' statutory monthly catch and effort returns and voluntary daily logbooks, and trawl fisher's statutory daily logbooks. Since the fishery closure, rigorous fishery-independent trap and trawl based data collections are undertaken to address knowledge gaps in some of the biological and life-history parameters, spatial distribution of stock and recovery rates and patterns and models to determine sustainable harvest levels. A preliminary harvest strategy and control rules have been developed for evaluation of the stock and the management of the fishery.

Retained Species

Commercial landings (season 2012/13):	36 t
Shark Bay trap fleet	20 t
Shark Bay trawl fleet	16 t

An exemption for an experimental commercial crab fishing trial was granted in June 2013 as a result of some improvement in the crab stock indicators and to assess the effect of a short-term commercial fishing on the crab stock. Trap fishing up to a maximum of 400 pots per day was allowed for 30 days with a catch limit of 18 tonnes. The trawl sector was also allowed to retain 18 tonnes of crabs (males and females ≥ 135 mm) (1 t per boat). The trap fishing in total produced 20 t due to additional days of fishing granted to allow for a commercial monitoring survey. The trawl sector fished for crabs over several months and caught 16 t in total.

Recreational catch:
Shark Bay **< 1 % of total**

Previous estimates of recreational crab catches from Shark Bay derived from a 12-month creel surveys of recreational boat-based fishing and as part of recreational surveys targeting pink snapper fishers and this estimate ranged between 0.3 and 1.9 t of blue swimmer crabs predominantly caught from the Eastern Gulf region. The 2011/12 statewide recreational fishing from boat survey found only 4% of the state's blue swimmer recreational catches came from the Gascoyne region.

Stock Assessment

Assessment complete:

Shark Bay: **Yes**

Assessment level and method:

Level 4 - Direct survey/Catch rate/Size Distributions

Breeding stock levels:

Shark Bay: **Environmentally limited**

There was a significant decline in the blue swimmer crab stock within Shark Bay following the marine heat wave and other climatic events which occurred in the summer of 2010/11. This decline led to the voluntary closure of both trap and trawl commercial sectors of the crab fishery in April 2012. Since the closure, intensive monitoring of the resource and its recovery has been undertaken using a combination of trawl and trap-based surveys. These surveys were designed to target key deep-water trawl grounds and inshore trapping grounds that have historically been used to commercially target crabs. However new survey sites have also been added to explore non-traditional crab regions to further understand stock distribution and movement at the lower abundances that currently exist. Data collected from these surveys will contribute towards a greater understanding of stock dynamics and biology of this stock and also provide performance indicators that are being used in developing a harvest strategy for this fishery.

A detailed statistical analysis on the effects of monthly water temperatures on annual commercial catch rate was undertaken. This analysis showed that that warm temperatures during the autumn/winter spawning appears to be beneficial to recruitment, however warm temperatures during the juvenile phase in the summer when the crabs are mainly in the shallow water areas appears to have a negative effect. This suggests that the cause of the low recruitment to the fishery in 2011/12 was a combination of a very cool winter in 2010 followed by the heat wave in the summer of 2010/11. The winter SST in 2011 and 2012 have returned to within historic levels but the summer SST in 2011/12 and 2012/13 have remained above average but lower than the record high level of 2010/11. Therefore an improvement in commercial catch rates was expected in 2012/13 and 2013/14. While there was no commercial fishing in 2012/13, fishery-independent surveys have demonstrated an improvement in abundance but not a full recovery to historic levels.

Indices of legal, sublegal, spawning, and recruitment biomass for the first half of 2013 were much improved compared to biomass levels observed for latter half of 2012. However higher biomass levels, particularly of legal-sized crabs (> 135 mm CW) have only been recorded within inshore waters (< 10 m depths). The level of recovery in the deeper depths, those most accessible to the trawl sector, remains much lower but steadily improving.

Improvements in the recovery of the inshore stock led to a short-term commercial crab fishing trial in June 2013 for the assessment of the effect of limited commercial fishing on the recovering crab stock. The average trap CPUE from the fishing trial was 1.95 kg/traplift and in general, daily catch rates were above the historical June daily catch rates

(logbook data) and there was no clear sign of stock depletion over this time period. Sustained recovery of the stock and positive results of the fishing trial led to considerations of a partial reopening of the Shark Bay crab commercial fishery for 2013/14 season based on a conservative TACC of 400 t.

The performance measure for the Shark Bay crab fishery requires legal crab abundance be maintained above a performance measure of 1.0 kg/traplift. There are currently trap and trawl based research surveys programs in place to monitor the recovery of the Shark Bay crab stock from which biomass indices of legal, sublegal and spawning levels have been developed to assess stock recovery to historical threshold levels.

Non-Retained Species

Bycatch species impact **Negligible**

Hourglass traps are purpose-designed to minimise the capture of undersized blue swimmer crabs and 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.

On-board sampling by departmental staff has indicated low numbers of bycatch species of mainly finfish (e.g. Snapper spp.), and other invertebrates (e.g. starfish, cephalopods and other crab species). The low number of fish caught and returned by crab fishers is considered to pose a negligible risk to these stocks. Impacts from discarded bycatch from trawl fisheries that retain crabs as a byproduct is dealt with in those sections of this report specific to the trawl fisheries.

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, 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 sea bottom occurring during trap retrieval. Sand and associated biota does 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 uprooted and 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

The closure of the Shark Bay crab fishery during 2012/13 had a significant socio-economic impact on both the trap and trawl sectors. The trap sector which once employed approximately 15 people as skippers and crew on vessels fishing for blue swimmer crabs in the Gascoyne Coast Bioregion and additional employment for some 30-35 workers through the development of post-harvest processing of the crab catch were inactive.

Economic Effects

Estimated annual value (to fishers) for 2012/13
Level 1 - < \$1 million (\$332 280)

The average beach price for uncooked crabs across WA was \$9.23/kg. During the commercial fishing trial, fishers were allowed to retain and sell their crab product which was worth \$332 280.

Fishery Governance

Target catch (or effort) range:
Shark Bay: Under Development

Target ranges are currently under development including precautionary target levels for limited fishing once the stock has recovered to acceptable levels. A precautionary TACC of 400 t was set for the 2013/14 season.

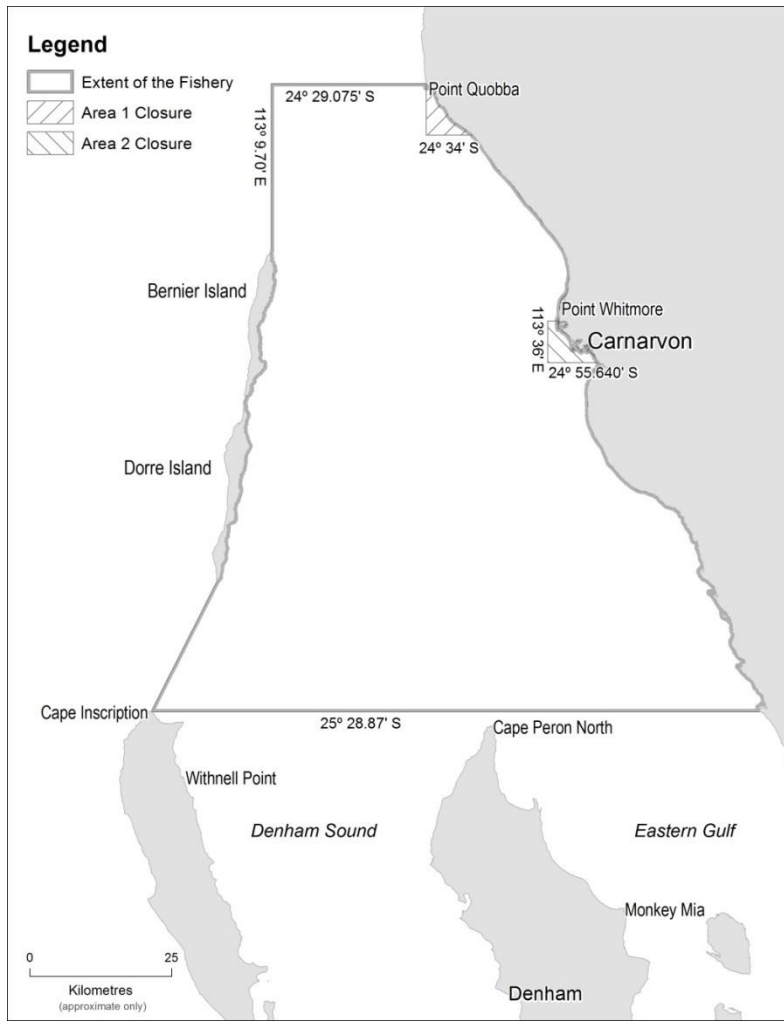
Current fishing (or effort) level:
Not Applicable as fishery closed

New management initiatives (2014/15)

A Ministerial decision on allocating catch shares within the commercial sectors was made in June 2013 (trap – 66%, prawn trawl 33.8%, scallop trawl sector 0.2%). Approval was also given by the then Minister to develop a managed fishery management plan that would incorporate an Individual Transferable Quota system of entitlement to apply across all three commercial sectors in Shark Bay. The current Shark Bay Crab Interim Management Plan expires on 31 August 2016. The development of the new management plan is in progress with consultation regarding the key components of the legislation ongoing. It is envisaged that the new management plan will be implemented in 2015.

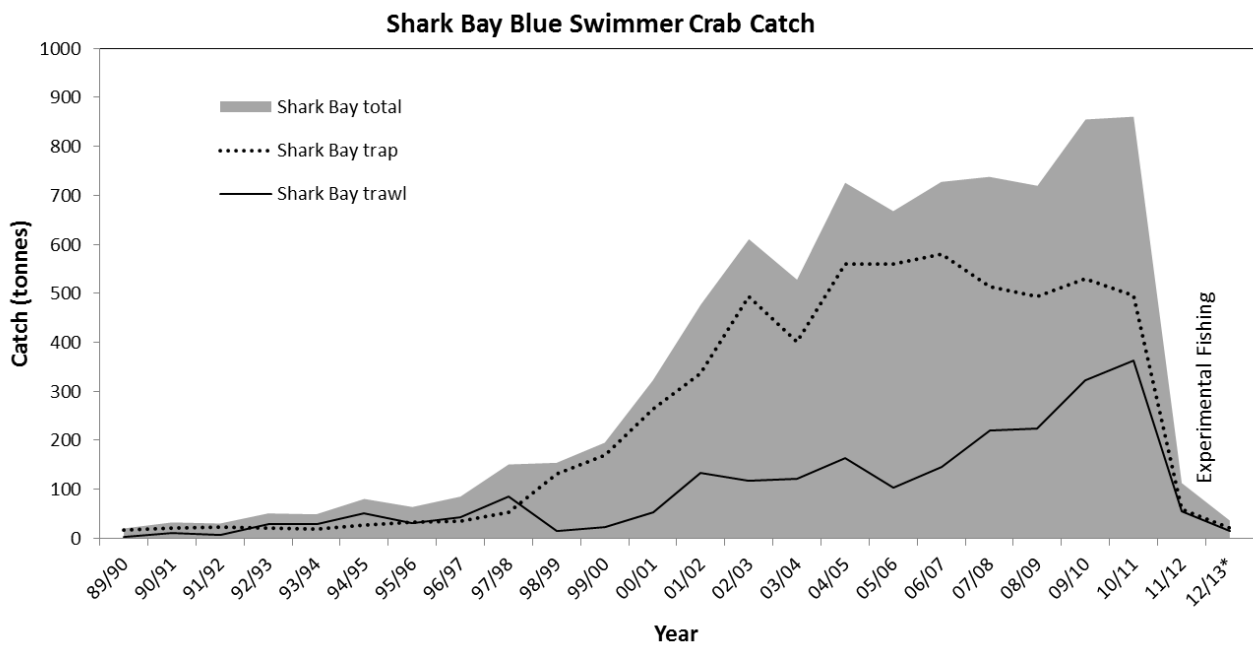
External Factors

The effect of the extreme environmental conditions in the summer 2010/11, winter temperatures and continued warm water temperatures in the summer of 2011/12 and 2012/13, are being assessed as part of the FRDC research project.



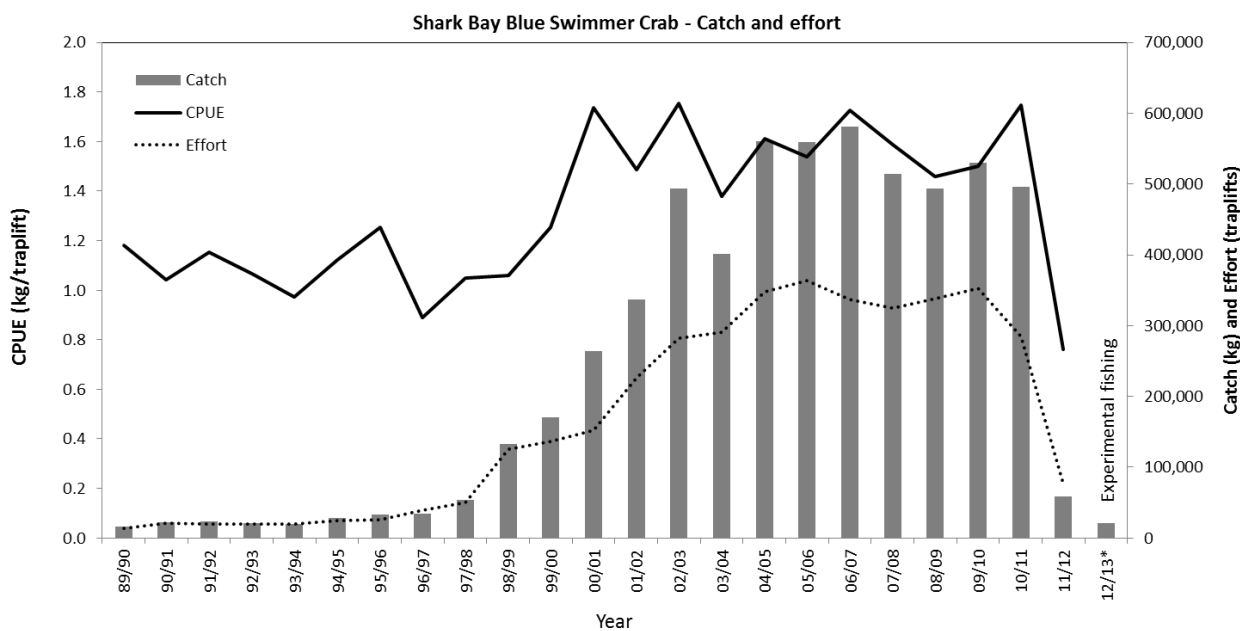
SHARK BAY BLUE SWIMMER CRAB FIGURE 1

Extent of the Shark Bay Crab (Interim) Managed Fishery. Two additional 200-trap exemptions allow for fishing in the western and eastern gulfs south of Cape Peron.



SHARK BAY BLUE SWIMMER CRAB FIGURE 2

Commercial catch history for the blue swimmer crab (*Portunus armatus*) between trap and trawl sectors since 1989/90. *The catch for 2012/13 is generated from the experimental commercial fishing trial.



SHARK BAY BLUE SWIMMER CRAB FIGURE 3

Blue swimmer crab trap catch (t), effort (traplifts x 1,000) and catch per unit effort (kg/traplift) in Shark Bay since 1988/89. *The catch for 2012/13 is generated from the experimental commercial fishing trial.

AQUACULTURE

Regional Research and Development Overview

For aquaculture in the Gascoyne, the Department of Fisheries continues to focus on the regulation of the regional pearling industry, including the blacklip oyster *Pinctada margaritifera* and Akoya pearl oyster *Pinctada imbricata*. These now complement the major State oyster industry sector which has been centred on the silver lip pearl oyster (*Pinctada maxima*).

The Department of Fisheries is also focusing on the management and regulation of an emerging local aquaculture sector, which is producing aquarium species that include

coral and live rock. This developing sector is regulated according to the policy entitled *The Aquaculture of Coral, Live Rocks and Associated Products*.

A land-based facility previously used for small-scale production of finfish species for local markets will be redeveloped as a specific-pathogen-free hatchery for marine prawns, subject to applications for translocation and a variation to add marine prawn species to the aquaculture licence being approved.

COMPLIANCE AND COMMUNITY EDUCATION

Compliance and community education services in the Gascoyne Coast Bioregion are delivered by Fisheries and Marine Officers (FMOs) and associated management and administrative support staff based at District Offices in Denham, Carnarvon and Exmouth. During 2012/13 the three district offices supported a total of ten FMO positions allocated to deliver services to several client groups including commercial and recreational fisheries, marine parks, pearling and aquaculture operations and fish habitat protection areas. The region covers approximately 2700 kilometres of the Western Australian (WA) coastline, some 13% of the WA coast. The various coastal landscapes represent some of the most remote, isolated, pristine and dangerous marine and

terrestrial environments in the State.

A significant aspect of the regions work is the provision of compliance services to the State's Marine Parks. The Gascoyne Coast Bioregion has two of WA's most iconic and significant Marine Parks, Ningaloo Marine Park and the associated Commonwealth Marine Park, Shark Bay Marine Park and the associated World Heritage Area. These two Marine Parks occupy just over 70% of the Gascoyne Coast Bioregion. In partnership with the Department of Environment and Conservation (DEC), FMOs monitor and deliver compliance and education programs covering some 30 Sanctuary Zones and Marine Managed Areas and other protected areas.

FMOs undertake regular land, air and sea patrols using a compliance delivery model supported by a risk assessment process and associated operational planning framework. Throughout the bioregion they employ specially equipped four-wheel-drive vehicles, quad bikes and small towable vessels. They also make use of sophisticated surveillance, mapping and GPS equipment to assist in evidence gathering. This includes high-powered telescopes and photographic mapping technology. A high visibility Recreational Fishing Mobile Patrol has been added to the Gascoyne pool of resources. This dedicated education and enforcement unit patrols the coast from Onslow through to Kalbarri.

FMOs at Exmouth make extensive use of the 13-metre Patrol Vessel (PV) the PV *Edwards* to conduct compliance activities throughout the Gascoyne bioregion. FMOs in Carnarvon and Denham use an 8 metre rigid inflatable boat and a 7.3-metre rigid inflatable boat respectively. Both vessels are used to conduct at-sea inspections in Shark Bay and within the Southern aspects of the Ningaloo Marine Park and Commonwealth Marine Park. In all 3 Districts FMOs spend approximately 90 days a year at sea on patrol duties. Historically large patrol vessels (greater than 20 m in length) have assisted FMOs at various times of the year for offshore patrols, especially in the Shark Bay Prawn Fishery. FMOs conduct patrols the length of the Gascoyne and target offenders in all of the recreational and commercial fisheries based on intelligence gathered by FMOs and also conduct aerial surveillance, at-sea and on-land catch, licence, gear and marine safety inspections, and attend community events as well as school education programs.

Activities during 2012/13

In delivering compliance services to the Gascoyne, FMOs under the management of the Compliance Manager make use of a risk assessment and intelligence analysis-driven model to compliance planning and prioritization. All the existing Operational Compliance Plans (OCP) were reviewed and updated during the 2012/13 year using this model. This continues to be the model for delivering compliance across the agency and continues to provide the most effective and efficient method for a planned and measurable approach to compliance delivery. The OCPs deliver agreed outcomes and provide a more accountable and realistic process for budget creation and the actual services that are to be delivered.

OCPs have been operating for several years now in the Exmouth Gulf Prawn Fishery, Shark Bay Prawn Fishery, Shark Bay Scallop Fishery, Shark Bay Crab Interim Managed Fishery, Gascoyne Aquaculture and Pearling Fishery, and, for the management of the Ningaloo Marine Park, Shark Bay Marine Park and Commonwealth Ningaloo Marine Park. A more targeted effective and relevant compliance service in terms of both cost and activities was delivered within the framework of this planning and delivery process.

FMOs delivered compliance activities directed at commercial fisheries mostly through pre-season inspections, catch inspections and quota monitoring, as well as at-sea inspections and investigations resulting from suspected breaches detected via the VMS and intelligence led operations. FMO effort was again directed at building

stronger relationships with industry through higher levels of contact both at sea and in port. The number of suspected breaches of closed waters detected through the VMS and other monitoring methods has increased due to a more focused intelligence base of compliance. However, compliance overall is assessed as being at an acceptable level across all the fisheries. Compliance staff assess that the commercial fishing industry continues to demonstrate a positive approach to complying with regulations and playing their part to ensure the sustainability of their fisheries.

During 2012/13 the Gascoyne Bioregion was pre-assessed by the Marine Stewardship Council (MSC) and information provided by the DoF allowed for the successful progression of the assessment process to the final stages for the Shark Bay Prawn Fishery and the Exmouth Gulf Fishery.

The monitoring of marine park activities with respect to recreational fisheries has divided the recreational fishing compliance program from a stand-alone program into two distinct programs, one with a marine park focus. FMOs increased their compliance activities in relation to both Ningaloo Marine Park and Shark Bay Marine Park in line with the increased importance and focus of government on marine parks across the State.

The addition of a Gascoyne Recreational Fishing Mobile Patrol based in Carnarvon allowed for a higher focus on education and enforcing management arrangements for Shark Bay Inner Gulf pink snapper, the Gnarraloo Bay area and Onslow town site and surrounds. Two Mobile Patrols from the Metro Region patrolled the Gascoyne Region increasing the effective contact rate at the peak of the season.

Three Recreational Fishing Mobile Patrols from outside the region were again active in the Gascoyne in 2012/13. "Mobile 1" provides a dedicated mobile recreational fishing patrol using specialized remote-area-equipped vehicles and surveillance equipment. "Mobile 1" patrols operated mainly in the Denham and Carnarvon Districts, working in a coordinated approach with District Officers to provide greater coverage and improved compliance outcomes.

Initiatives in 2013/14

For the 2013/14 year a number of initiatives across the Gascoyne Bioregion have been planned. These include:

- Final pre -assessment of the Gascoyne Bioregion commercial and recreational fisheries by the Marine Stewardship Council.
- Finalisation of position requesting Ministerial approval for statutory consultation of Stage two of the Gascoyne Demersal ScaleFish Management Plan
- Development and implementation of new statewide marine park Collaborative Operational Plans with the Department of Environment and Conservation (DEC)
- Improve recruitment and retention practises to attract and retain staff in the Gascoyne.

GASCOYNE COAST COMPLIANCE TABLE 1

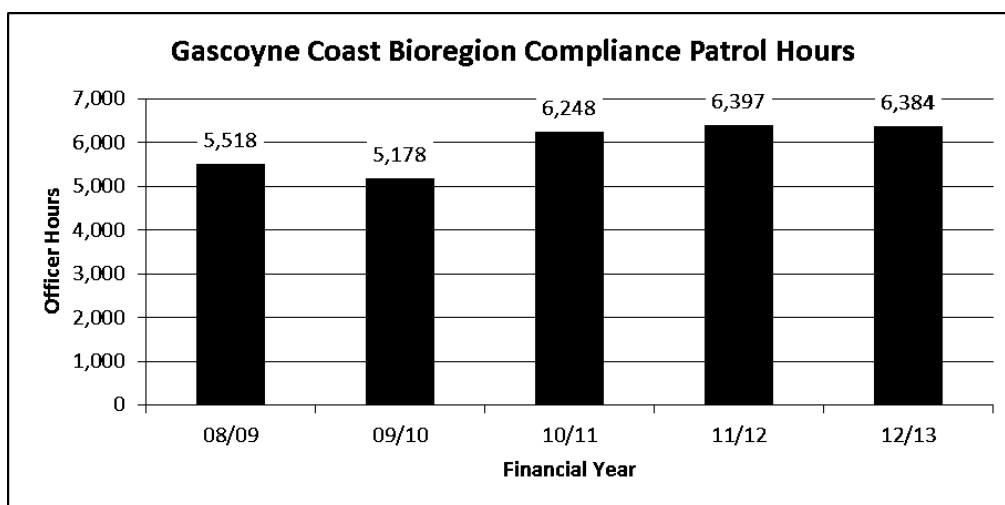
Summary of compliance and educative contacts and detected offences within the Gascoyne Coast Bioregion during the 2012/13 financial year.

PATROL HOURS DELIVERED TO THE BIOREGION	6,384 Officer Hours
CONTACT WITH THE COMMERCIAL FISHING COMMUNITY	
Field Contacts by Fisheries & Marine Officers	115
Infringement warnings	1
Infringement notices	6
Prosecutions	2
Fishwatch reports**	0
VMS (Vessel Days)***	7,614
CONTACT WITH THE RECREATIONAL FISHING COMMUNITY	
Field Contacts by Fisheries & Marine Officers	16,752
Infringement warnings	88
Infringement notices	175
Prosecutions	14
Fishwatch reports	34
OTHER FISHING-RELATED CONTACTS WITH THE COMMUNITY*	
Field Contacts by Fisheries & Marine Officers	2,722
Fishwatch reports	2

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

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

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



GASCOYNE COAST COMPLIANCE FIGURE 1

“On Patrol” Officer Hours showing the level of compliance patrol activity delivered to the Gascoyne 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*).